Strengthening Our Connections

ATMAE 2012 Conference Proceedings

ATMAE

The Association of Technology, Management, and Applied Engineering

ATMAE 2012 Conference Presentation Abstracts and Proceedings Papers

Review Process & Statistics for Presentations and Papers

This CD-ROM of the *ATMAE 2012 Conference Presentation Abstracts and Proceedings Papers* is the result of the work of many authors in technology, technology management, and applied engineering degree programs throughout the United States who gathered to share their work at the 2012 Annual ATMAE Conference, "Strengthening Our Connections," in Nashville, Tennessee, November 14-17, 2012. This CD-ROM includes all of the conference presentation abstracts that were accepted through peer-review for presentation and publication (except those withdrawn by the authors), and the Conference Proceedings Papers (that are based on accepted presentations) which were accepted through a secondary peer-referee process.

The reviews of presentation proposals and conference papers were led by ATMAE Division Presidents and Focus Group Chairs. The proposals and papers were reviewed in a double-blind process by a panel of at least three ATMAE members with expertise in the topical area. Using the review criteria (posted on the ATMAE website), panelists evaluated and ranked each paper, and a cumulative rank-ordering system was used to help select the presentations and papers.

The ATMAE 2012 Conference Presentation Abstracts were subject to a double-blind peer review process. In 2012, the peer-review process led to acceptance of 79% of presentation proposals, 197 accepted of 252 proposals submitted. Some proposals were withdrawn after acceptance and are not published in the Proceedings.

The ATMAE 2012 Conference Graduate Student Research Presentation Abstracts were chosen by a blind-review process led by ATMAE members who are University faculty. Nine abstracts were submitted, and four were chosen for presentation, an acceptance rate of 44%.

The ATMAE 2012 Conference Proceedings Papers went through a similar process. Authors of accepted conference presentations were invited to submit full papers based on their presentation abstracts; the *Conference Proceedings Papers* were selected in a double-blind peer review process, with panels of at least three reviewers involved in reading and reviewing each paper. In 2012, of 197 accepted conference presentations, 44 were expanded into longer papers and were submitted for the peer-review process. The double-blind peer review process led to acceptance of 50% of the papers submitted, for a total of 22 "ATMAE 2012 Conference Proceedings Papers." These 22 Conference Papers represent 11.2% of the proposals accepted for presentation at the 2012 ATMAE Conference, and only 8.1% of proposals submitted.

Best 2012 ATMAE Conference Proceedings Paper: *"Integrated CAD/CFD Analysis of HVAC Fresh Air Intake System Design of an On-Highway Crane"* (Graphics track), by Mr. Charles M. "Matt" Watson, Link-Belt Construction Equipment Co., and Dr. Nilesh Joshi, Morehead State University. This paper was selected in a blind peer-review by six past and present members of ATMAE's Executive Board from the nine papers evaluated as best in their respective review tracks.

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Conference Presentation Abstracts (by track):

- *Administration & Teaching Innovations:* Chair, Marion Schafer; Todd Alberts, Mohammed Ali, Roya Azimzadeh, Jerry Cloward, Raj Desai, Denise Gravitt, Mitchell Henke, Sudershan Jetley, James Jones, Daniel Kirby, Zaki Kuruppalil, Mahyar Izadi, Gholam Massiha, Richard Miller, Isaac Slaven Jeff Ulmer, Michael Whelen, David Yearwood
- *Construction:* Chair, Lewis Waller; Sami Ghezawi, R. A. McFarlane, Loren Niemeyer, Clair Roudebush, Keith Touchet, Gary Winek
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- *Electrical, Electronics, & Computer Technology:* Chair, Derrek Dunn; Raj Desai, Mehmet Goksu, David Hua, Ognjen Kuljaca, Loren Niemeyer, Walt Pozgay, Ron Tuttle, David B. Wiedner, Baijian Yang, David Yearwood, Faruk Yildiz
- *Graphics:* Chair, Carl Blue; Kevin Howell, John Irwin, Samson Lee, Suzan Perry, Earlene Washburn
- *Management:* Chair, Randell Peters: James W. Jones, Daniel Lybrook, Arun N. Nambiar, Leonard S. Pederson, Tim Ross, Kenyatte Simuel
- *Manufacturing:* Chair, Pete Klein; Jeff Cunion, Ahmed ElSawy, James Keyes, James Maxwell, Mark Miller
- *Nanotechnology:* Chair, Dominick Fazarro; Dennis Field, Mark Miller, Walt Trybula
- *Safety:* Chair, James O. Wright; Dominick Fazarro, Steven Freeman, James O. Wright

Graduate Student Research Presentation Abstracts: Marion Schafer, Michelle Surerus

Conference Proceedings Papers (by track):

- *Administration:* Chair, Marion Schafer; James Jones, Doug Koch, James Maxwell, Michael Whelen, and Pao-Chiang Yuan
- *Construction:* Chair, Lewis Waller; Richard Boser, Clair Roudebush, Musibau Shofoluwe, Akshitha Sivakumar, Keith Touchet
- *Distance & Online Learning:* Chair, Jin Zhu; Mahmoud Al-Odeh, Ahmed ElSawy, Sudershan K Jetley, James Maxwell, Suhansa Rodchua, Linda Wanless
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- *Safety:* Chair, James Wright; Dominick Fazarro, Mark Miller, James Wright
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Best Conference Proceedings Paper Review Process: William Brauer, Lynda Kenney, Doug Koch, Argie Nichols, Kim Travers, Ahmad Zargari

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Strengthening Our Connections

2012 Conference Presentation Abstracts

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The Association of Technology, Management, and Applied Engineering

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Administration

Administration

An Investigation of the Awareness of Recycling Services at Student Family Housing Units

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Need: Data from the Indiana State University Recycling Center show that recycling is occurring but is limited to certain on-campus areas. Student family housing units are not covered by the center. Meantime, plenty of trash is generated in these units. This study investigated the awareness and demonstrated the need for recycling in these units.

Overview: This research investigated the awareness of recycling programs at student family housing units at Indiana State University. The purpose of this research was to find out the awareness of recycling in these areas. It allowed the researcher to examine the recycling awareness among other variables such as willingness to take part in pickup and willingness to take part in drop-off, among students at these areas. The researcher employed an IRB (Institutional Review Board) approved survey to survey students who resided in four units, and who were willing to participate in the study. The researchers used systematic sampling to sample the population to get the 240 sample size. Based on a coin toss, every odd apartment number from the apartment numbers of the family housing units was selected for the one-month survey. The data was coded into value labels and recorded in SPSS for a statistical analysis. Bar charts, chi-square, and cross-tabulations were used for the analysis of the data at 0.05 significance levels. Descriptively, 59% family housing residents were not aware of recycling program.

Major Points:

- Eighty eight percent of the participants believed that recycling would help them dispose of their trash.
- Seventy eight of them were willing to take part in pickup, while 70 % would also do so in drop-off.
- About 45 % were confident that the recycling center would recycle the materials they sorted for recycling, while 22 % recorded inconvenience as the reason for not taking part in both pickup and drop-off programs.
- About 34 % wanted ISU authorities to promote pickup recycling in order to make recycling appealing or convenient to them.

Summary: Attendees will be exposed to a study conducted on recycling services awareness in diverse university housing units. This approach could be used for other units on various campuses in the country.

Administration

Increasing Student Enrollment and Retention at HBCU through Mentoring High School Students in Science, Technology, Engineering & Mathematics (STEM) Programs: A Case Study at Alcorn State University

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Need: Since time immemorial, private organizations, academic institutions, non-governmental organizations, as well as government institutions have engaged in one form or other mentoring program to help youth, workers, students etc. develop the resilience needed to get through the challenges of life. In many instances, academic mentoring programs pair students with trained mentors who engage in a supportive relationship based on academic tutoring or enrichment. It also helps student create career awareness in the discipline they would want to specialize. The main goal of these mentoring programs is to increase the rate at which students complete secondary education, enroll in and graduate from institutions of postsecondary education in STEM related programs.

Overview: For the past four years Alcorn State University's Department of Advanced Technologies has been in the forefront of mentoring high school students, STEM related programs, from Adams, Claiborne, Jefferson, and Wilkinson Counties in the State of Mississippi. Most of these students population, from the southwestern part of Mississippi, are from disadvantaged families living below poverty and are potentially first-generation, secondary education students. The primary purpose of this presentation or paper is to examine how mentoring programs at the high school level can helped to increase enrollments and retention of high school students into Department of Advanced Technologies related STEM programs at Alcorn State University.

Major Points:

- Role of mentoring students in STEM related programs;
- Socio-economic conditions of Southwest Mississippi; and
- Highlight some of the recruitment, retention and successes;

Summary: The presenters will share their experiences, and strategic plans about mentoring of high school students in science, technology, engineering, and mathematics (STEM) programs, and how these programs help to increase enrollment and retention at minority colleges and universities with the attendees or participants.

Administration

Campus Ventures: A Model for Experiential Learning and Engagement in STEM

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Need: There are three significant challenges in fostering science, engineering, technology, and math (STEM) programs in education. One is attracting students to programs in an environment that is increasingly competitive. It is likely that many institutions will see continued growth in competition from online education; for-profit and private institutions; and the challenge from opportunities that are less costly for students. A second challenge is the desire to retains students and increase graduation rates. Retention is not only a way of maintaining enrollments; it is also an issue of public concern and accountability. A third challenge is maintaining the relevance and uniqueness of programs in the highly dynamic environment of STEM education. The latter serves as a value proposition that both attracts and retains students.

Overview: Programs that can offer a challenging and relevant curriculum combined with engaged learning will be in the best position to offer current and prospective students an attractive value proposition. Engaged learning is about finding ways, both in and out of the classroom, to add value to the student's educational experience. The challenge of making classroom learning real is part of the value found in such activities as internships and student participation in competitive events. Campus Ventures is intended to provide a similar experience where students apply what they learn in the classroom to "real world" problems. The funded project had its origins as a commercialization accelerator program for startup companies and university technology transfer/spin-off projects. The program is designed to help entrepreneurs, university faculty, and technical organizations advance technology-intensive projects and provide rich experiential learning opportunities for students. Interdisciplinary teams of students work with faculty members on projects brought into the institution. Most of the projects are developmental in nature with the intent of helping individuals or companies commercialize or improve products and technologies. The projects offer students the opportunity to work on real projects as part of an interdisciplinary team in a manner similar to what would be encountered in the workplace.

Major Points:

- Program that connects students to real-world problem solving on an ongoing basis.
- An approach that provides meaningful experience for student transition from school to work.
- Encourages interdisciplinary group-based experiences consistent with real-world environments.
- Provides an environment that helps maintain student interest in STEM.

Summary: Attendees will see a strategy for engaging students in meaningful activities that take classroom theory and practice into a real-world situation. An overview of the Campus Ventures project will be provided in the context of an overall strategy to provide a high level of student engagement designed to reinforce what they learn in the classroom and motivate students in their respective field. The program links several disciplines and provides opportunities for students to work with others in problem-solving activities.

Administration

Quality Management Systems in Higher Education

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Need: The context for determining quality has historically been limited by the accreditation standards of the accreditation organization. However, there has been growing demand for increased accountability of higher education and the accreditation system. This paper proposes that higher education institutions adopt quality management system concept in order to achieve its mission and satisfy the stakeholders.

Overview: Accreditation plays a critical role in assuring that educational institutions and programs meet acceptable levels of quality, and accreditation organizations have developed quality standards for defining and assuring that institutions and programs meet these standards. The quality of an academic institution determines its ability to ensure that appropriate and effective teaching, support, assessment and learning opportunities are provided to help the students achieve their objectives. However, there has been growing demand for increased accountability of higher education and the accreditation system. This paper will examine how higher education institutions can apply quality management system (QMS) standards to achieve the goals and objectives set out in its policy and strategy in order to satisfy stakeholder requirements.

Major Points:

- Poor quality in higher education, as in manufacturing or service organization, results in waste
- QMS enables an organization to:
- Achieve the goals and objectives set out in its policy and strategy;
- Identify customer requirements and meet or exceed their satisfaction.

Summary: This paper proposes that higher education institutions adopt QMS, similar to the ISO requirements, in order to satisfy the expectation of the stakeholders.

Administration

Strengthening Learning Connections in the Technology Classroom by Redesigning Shared Learning Facilities for Non-Traditional and Traditional Students

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Need: Typical technology facilities may not be well suited for the educational needs of the non-traditional learner. They prefer problem-centered, experiential and collaborative learning environments, and this approach to learning is markedly different from their traditional counterparts. The learning environment needs to be redesigned with considerations for a broader spectrum of learners, thereby enabling all students to participate effectively.

Overview: Facilitating learning in the classroom or laboratory requires a deep understanding of the content, the learner, learning strategies and the learning environment. The changing profile of the 21st century leaner requires corresponding changes to the learning spaces for improving student engagement in their learning. Using the principles of Design for All (DfA) and Universal Design (UD) classrooms can be reconfigured for simultaneously meeting the needs of all learners.

Major Points:

- The post-secondary learning environment and the changing learner profile
- Varying classrooms and laboratory needs of traditional and non-traditional students
- Considerations for educational facility redesign of shared learning spaces
- Design for All and Universal Design in the technology classroom
- Examples of redesigned learning spaces

Summary: The presentation will discuss challenges encountered while teaching traditional and non-traditional technology students from the standpoint of educational facilities. Participants of the session will learn about Universal Design principles for improving classroom interaction and participation of students in activities. This in turn will enable students to build connections within the classroom and strengthen their learning experiences.

Administration

Certified Technology Manager Certification Exam: Ascertaining Readiness

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Need: A robust assessment process is key to ongoing improvement of overall program performance and thus the successful production of program graduates. Robust in that the assessment process is a fact based, bottom up review of all key processes, products, and services associated with the program under scrutiny. A study was conducted to ascertain the readiness of selected senior technology management and applied engineering students from a selected ATMAE accredited program to pass ATMAE's CTM certification exam.

Overview: A decision was made to ascertain the value of employing ATMAE's CTM certification exam to assess the effectiveness of a technology management and applied engineering program's professional core of courses (aka the management foundation requirements courses) and the readiness of students for employment in technology management and applied engineering occupations. The content of ATMAE's CTM certification exam was compared to the content of the program's professional core of courses. Senior technology management and applied engineering students, who have fulfilled most if not all their professional core of course requirements, were pretested. Then this sample of students sat for ATMAE's CTM certification exam.

Major Points:

- Background—Institution, Program, Students
- Method—Survey of CTM Certification Exam Content vs Professional Core Content, Pre-Testing Students, Professional Core Courses Completed by the Students, Nature of Interventions, CTM Certification Exam Results
- Results Discussion—Exam and Courses Comparison, Students' Background, Student Performance

Summary: The background, method, and results of a study to ascertain the readiness of selected senior technology management and applied engineering degree students to pass ATMAE's CTM certification exam will be presented. Following the presentations, an opportunity to discuss the study's findings will be provided.

Administration

Designing New Ways for Improving Students Performance on National Certification Examinations to "Strengthen Our Connections" with Industry and Industrial Advisory Boards

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Need: Advisory boards for engineering and technology-based programs have high expectations that students perform well on national certification exams. Since the early 1990s Pittsburg State University's (PSU) automotive baccalaureate programs have followed the advice of its industrial advisory board and required students to take ASE exams. The faculty advise students on the importance of passing the ASE exams. ASE also proctors the exams on PSU's campus. Despite requiring students to take the exams, coaching students on the importance of the exams and providing students the opportunity to take the exams on campus, many students have not taken the exams seriously. While the advisory board continues to push students to succeed on the exams, the university administration will not allow the programs to force the students to pass a minimum number ASE exams prior to graduation, because that would leave ASE in control of determining who earns a PSU automotive degree.

Overview: The previous methods have fallen short in motivating students to excel on ASE exams. In addition to poor performance on the exams, PSU faculty have been unable to obtain student results on the ASE exams, which prevents faculty from knowing if students passed the exams as well as if students were struggling in any of the individual portions of the exams. While not being able to force students to pass the exams, the PSU automotive baccalaureate programs chose to take a fresh new strategy and implement multiple mechanisms designed to improve student performance on ASE exams.

Major Points:

- Students were taking exams, but not passing them
- The need to obtain student results
- Tools for solving the dilemma: portfolio, grade bump, preparatory/remedial classes, mentor group, & study material in the library

Summary: Attendees will receive new ideas for motivating students to succeed in national certification exams. Attendees will also receive the departmental three-page policy that is being used for the letter grade bump as well as an outline of the capstone portfolio, which motivates students to study and pass the exams.

Administration

Designing and Implementing a Senior Capstone Portfolio in a Baccalaureate Automotive Technology Program

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Need: Technology-based programs continue to feel pressure from industrial advisory boards, administration, accreditation associations, as well as state and national legislatures in improving assessment and to be held accountable for student outcomes. Automotive programs have been hesitant to adopt portfolios as a mechanism to meet these outcomes. In addition, programs are looking for new methods to motivate students to excel.

Overview: During the 2009/2010 academic year Pittsburg State University's automotive baccalaureate programs went through the university's program review process. During this process the automotive baccalaureate programs, in consultation with the advisory board, the dean and the director of assessment, designed a "capstone portfolio" with the goal of measuring and improving student performance in seven different competency areas: written communication skills, oral presentation skills, technical competencies, team work, employability, safety, and management competencies. This presentation will explain the rationale for the design of the capstone portfolio as well as the implementation during the 2010-2011 academic year and 2011-2012 academic year.

Major Points:

- Using portfolios to motivate students
- Documenting student outcomes & results
- Advisory board participation and support
- Development of the capstone portfolio
- Implementation of the portfolio

Summary: Attendees will receive new ideas for implementing portfolios that can: (1) motivate students, (2) enable faculty to evaluate the portfolios in an objective and efficient manner, and (3) assess students over several different competency areas.

Administration

How Important Are External Certification Credentials to ATMAE Graduates?

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Need: Member academic programs in our association place high priority on preparing graduates who are competent to 'hit the ground running' in the management of complex technological systems. Yet, there is considerable debate in our academic society as to what constitutes the *most effective gauge* of professional competency. Is it enough for ATMAE-accredited programs to agree on a 'Body of Knowledge' (BOK) and offer an optional ATMAE certification exam? Or, might students be better served sitting for and passing one or more external (and perhaps more recognized) certification exams? What should be the role of the ATMAE governing board and executive director in addressing this key question? A review of relevant external certification opportunities, and an action-oriented framework for analysis of opportunities for our association, is presented.

Overview: Over the years, considerable work has been done in the development of ATMAE certificate exams (CIT; CTM; CTP; CEG); there remains some question as to the potency of these certificates in the real world. If the goal is to help our graduates capture employer recognition for key competencies, we must propound the most advantageous certification strategy for our students. This presentation addresses the over-arching question of how our association should best proceed with the issue of certification exam(s).

Major Points:

- Statement of the problem and its significance – ATMAE program graduates are challenged to substantiate their professional competencies to prospective employers. We have developed several 'in-house' certificate exam (CIT; CTM; CTP; CEG), but these do not enjoy wide recognition in the field. Program graduates could augment their professional credibility by obtaining external certification(s).
- Review of external certificate opportunities.
- Synthesis: Presentation of suggested process for ATMAE to: 1) Systematically evaluate external certification opportunities and then, 2) Develop guidance for individual member schools.

Summary: Widely-recognized external certification exams provide an opportunity for program graduates to demonstrate competency to prospective employers.

Administration

Tools for Collaboration Across STEM Fields

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Need: Supporting learners at different stages of learning is essential to achieve positive learning, critical thinking, technical and problem solving skills, and gainful employment upon graduation. For ATMAE programs to prepare students with skills necessary to supervise and manage the future workforce of any organization successfully, necessary tools must be utilized for the success of the collaborative effort. In this presentation, leadership and knowledge sharing among collaborators, the educational aspects of research facilities and research clusters will be presented as some of the tools necessary to develop program through collaboration in STEM fields.

Overview: Collaboration is the vehicle for sharing responsibility and combining knowledge, creativity, and experience of others. The recognition is growing in academics and business that pooling the ideas, resources, commitment and efforts of many is more effective than relying on the few best individuals. From this perspective, collaborators will bring a shared understanding of contextual influences on their differing background to their programmatic efforts. Collaboration can eliminate redundancy and overlapping that results in inefficient use of resources and the duplication of services.

Major Points:

- *Why collaborate?*
- Team leadership through collaboration and harmony
- Knowledge sharing and management among departmental scholars
- Utilization of the core laboratories and facilities
- **Breaking** barriers to the success of collaboration among STEM educators

Summary: Partnership among scholars from various departments (cluster groups) in the university will enable further knowledge sharing with effective cost saving in the preparation of the future workforce for the emerging fields that will be developed by the integration of STEM disciplines. Given the fact that the equipment needed in any collaborative facility is expensive, existing core laboratories and facilities could serve as the appropriate starting point. More important, collaboration in the STEM fields will be effective if only the capacity of all involved work for one another and go beyond personal recognition.

Administration

Overcoming Barriers To Collaboration Among STEM Disciplines

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Need: Collaboration plays a major role in interdisciplinary activities among STEM disciplines or fields. It also affects the relationships among cluster members on the management team. Although effective collaboration does not guarantee success among STEM disciplines, its absence usually assures problems. More specifically, collaboration has the obvious roles of identifying talents coming together for a common purpose of sharing responsibility and combining knowledge, creativity, and experience of others. This presentation will address improving collaboration skills among STEM faculty by knowing the benefits and removing the barriers to collaboration.

Overview: The need to have students design and build a technical solution to a problem has necessitated faculty collaborations across the Science, Technology, Engineering, and Mathematics (STEM) fields. Breaking the barriers to marrying these disciplines effectively is necessary so as to be able to bring all the tools you can to building the solution. When people with multiple talents are placed in teams, they will interact, cross-fertilize ideas, and collaborate to produce. As such, a mindset that allows for the free exchange of ideas, joint policy making, and shelving all complexes (undue proclamation of superiority of a discipline) will help to forge on. This presentation will discuss the benefits of collaboration and how to overcome the barriers to collaboration across STEM disciplines can forge on successfully.

Major Points:

- Benefits of collaboration across STEM disciplines
- Barriers and solutions to collaboration among STEM fields
- Facilitating student's activities in STEM program
- Factors influencing effective facilitation

Summary: It is clear that the integration of STEM fields will play an important role given the fact that groups of people from diverse functional areas become high-collaboration teams. Similarly, our focus should be on the higher level thinking skills, collaboration, and innovation needed in all areas as we look at the global workforce.

Administration

Industrial Partnerships: Creating a Win-Win Scenario in Community Colleges with Local Industry

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Need: With everyone in the nation responding to a stretched economy, academic institutions need to change their approach for maintaining the latest technology to ensure the student classroom experience mirrors the "real world". Industry also needs to be creative in how to maintain an atmosphere of continuous improvement with limited funding for outside consultants and reduced staff, limiting internal optimization projects. This presentation addresses both those needs and is applicable to business and academic institutions alike.

Overview: The presentation will illustrate an industrial partnership which combines meeting the needs for state of the art training for college students, with the need for industries to acquire consultants in the areas of lean manufacturing, logistics and metal fabrication. For academic institutions, this means coordinating curriculum with project based or service learning opportunities that make use of partnerships with local industry for advanced learning opportunities. For industry, this means understanding how to best use the talent available from academic institutions to the benefit of their operations. Additional academic goals include potential funding sources, opportunities for internships and jobs for graduates, and advisory board. Additional industrial goals include tangible recommendations ready for implementation, with a full cost analysis and return on investment analysis. The presentation will review areas of how to create relationships between colleges and industry and how to agree to expectations and outcomes for both parties, building an ongoing relationship, beyond a single project experience.

Major points:

- Developing mutually beneficial projects in an industry atmosphere
- Managing expectations for industry, students and instructors
- Relevant outcomes and assessment tools
- Future steps for expansion

Summary: Attendees will learn the benefits of industry-based project learning and be provided with a template for creating a program at their academic institution/business. An example of a working relationship between a community college and a local manufacturer, implementing collaborative projects in multiple business functions will be presented.

Administration

A Pareto Perspective of Submissions to the Journal of Technology, Management, and Applied Engineering

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Need: A Pareto analysis of issues cited by Referees during their evaluation of manuscripts will be of value to future authors by allowing them to identify and address the most common problems associated with a manuscript prior to the initial submission.

Overview: The presentation will provide aggregate data regarding evaluation results for manuscripts submitted under the various categories of investigation. Referees complete evaluation forms covering such areas as Significance of the Problem, Scholarship and Objectivity, Clarity of Presentation, and Insight and Perspective. Typically, two to four subtopics under each area are scored as "Excellent," "Adequate," or "Poor," and a Pareto analysis of these results will provide future authors with a better idea of what areas and subtopics are most often flagged for problems in the evaluation process.

Major Points:

- ATMAE provides accept/reject results for manuscripts submitted to the Journal
- Aggregate data based on results from referee evaluation forms can be useful for future authors as they prepare manuscripts
- A Pareto analysis is a useful approach for identifying categories of most concern from the evaluation process

Conclusion: Publishing a peer-reviewed manuscript can be a lengthy process, with several iterations of reviews and author revisions. More clarity and transparency in the review process and understanding issues of concern to the referees and Editorial Panel can improve the initial manuscripts and speed this process. Attendees will be shown aggregate data regarding evaluation results for manuscripts submitted under the four categories of investigation: Applied, Research, Pedagogical, and Perspective/Meta-analysis.

Administration

Ascertaining the Relevance of ATMAE Services and its Level of Engagement

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Need: It is said that recruiting and retaining members is the life of an association, and that providing relevant value and engaging members is key to keeping them. In order to ensure an association remains relevant and viable to its members, a self-examination should be conducted from time to time and on a regular basis. An association will surely flourish and succeed if that which is important to an association's membership is [identified and] sustained.

Overview: A self-examination of ATMAE services was conducted on the order of whether they are relevant and whether the membership is being engaged. In order to ascertain the extent to which relevant value is being achieved, the following were examined: segmentation, insight, resources and services, affinity programs, communication, connection, advisory roles, and community. In addition, the extent to which the attention, affiliation, and loyalty of ATMAE members is being captured through relevant value-building activities was examined.

Major Points:

- Background
  - Relevant value: segmentation, insight, resources and services, affinity programs, communication, connection, advisory roles, and community
  - Engagement: extent to which attention, affiliation, and loyalty are being captured
- Method
- Results
- Discussion

Summary: The background, method, and results of a study to ascertain the relevance of ATMAE services and its level of engagement will be presented. Following the presentations, an opportunity to discuss the study's findings and the way ahead will be provided.

Administration

An Evolutionary Approach to Incorporating Sustainability into an Information Technology Curriculum

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Need: A review of undergraduate information technology programs at colleges and universities from across the United States found that curricula focused on three main areas. To varying degree, these programs contained courses from computer science, information systems, and information technology. They also shared an absence of any courses specifically identifying an emphasis on sustainability in information technology. In light of the growing pressure from governments, corporations, and society (Esty and Winston, 2006; Watson, Boudreau, and Chen, 2010) for Green IT practices, academia in the information technology discipline has failed to formally address these issues in their curriculum design.

Overview: The Computer Technology program at Ball State University has been progressively moving towards a curriculum that integrates sustainability concepts and practices throughout its courses. This presentation will highlight the reasons why IT curricula in higher education need to incorporate sustainability. It will be shown how the level of sustainability integration has evolved in the Computer Technology curriculum at Ball State University. Based on these experiences, it will be shown how other institutions can incorporate sustainability into their curricula.

Major Points:

- The need for incorporating sustainable practices in information technology curriculum will be highlighted.
- Different goals for sustainability integration will be identified.
- Varying levels of integration of sustainability into an information technology curriculum will be presented.
- It will be shown how these strategies can be incorporated into an existing information technology curriculum.

Summary: The need to adopt sustainable within the field of information technology is readily apparent. Governments, corporations, and society are all calling for increased use of Green IT practices. However, higher education appears to have been slow to respond to this demand. The purpose of this presentation is to provide information technology educators with strategies for incorporating sustainability into their classes and overall curricula

Administration

Industry Partners-Sponsored Ethics Seminar: Preparing Graduates to Avoid Workplace Landmines

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Need: *"Ethical errors end careers more quickly and more definitively than any other mistakes in judgment or accounting" –Unknown.* According to our Advisory Council, many universities do a great job of developing graduates with technical and management-based skills, but fail to prepare graduates to deal with ethical issues associated with today's workplace. Consequently, some graduates are no longer employed because of their unethical decisions. Therefore, advisory council members and partners saw a need to develop an ethics seminar to better prepare current and future graduates.

Overview: This presentation shares about a seminar initiated, developed, and presented by industry management professionals to help young professionals avoid workplace pitfalls and landmines. The seminar grew from one industry leader's disappointment in having to release a promising young professional for poor ethical decision making. From this negative situation has come a seminar that has evolved over the last seven years to the benefit of hundreds of graduates. Real world scenarios presented in an interactive format provide participants with problems as well as solutions. Participants also receive related PowerPoint, text and internet resources for their use.

Major Points:

- Need for an ethics seminar and professional development course (Advisory Councils)
- Critical ethics-related issues and sample Codes of Conduct (Caterpillar, Toyota, et al)
- Areas of interest—behavior in the office and on the road; hostile work environment; company property; customer/supplier/distributor relationship management
- Real world scenarios with solutions (interactive activity); and recommended resources
- Seven years of Ethics seminars—lessons learned, feedback and recommendations

Summary: Attendees will understand the necessity and benefits of an ethics seminar and a professional development course in preparing graduates in technology management career fields. The materials shared in this presentation can be readily adapted to other curriculum to prepare graduates for today's workplace.

Administration

Evaluating Professional Dispositions in Students: Methods and Responses

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Need: Students in applied engineering programs are evaluated on both technical and managerial competencies during their courses of study. However, what may be absent is the opportunity to evaluate the professional disposition of an applied engineering candidate. When an internship sponsor, employer, or faculty member identifies problems with a student's disposition, program administrators find themselves in the difficult position of determining how to evaluate and assist future students who may lack professionalism.

Overview: This presentation will review the literature regarding professional disposition evaluation in other professional disciplines, such as teacher education. A methodology for evaluating the professional dispositions of undergraduate students prior to their senior internship experiences will be proposed. The methodology will encompass different approaches for assisting students with improving their professional behavior and disposition.

Major Points:

- Professional dispositions are a key factor in student placement and career success
- Assessing professional dispositions is therefore necessary and helpful as students approach their senior internship experiences
- There are different approaches for intervention and assistance when students do not exhibit professional dispositions

Summary: This presentation will explain why professional dispositions are necessary for career success. Methodologies for assessment of dispositions will be discussed, as will approaches for assisting those students who need to develop more professional attitudes and practices.

Administration

Knowledge Capture: Retaining Organizational Knowledge in Technology Programs

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Need: Program leaders face seemingly constant recruiting and retention challenges, which can affect program quality if not properly addressed. Capturing the organizational knowledge of a technology program can be challenging, particularly with faculty turnover, varied delivery methods, increased reliance on adjunct faculty, and other administrative demands. However, armed with a plan and best practices from both academia and industry, leaders can capture, retain, and use this organizational knowledge for continued program success.

Overview: While many industries have been working on capturing and retaining organizational knowledge for years, academia is seemingly lagging behind, with little research or practical information available. The result is often that any knowledge of the organization is developed and used at the individual level rather than being available for use at the program and departmental level, and when individuals leave the organization this knowledge is lost. Awareness and planning are the keys to successful organizational knowledge capture and use. By adopting current practices, such as accreditation and assessment activities already being done, and utilizing best practices from industry and academia, program administrators can build programs that build on existing knowledge rather than starting over with every faculty turnover.

Major Points:

- Defining organizational knowledge
- Challenges to retaining organizational knowledge
- Best practices for knowledge capture
- Developing the plan
- Accessing and using organizational knowledge
- Teambuilding and sharing
- Integrating accreditation and assessment
- Conclusions and recommendations

Summary: Attendees of this presentation will understand how to capture and retain organizational knowledge within their programs. Best practices, integrating accreditation and assessment, and teambuilding approaches are covered as they relate to the administrator of a technology program.

Administration

Student Leadership Program: Results and Benefits

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Need: Students, universities and industry are all struggling during these economically challenging times. Students are faced with skyrocketing tuition costs, universities are faced with reduction of state funding, and industry has a looming shortage of future technical leaders. In this difficult economic environment, developing industrial partnerships to support curriculum and labs has become imperative. Southern Illinois University Carbondale's (SIUC) Leadership Development Program (LDP) has become the solution to many of these pressing problems.

Overview SIUC's Leadership Development Program has received over $1 million dollars from corporate and federal government sponsors that see a great value in investing in student's technical leadership development. The program has grown steadily over the past five years and has amassed a long list of student, university and industry accomplishments that confirm the program's value. This presentation will discuss sources of funding for an LDP, the steps for constructing an LDP, and SIUC's successes.

Major Points

- Need
- Funding
- Sources
- Structure
- Recommendations

Summary: The value of creating a student LDP lays with the principle stakeholders: companies, students, government, and the university. The SIUC corporate sponsor has attracted 15 graduates of the program, achieved an impressive retention rate and attests to the difference it makes with its hires. Students receive leadership training receive a tuition waiver for the last two years of their undergraduate education and leadership skills that will last throughout their lifetime. Government is achieving its goals of producing more students in the STEM field. The university is able to attract more and higher quality students by offering an abundance of tuition waivers.

Administration

Continuous Improvement of Program Outcomes through Assessing Student Demonstration of Workplace Competencies

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Need: Student-centered, learning-based educational systems place demands on institutions to provide evidence that students have achieved competency in defined program outcomes. Experiential learning environments provide a platform for students to demonstrate competency of program learning outcomes. Key actions that provide quantitative measures to assess competency of learning outcomes ensure the ability to assess changes in learning outcome competencies. Data collected from these assessments translate into achievement of the program outcomes. The ability to convert workplace competencies into curriculum strengths and deficiencies is valuable for continuous improvement of the program curricula. In this presentation, I will present my study how ISU has converted student and supervisor competency assessment surveys into quantitative measurements that is used to improve the program curricula.

Overview: Experiential learning environments are an important resource for providing students with practical work experience. These environments also provide student's additional opportunity to learn and apply knowledge and skills that they have learned during their classroom education. An equally important component of experiential learning is the ability to demonstrate prior knowledge. This study investigates the feedback gained from the experiential learning experience and translates that information into quantitative data that supports continuous improvement of the program curricula. This longitudinal study spans ten years, between spring 2001 and spring 2011 semesters. Analysis at the aggregate and program levels provide strong evidence to evaluate student competency of college and program learning outcomes. Continuous improvement of the engineering curricula depends on reliable measures for assessing student competency. The assessment of workplace competencies provides the curriculum development process with the information needed to continuously monitor and adjust to changes required for program learning outcomes.

Major Points:

- Need for quantitative evidence that students are able to demonstrate learning outcomes in the workplace.
- Ability to translate workplace competencies into continuous improvement of the program curricula.
- Identification of experiential learning by program constituents as the most important opportunity for students to learn and demonstrate program outcome competencies
- Addressing reliability of student self-assessment of workplace competencies
- Program interest in workplace competencies and the impact on curriculum development
- Relational change of self-assessment to supervisor assessment measured over 10-year cycle of continuous improvement
- Relationship between of program outcomes provide measurement for student learning in the classroom
- Relationship between internship self-assessment and graduate self-assessment of workplace competencies to support post-graduate competency assessment for curriculum development.

Summary: Attendees will understand how the demonstration of workplace competencies by students in an experiential learning environment is effectively used to assess ISU program learning objectives and provide valuable information in the continuous improvement of the program curricula. Data collected through on-line student and supervisor assessment surveys is translated into quantifiable evidence used in the continuous improvement of the program curricula.

Administration

Why and How to Rejuvenate an ATMAE Student Chapter: What's In It for Me?

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Need: As ATMAE student membership continues to decline each year, faculty need to do their part to increase membership to keep the organization healthy with new blood and fresh ideas. ATMAE chapters are presently having a difficult time retaining active membership as well as increasing active participation at the conference. In fact, ATMAE student membership dropped by over 50 members in just this past year alone.

Overview: This presentation will discuss several ways in which a university's program faculty can improve their ATMAE chapter to increase their enrollment as well as lead them to becoming an Outstanding Student Chapter of the year. Moreover, information will be presented on all the direct benefits related to improving student chapter involvement and the effects it will have on program growth as well as that of ATMAE.

Major Points:

- Methods of strengthening your connection with your ATMAE chapter
- Retention of active ATMAE members
- Types of incentives
- How to get your university or college involved in your ATMAE chapter
- Student chapter activities and growth implications on enrollment

Summary: This presentation will focus on effective methods for rejuvenating an ATMAE chapter and keep a positive retention number as the years progress. Presenters at this session will also discuss methods that they have used to improve their ATMAE chapter in order to win ATMAE's Outstanding Student Chapter award.

Administration

Development of a Common Core for a College of Technology

Mr. Dan Lybrook,
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Dr. Patrick Connolly,
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Need: Included in the most recent strategic plan of the College of Technology at Purdue was a goal of creating a core curriculum for the college, to consist of a common set of courses required of ALL College of Technology students (7 different departments and 11 programs). In this presentation, we will discuss the process of development for this core – how the content for inclusion was identified and selected into the appropriate courses, the requirements for delivery, as well as the issues and obstacles that arose during the process and how these challenges were met.

Overview: In our current environment, we are all faced with resource challenges – delivering the best product with finite resources, as well as creating a shared experience for students across seven majors. The end result of this process is a three course, nine credit hour sequence: TECH 12000 – Technology and the Individual, TECH 32000 – Technology and the Organization, and TECH 33000 – Technology in a Global World. TECH 12000 is a course required of all freshmen in the College and includes the history of technology as well as topics enhancing a student's transition to the college experience. This course has been taught twice and results and strategies will be shared. TECH 32000 will be offered as a beta in Fall 2012 and officially in Spring 2013. This course is required of juniors. Content includes public policy, teaming, and project management. TECH 33000 is a cross-cultural exploration of technology around the globe.

Major Points:

- Development designated in strategic plan
- Committee process and steps to identify core content areas of college
- Development into discreet courses
- Challenges and obstacles that we have faced and resolutions
- Fitting into the new University Core
- Where we are going, based on assessment and feedback

Summary: Most colleges have an identified general education core. Our College of Technology has taken this a step further in identifying common curricular content across all programs in the college and developing a three-course sequence for ALL students of the College. This model will be of use to anyone considering a like initiative. The presenters have been involved from the beginning in content planning and at present have lead responsibility for course development of TECH 12000 and TECH 32000.

Administration

Changing Program Names – Did it Help?

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Need: Many institutions are still contemplating program name changes based on the professional organization's change from the National Association of Industrial Technology (NAIT) to the Association for Technology, Management, and Applied Engineering (ATMAE). Gathering pertinent information from an institution that has changed programs names to reflect applied engineering could provide valuable insight for those debating name changes.

Overview: This presentation will provide background information regarding the process used to determine program name changes and will highlight feedback regarding the impact of the name changes. Attendees will learn about what current students, alumni, employers, colleagues in other departments, and high school students and counselors are saying about the changes.

Major Points:

- Selection of new program names
- Getting approval for program name changes
- How our current students reacted to the name changes
- How our alumni react to the name changes
- How about employers?
- RESPECT from other units?
- Will the name changes affect recruitment of prospective students?

Summary: Attendees will learn how the department developed and implemented program name changes and the reactions to those name changes one year later.

Administration

An Analytical Assessment of Students' Performance within the B.Ed. TVET and B.Ed. in Industrial Technology from 2008 – 2012 at the University of Technology, Jamaica

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Need: The School of Technical and Vocational Education was given the mandate in 1970 to train teachers of technical subjects for the Jamaican secondary school system. This mandate was later extended, in 1999, to include Technical and Vocational teachers and trainers for the lower tertiary institutions. Since the entry of the first cohort in 1999, the entry requirements have remained as five (5) CXC CSEC General or Technical Proficiency passes or GCE O'Level passes. During the period 1999 – 2009, applicants were required, in addition to Mathematics and English Language A, to have at least two (2) subjects in their desired specialization. Subsequent to this, the programme was reviewed in 2009, which resulted in applicants no longer being required to have passes in their area of specialization. However, in an initial review of the 1st cohort since 2009 (Year 2 students), it has been noted that students are displaying a weak performance in core specialized modules. Thus, this research and presentation will share findings on the analytical review of students' performance in core specializations based on their entry status.

Overview: The Governments of developing countries across the globe are accelerating their investments in technical and vocational education (TVET). The two main objectives for this thrust are to (i) advance the skills of its young population many of whom have had no opportunity to enroll or graduate in the education system and (ii) meet the needs of future industrial growth. In keeping with this, the UNESCO-UNEVOC discussions in Bonn, Germany, 2007 outlined that University education for vocation education teachers is required and should include occupational domains and pedagogical qualifications. This presentation will be divided in to three sections: 1) An outline of the B.Ed. TVET and B.Ed. in Industrial Technology at University of Technology (UTECH) by highlighting the review process, the history of TVET in Jamaica and current happenings; 2) Data collection and analysis; entry qualifications and progression of students between 2008 – 2012; 3) Presentation of findings and recommendations

Major Points:

- The importance of TVET and outlining its contribution to sustainable development.
- UTECH's role in preparing TVET teachers and trainers for secondary and lower tertiary institutions.
- The role of the Ministry and Secondary School administration in preparing students for TVET careers.

Summary: The information presented will inform stakeholders in the TVET arena on measures which can be taken to improve the marketability of TVET to the Jamaican population.

Administration

Factors Considered in the Development of Curricular Content in Engineering Technology for Diverse Audiences

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Need: Process industry supply chains which handle products such as food and foodstuffs have unique challenges in the management of large-scale raw materials. Engineering Technology solutions offer potential strategies for addressing uncertainties, adding value, and managing risks of raw material products. Yet, preparation of the existing and future technical workforce remains a largely unfilled need in both higher education and workplace training arenas. This presentation will discuss the factors considered in the development of core learning competencies and delivery options for curriculum in process supply chains for community college, university, and non-traditional and adult students.

Overview: This presentation will discuss the curricular needs for food and foodstuff supply chain professionals and the role of engineering technology curricula in preparing technical professionals to meet these needs. Factors used in determining content and delivery options for students at three levels will be discussed. Implications for the discipline of engineering technology will also be shared.

Major points:

- Characterization of process-based supply chains
- Role of engineering technology in process-based supply chains
- Description of process used to define core learning competencies for three levels of students
- Implications for the field of engineering technology

Summary: The audience will learn about the curricular needs of process-based supply chain professionals and how engineering technology is poised to meet these needs. The development of core learning competencies and delivery options will also be shared.

Administration

Improving Program Retention and Student Success with the Creation of a Student Chapter of a Professional Organization

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Need: According to data from ACT, Inc., national first- to second-year retention rates among students enrolled in public universities in the U.S. average 55.4% for two-year institutions and 65.6% for four-year institutions. It is clear that both academic institutions and the students they serve will benefit from a coordinated effort to improve these retention rates.

Overview: Significant research demonstrating the connection between student retention and student-peer interaction is extant. Such interaction is facilitated by the creation and growth of a student chapter of a professional organization that welcomes students who might not be otherwise engaged on campus and encourages their involvement in the organization. Benefits are multiplied when the organization is located at a joint facility which houses a lower two-year program feeding an upper two-year completion program, as it can be shown that the students groups who benefit the most from student-peer interaction are students indigenous to the institution and transfer students from two-year institutions. We will discuss how a student chapter of the American Association of Airport Executives was created at our facility, and the benefits in terms of both student retention and opportunities for career advancement that have resulted at both the two-year and four-year institutions that are located therein.

Major Points:

- Need for improvement in student first- to second-year retention rates
- Identification of appropriate engagement mechanisms
- Development of a student professional organization chapter
- Methods used to get students involved in the chapter
- Measures of student and program success

Summary: Attendees will develop an understanding of the student engagement model that has been implemented successfully at our university to allow us to improve student retention and success, in conjunction with an appropriate partner institution.

Administration:

Closing the Gap Between Women and Technology by Using STEM Based Student Organizations to Help Recruit, Retain, and Offer Support to Prospective and Current Students

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Need: According to the American Society of Engineering Education, the percentage of undergraduate engineering degrees awarded to women hit an all time low in 2009. Despite accounting for half the workforce, women only represent 25% of the STEM economy. This inequality is also mirrored on many college campuses. With this disparity in place it has become even more crucial to insure the success of female students pursuing technology based academic plans by providing support through student activities and involvement. This has also caught the attention of the federal government. According to White House Council on Women and Girls, Executive Director Tina Tchen says that "Jump-starting girls" interest in science, technology, engineering and math so-called STEM subjects – and boosting the percentage of women employed in science and engineering is not just the right thing to do but is also the smart thing to do for America's future and the economy." In this presentation, we will present ideas, activities, and best practices utilized through Ivy Tech Community College student organization sWiST (supporters of Women in Science and Technology).

Overview: Since 2008, supporters of Women in Science and Technology (sWiST) has provided support for its students through career exploration, social activities, community service and mentoring. With strong support from the Deans of the School of Technology and School of Applied Sciences and Engineering Technology at Ivy Tech, the group has grown to also support other departments on campus. sWiST is heavily involved in initiatives including Women's STEM Day on Campus which is a program designed the introduce STEM careers to area high school students. These activities, along with other recruiting efforts have led to an increase of 52% in female students pursuing degrees within the School of Applied Sciences and Engineering Technology since 2008.

Major Points:

- Need for women in technology fields
- Increasing the number of female students in STEM programs
- Bridging the gap between students and faculty
- Creating network opportunities
- Early Outreach opportunities
- Building fellowship among female STEM students

Summary: Efforts to increase the number of female student in STEM programs at Ivy Tech Community College included the creation of a student group called the supporters of Women in Science and Technology (sWiST). The presentation will illustrate techniques used to engage and retain female students to STEM programs by using student leaders and organizations involved within these fields. Attendees will also learn approaches to create partnerships with other institutions in an effort to assist each other on programs and other collaborations.

Administration

Converting an Engineering Technology and Management Program from a Quarters System to a Semester System

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Need: Programs are being forced to change from quarters to semester based systems in order to harmonize with programs from other colleges and universities on semester systems and make it easier for students to transfer and move credits from one program to the other. This presentation will review the process that a program used to collapse courses, adjust labs, and identify new content in the process of adjusting the curriculum to fit within the constraints of the new semester system.

Overview: Understanding this process may help prepare other programs getting ready to make similar conversions.

Major Points:

- Identification of key content
- New system Lecture and Lab constraints
- How class size growth was handled
- Confirmation of curriculum changes with stakeholders
- Accreditation concerns

Summary: At the end of the presentation the attendees will have a better understanding of the process and concerns of altering a program from quarters to semesters.

Administration

The Role of Emotional Intelligence in Leading Organizations

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Need: For any organization to be fully successful in its mission, it is imperative that all the constituents of that organization be motivated to work toward the common goal. In this ever changing business world, organizations continuously look for ways to gain a competitive advantage over the competition. One way is to have a highly motivated workforce. The big question is: How does an organization get everyone onboard, and motivated toward the common interest and or Mission of the organization? For a corporation to truly be successful in the long-term, strong leadership is a critical factor for how well a company will perform. As much as corporations strive to recruit, train, and develop young people with strong technical skills, they must also do the same to cultivate people with strong leadership skills within the company.

Overview: This presentation focuses on the Emotional Intelligence of Leadership. It is a method of leadership that hinges on the ability of an organization's leader to make decisions, influence and motivate people, and to think strategically. This method not only results in positive feelings on the part of every stakeholder but it builds sustaining bond that binds everyone in the organization together to the end that each member goes to work fired up to make a difference in the organization and as a result contributing to the bottom line and to the vitality of everyone in the organization becomes an achievable goal. It influences organizational development in a number of areas such as emotional recruitment and retention, development of talent, teamwork, employee commitment, morale, innovation, and productivity (Srivastava & Yuvaraj, 2007).

Major Points:

- What is emotional intelligence and why is it important for any organization?
- What are the five components of emotional intelligence?
- How can an individual attain emotional intelligence?
- Application emotional intelligence to a department, a unit of an organization or to the entire establishment.

Summary Emotional Intelligence is a key indicator in successful leadership. Sometimes the most successful leaders aren't the most technically savvy, but when faced with a problem, they know where to find the answer. Participants will learn about how to apply all of the Goleman's five components of emotional intelligence: self-awareness, self-regulation, motivation, empathy, and social skill.

Administration

Development of an Interdisciplinary Lab Module

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Need: The presenters will discuss the development of an interdisciplinary module to be implemented in a flexible lab space in their department's newly constructed facility. The importance of this presentation is that it will highlight the processes used to identify the needs of the department's programs and to design a module that satisfies these needs.

Overview: The Department of Industrial and Engineering Technology at Central Washington University just moved into the first phase of its newly-constructed facilities, which includes a flexible lab space that was intentionally positioned central to the department's various labs. The lab provides easy access to move equipment in and out of the building, between labs, and between floors. The facility was designed to be LEED certified at the platinum level, and the labs were built to openly showcase how this was done. Students also have access to view the systems and monitor its controls. Since the early stages of facility development, the department's faculty has envisioned having a lab space that is open and can be reconfigured as desired to perform a number of functions. Chief among these was the desire to allow students from the department's diverse programs to engage each other by establishing cells or modules that offer opportunities for interdisciplinary projects. The department has bachelor's degree programs in Industrial Technology, Mechanical Engineering Technology, Electronic Engineering Technology, Construction Management, Safety and Health Management, and Technology Education, as well as a master's degree in Engineering Technology. The faculty is also developing a program focused on the management of renewable energy resources. The purpose of project outlined in this presentation was to develop a modular lab unit that can be set up in a variety of configurations, either in the Fluke Lab or outdoors, and serve as a vehicle for conducting lab projects for undergraduate classes and research projects for master's students. The stages to be discussed will be the planning, concept development, system level design, and detail design phases. Implementation of the design will occur during the 2012-2013 academic year.

Major Points

- The planning phase was central to the entire project's success; critical activities included the identification, classification, and prioritization of stated and latent needs, and setting the project's scope.
- Concept development required a mixture of creative thinking and disciplined decision making.
- Specification of the system level design was the phase during which the team was challenged with optimizing the level of modularity and flexibility.
- The detail design phase required the team to continually focus on creative ways to maintain the project's scope.
- Development of the module provided an opportunity to document case studies that model many of the concepts that students learn in their upper-division courses.

Summary: An interdisciplinary lab module can provide students with opportunities to engage in projects with rich experiences they otherwise would not be likely to have during their academic preparation. This presentation highlights the development of a lab module that can provide such experiences.

Administration

A Report on the Middle School Career Camp: Strengthening Our Connections to Our Future Students, Generating Early Interest in Technology

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Need: Many businesses realize success by forecasting the needs of their future customers. Looking ahead five to seven years can often reveal where the market is heading and allows businesses to adjust to better serve their customers. Educators should be doing the same thing. We should be marketing the college courses of the future to children in middle school so they develop interest in our products.

Overview: This presentation will be a report on a recent Middle School Career Camp where seventh and eighth grade students attended a four-day series of activities that introduced them to technology at a community college. These young students learned theory and gained hands-on skills in product development, engineering, computer game programming, and video production. This presentation will focus on the product development sessions that took place in a manufacturing environment.

Major Points:

- Middle school students are the community college's target customers in five years
- Young students can benefit by developing career interests in technology early
- Designing a relevant theoretical and practical hands-on activity to help children understand technology
- Best practices for planning, organizing, and implementing a career camp at college

Summary: Attendees will be shown the planning process and implementation of a middle school career exploration summer camp activity that took place at a community college. Young students were shown real world applications in manufacturing technology, learned theoretical concepts, and gained hands-on skills.

Administration

How to Manage Multiple Accreditations Efficiently and Effectively

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Need: In the current budget constrained environment, we are all called on to do more with fewer resources and at the same time the legislators and university administrators are calling for greater accountability. As administrators look to improve their programs, they not only have to satisfy regional accreditation requirements as dictated by entities such as SACS, MSACS, NWAC, but they also have to meet the requirements of their discipline specific accreditors such as ATMAE, AACSB, ABET, NCATE and more.

Overview: This presentation will focus on how regional and discipline specific accreditation requirements can be met using the same data collection methods, thereby, streamlining accreditation for faculty, staff and administrators. More specifically, a model will be presented outlining the steps involved with successfully integrating guidelines defined by ATMAE, AACSB and SACS.

Major Points:

- Review accreditation guidelines and philosophies for ATMAE, AACSB, and SACS.
- Describe the similarities and differences between the accrediting bodies.
- Define data collection methods for assessing program quality.
- Showcase a model for streamlining accreditation for programs of different disciplines.
- Discuss best practices and lessons learned.

Summary: As accreditation becomes more prevalent to improve program quality, this presentation focuses on how accredited technology programs can work with accredited business programs to minimize efforts to maintain accreditation. In addition, a step-by-step model will be presented on how to coordinate maintenance of accreditation efforts quickly and effectively.

Administration

An Industry-Based Approach to Professional Studies in Technology and Applied Research

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Need: In addition to innovative programs to address conventional university student preparation for the engineering and technology workforce, given today's economy, universities have a responsibility to also make it possible for currently employed professionals to advance their skills and education – while remaining employed. To this end, the proposed presentation will share the reframing of an essential component of STEM education: the working professional adult learner sector of the STEM client spectrum.

Overview: The Center for Professional Studies in Technology and Applied Research (ProSTAR) was approved by Purdue University under the College of Technology as an academic Center on February 9, 2009. At that time, an effort was initiated to create an underlying infrastructure that would promote the current and future growth of professional studies. The intent was to organize facilities, human capital, processes, practices and methodologies in support of anticipated program offering growth.

Major Points

- Employed an industry-based, internationally recognized program management process to design, develop and implement an organizational infrastructure and matrix organizational design model to accommodate future growth
- Responded to the needs of the working professional adult learner client group by re-visioning the student - university interactions by providing corporate-level learning comforts from facilities to handling of registration, plan of study pre-recording and other professional services
- Utilized industry-cognizant faculty and instruction supported by advanced technologies
- Provided face-to-face instruction along with distance learning via hybrid, time sensitive, weekend formats, supporting work and family considerations

Summary: This paper depicts the organizational design model currently employed. The paper will also address the synergies attendant to the employment of senior retired leaders, and their applicability to effective teaching of professional adult learners. This paper shares the results of a ten-year longitudinal follow-up study of nearly 300 professionals, from business and industry, who graduated from Purdue University in the Center for Professional Studies in Technology and Applied Research (ProSTAR) programs.

Administration

ATMAE Alumni: A Trends Analysis and Demographics of 2007 ATMAE Accredited Programs Alumni

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Need: The ATMAE accredited programs alumni survey results were among the indicators that created the need for changing the name of NAIT to ATMAE. A trends analysis of ATMAE graduates will help to determine the market value of our graduates, and to help promote ATMAE programs. This presentation presents the data obtained from selected ATMAE accredited institutions alumni of 2007 regarding their positions and responsibilities, salaries, job satisfaction, professional achievements, qualifications, and promotions. The data presented will contribute to the revision and development of the discipline.

Overview: A review of literature regarding the need for obtaining feedback from alumni will be presented. The results of the surveys will be analyzed, and the process of developing, validating, and administering the questionnaire will be discussed

Major Points:

- The salary trends during the past five years will be explained.
- Positions held by ATMAE graduates as well as their responsibilities and salaries will be presented.
- Highest academic degree and qualifications of graduates will be presented.
- Perceptions of graduates regarding potential improvement in programs and courses will be discussed.
- The professional impact of ATMAE accreditation on program's graduates will be discussed.
- Graduates perception of ATMAE certifications such as CTM, CSTM will be discussed.

Summary: Although ATMAE has recognized the importance of programs graduates feedback by asking ATMAE accredited programs to conduct an alumni survey and disseminate the results, a review of literature indicates that very limited research data is available on alumni perceptions of their programs. This presentation will provide a trend analysis of ATMAE alumni of 2007 at the national level.

Administration

A Comparative Study of Faculty Salaries in Related Disciplines: Establishing a Benchmark and Enhancing Visibility in a Market Driven Economy

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Need: Faculty shortage in ATMAE programs and how the next generation of ATMAE faculty will be prepared is a major concern. Diversity of background among faculty and administrators is a unique characteristic of ATMAE programs. However, at this critical time that rightsizing, restructuring, and downsizing of programs have become a new norm in the institutions of higher education, ATMAE professionals need to network together in order to provide and maintain a consistency of purpose and enhance the professions' visibility in accordance with the ATAME's new mission.

Overview: The diversity and dynamics of our technological programs as well as the paradigm shift in instructional and funding models has been the catalyst for administrative innovation to sustain program quality. Our organization has changed its name and mission to the Association of Technology, Management, and Applied Engineering (ATMAE) which truly reflects the purpose of our programs. The main thrust is to learn from our past experiences, and continually improve our practices in order to not only stay competitive but also take a leadership role in the development of the national economy.

Major Points:

- Internal and external challenges with market value and faculty salaries will be discussed.
- Integrating research grants and contracts as a contemporary model for funding departmental operations will be introduced.
- The strategic directions for industrial technology and the role of new ATMAE leadership will be discussed.
- The socio-economic roles, positions and responsibilities of ATMAE alumni will be explained.
- Internal and external efforts with market value of faculty salaries will be discussed.
- The focus of IT programs in the future will be discussed.

Summary: The presentation will provide ATMAE professionals with a database regarding the challenges faced by and opportunities existing for the ATMAE profession in the 21st. Century.

Administration

Trends and Characteristics of the ATMAE Faculty - A Demographics Study and Faculty Salaries

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Need: The primary purpose of this presentation is to present the 2012 demographics data collected to determine the characteristics of the ATMAE faculty, and to update the data on the Demographics section of the ATMAE website: *http://atmae.org/index.php?option=com_content&view=article&id=11&Itemid=28*

The data will exhibit the salary, positions, field of preparation, background, employment status and projected retirement of ATMAE faculty, and administrators. The data will enable the ATMAE professionals to look forward and address the critical issues such as market value, program recognition, professional visibility, that impact the development of the ATMAE profession and recruitment and retention of qualified professionals in the discipline. The Demographic data is used to benchmark the salaries among ATMAE accredited institutions.

Overview: A three-page survey information form has been posted on the ATMAE web site, and communicated with the deans, department chair-persons, department heads and administrators of the ATMAE accredited Associate and Baccalaureate programs. The questionnaire focuses on key characteristics of ATMAE faculty including salaries, primary field of preparation, teaching and research responsibilities, academic status, earned degree, age and gender, and retirement status in the academic year 2010-2011.

Major Points:

- The salary range of IT faculty/staff will be presented and compared
- Faculty salaries will be compared with similar disciplines.
- The primary field of preparation of ATMAE faculty will be discussed.
- Recruitment strategies will be introduced
- Teaching/research responsibilities of ATMAE faculty will be described.
- Academic rank of ATMAE faculty will be presented.
- Qualifications of ATMAE faculty will be discussed.
- Benchmarking of ATMAE faculty salaries with closely related disciplines such as Engineering, Engineering Technology, Management, and Business Administration will be discussed.

Summary: This presentation will provide ATMAE professionals with an accessible, relevant, and recent database regarding the key characteristics and qualifications of faculty members who currently teach in ATMAE accredited programs. The data will assist the ATMAE organization and ATMAE leaders to make informed decisions regarding the future of the profession.

Construction

Construction

Analysis of Current Trends of Highway Maintenance to Determine Future Improvements

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Need: Our highway system needs to develop a better innovative way to maintain so that it can help to lengthen the effective life of our current highway system. Maintaining and keeping roads safe is an essential part of traveling in everyday life. Therefore, designing a new way of maintaining and implementing safe conditions under which the lifetime of the highways may be extended. The intention of this project is to analyze the current trend of highway maintenance, in a specific case study between Morehead and Lexington on I-64 West bound.

Overview: Research will be performed in order to analyze the condition the highway in presently, and to determine successfully what types of materials should be used and under what conditions to improve the longer-term reliability of the highway system for the future. Distress and cracking of the pavement are common faults which need to be understood better to effectively plan and design a more efficient way to construct a better highway system. Data will be gathered by studying distress within this region, why it occurs and why it is very challenging on this region. Investigation in determining what different types of good material could be implemented in order to make the highway more durable is essential.

Major Points:

- Analysis of major crack and repave at highway
- Investigating to determine what different types of good material could be implemented to have durable highway
- Analyzing the current trend of highway maintenance, in a specific case study between Morehead and Lexington on I-64 West bound

Summary: Maintaining and keeping roads safe is an essential part of traveling in everyday life. The intention of this project is to analyze the current trend of highway maintenance, in a specific case study between Morehead and Lexington on I-64 West bound. Research will be performed in order to analyze the current condition of highway and to determine the best materials should be used to improve the longer-term reliability of the highway system for the future.

Construction

Impact of an Effective Six Sigma Quality Management System on a Construction Management Organization

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Need: An effective Quality Management (QM) system in Construction Management is important in order to establish best quality standards. The most prevalent applications of Six Sigma are typically related to manufacturing, electronics and other services. Though, Six Sigma is relatively new to the field of construction, it is important to integrate effective safety and quality control standards in the execution of construction projects. A construction management team has many options and opportunities to continually improve and ensure a safe environment as well as constructing a conforming product. The Six Sigma Define-Measure-Analyze-Improve-Control (DMAIC) process is one of the practices a construction management team can implement for continuous improvement and customer satisfaction.

Overview: Six Sigma is a proven Quality Management technique, aimed at ensuring a nearly defect-free product performance. Effective implementation of Six Sigma ensures improved customer satisfaction and overall profit for the organization. Construction management organizations oversee quality construction work and also ensure the safety aspects of quality control. Construction teams are trained to maintain sound quality work throughout the entire construction process. The Six Sigma DMAIC approach is one of the practices that a construction management team can integrate into their processes for sustained quality improvement.

Major Points:

- Six Sigma principles and matrices
- Roles of management and teams
- Implementation of DMAIC steps to quality and safety of construction projects.
- Benefits and challenges for customers and management.

Summary: Six Sigma is a proven efficient Quality Management technique for ensuring defect-free products and processes, while improving customer satisfaction and profits. By effectively integrating the Define-Measure-Analyze-Improve-Control (DMAIC) processes, construction management organizations can maintain reliable measurements, solve recurring problems and, ensure high quality and safety standards for building projects.

Construction

Protecting Innovation in Construction Technology

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Need: Intellectual Property (IP) management is a key consideration in the development of construction technology. For example, new and improved construction machines, parts, tools, and even processes can all be protected with IP. A well-formed IP portfolio can serve not only as a sword to prevent others from stealing your ideas, but also as a shield to discourage them from suing you. Proper technology management can strengthen connections with a company, department, or organization by ensuring that it has channels in place for encouraging and capturing innovation. In addition, major changes to the U.S. patent laws under the recently enacted America Invents Act may require the reevaluation of current IP strategies.

Overview: This presentation will provide an overview of various techniques and strategies for developing and protecting innovation in construction technology. In particular, the presentation will provide information on best practices for companies, departments, and organizations who want to encourage, capture, and protect innovation through IP law. The presentation will also cover the current state of U.S. patent law following the recently enacted America Invents Act and what changes can be expected under the new laws.

Major Points:

- IP strategy is a key component of construction technology management.
- Many types of innovations can be protected through IP.
- A comprehensive IP program can ensure that proper channels are in place to encourage, capture, and protect innovation.
- The recently enacted America Invents Act may require the reevaluation of IP strategy.

Summary: Attendees will understand the importance of protecting innovation in construction technology through IP law and will come away with tips and techniques to help do so. In particular, the presentation will provide examples of types of innovations that can be protected with IP as well as detailed information on developing programs to encourage and capture innovation and expected changes to the laws under the recently enacted America Invent Act.

Construction

An Argument for a Risk Management Course in Construction Management Programs

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Need: Construction Management programs recognize the need for Safety and Quality Management coverage in their curricula due to industry needs. These needs arose out of laws and competitive practices. In short, construction companies want to increase profits and reduce the amount of costs for things such as: insurance, fixing poor quality work, paying fines, or losing lawsuits relating to the issues on their projects. These are two examples of detailed Risk Management plans, but do not really address an overall risk management strategy that applies to all potential sources of risk. Currently, in response to client demand, the number of Sustainable & Green construction projects, including LEED certified projects, is increasing. Many of these projects commonly require the use of Building Information Management (BIM) software techniques. The result has been a growing wave of lawsuits filed by clients that were promised one thing in the contract documents, yet the promise results were not achieved in the finished product. For example, an owner that was promised a LEED Gold rating building prior to construction, finds out more than a year after the construction was completed that the building only achieved a LEED Silver rating. The number of lawsuits such as the prior example is expected to climb rapidly in the next decade in direct correlation to the number of these types of projects. Thus, there are now two new topic areas that should be included when discussing Risk Management within Construction Management programs. The problem we face is that the content coverage within these programs focus on managing Sustainable, LEED or BIM construction projects, yet often do not include how to identify and manage the risks associated with these types of projects. In addition, many programs are being pressured to add new content areas, while attempting to reduce the total number of program credit hours needed for graduation. The current push in many states is to have only 120 credit hours for a Bachelor of Science degree. So the question is, how can programs increase the number of topics covered and maintain the necessary content level, while simultaneously reducing the total number of program credit hours required to graduate?

Overview: This presentation will propose a general Risk Management course with modules in Safety, Quality, Sustainable/Green Construction, and BIM. In depth coverage of each of these topics may be offered in specialized elective courses if programs need to reduce the overall level of required credit hours. The Risk Management course proposal will address the basic Risk Management process, and present to students and faculty how this process applies to the different areas of construction.

Major Points:

- Current number and relative percentages of the ASC programs with material coverage in Safety, Quality, Sustainable/Green Construction, and BIM.
- An outline of a proposed Risk Management course, which may help to consolidate multiple courses into one, thus reducing the overall number of program credit hours required, allowing students to gain additional knowledge in various other topics by taking elective courses instead.

Summary: This presentation will summarize the argument, and the benefits, for including a general Risk Management Course in Construction Management programs.

Construction

A Study of Associated Schools of Construction Member Programs' Curricula and the Correlating Major Areas of Content for the Purpose of Creating an ATMAE Construction Management Certification Exam

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Need: All programs need ways to do outcomes assessment. One way to do this is for students to take certification exams created for their majors that students from other similar programs may also take. ATMAE has a charge for the Certification Committee to create a construction management certification exam that graduating seniors may take no matter what accreditation the program may have. The number of questions has been determined to be 120, but the breakdown of the question content areas nor the number of questions for each category has not been determined. In order to create a balanced exam, a study of all current (as of December 2011) Associated Schools of Construction (ASC) member programs with Bachelor of Science degrees were quantified in terms of program hours, accrediting organization, and content hours of coverage in various common subject categories for construction management program. Percentages of ASC programs with the major or main content areas were calculated. Now that current the program majority content areas and commonality has been found, the questions categories and number of questions per common category content can be determined for the pool of questions to be created for the ATMAE certification exam.

Overview: This presentation will summarize the current status of ASC Construction Management programs' curricula and hours of coverage of the major content areas and topics as determined by the study. It will also summarize the accrediting groups and their representative percentage of all the programs included in the study, the correlations between the accrediting groups and program credit hours, the percentage of programs with the areas of course content, and how many hours of content coverage in the major topic areas including, but not limited to: Building Information Management (BIM), Design (AutoCAD), Sustainable & Green Construction, Soils & Foundations, Structures/Design- Statics, Strengths of Materials & Temporary Structures, Documents & Plan Reading, Estimating, Scheduling, Construction Law, Construction Safety, Quality, Construction Management &/or Administration.

Major Points:

- Current number of ASC Programs (as of November 2011) and the programs included in the study.
- Current number & relative percentages of the main Accrediting groups: ACCE, ABET and ATMAE.
- A breakdown of the program course content areas and the percentage of programs with those content areas to determine the "major content areas".
- A breakdown of the number of hours of content (averages) in the programs with those courses.
- A ranking of suggested ATMAE Certification exam question content areas based upon the percentages of programs with those courses.

Summary: This presentation will summarize a relative "state of the union" for Associated Schools of Construction member organizations and programs. It will summarize the current major content areas and the amount of hours of coverage for these topic areas, as well as summarize overall program credit hours required for degrees. The current numbers of programs with the major three accrediting groups will also be presented along with correlations, if any, to total program credit hours.

Construction

Increasing the Interest of High School Students in Pursuing a Career in Construction

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Need: The construction industry is one of the major contributors to the World as well as the U.S. economies. Harmon (2003) predicted that the size of the world construction industry would reach US $5.5 trillion by the end of 2007. In addition, the contribution of this industry to the U.S economy was estimated at US $1.2 trillion (El-adaway 2008). However, the growth of this industry is dependent on a number of factors, among which is the quality of its practitioners. Consequently, it is constantly in need of highly educated and qualified students that can become successful and productive in the field. "The most important struggle is over how to engage students, hold their interest and make the subjects come alive. Without that component, all is lost, including the many students who may wander away to other fields and industries" (Engineering News Record (ENR) 2002). The need to attract students' attention and interests towards construction is critical for the continuing success of this industry. Programs like the ACE (Architecture, Construction, and Engineering) Mentor Program and The Home Builders Institute (HBI) Construction-Coaching Opportunities to Reach Employment (C-CORE) have been developed to attract such students and provide scholarships for continuing education in these fields. Despite this, there is a pressing need for more programs and initiatives to be taken in order to enlighten and inform today's youth about the potentials of this industry properly and in a timely manner.

Overview: The construction industry is looking for students that are hard working and already trained on the necessary tools and equipment that are used. However, many students are either uniformed or uninterested in this challenging and rewarding career. The objective of this study is to find out what efforts have been made to raise high school students' interests in construction and to note-worthy programs, activities and school curricula that have been successful at holding students' interests in construction.

Major Points:

- The current need of qualified workers (students) for the construction industry
- What can be done to initiate student interests in construction
- Methods to keep students engaged and excited about construction
- Discussion of existing programs and extra-curricular activities that work and are successful

Summary: The audience will gain insight on effective ways to capture students' attention in the construction field. The audience will also gain knowledge of programs and other extra-curricular activities that are available for students to pursue their interests in construction and construction-related fields.

Construction

Participation on Competitive Teams in Construction: Students' Perspectives

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Need: Teamwork is vital in the construction industry, and university construction programs prepare students for working on teams by using a variety of classroom and extracurricular methods. One approach that is gaining popularity is student competitions, where teams of construction and related majors compete against other schools in a variety of simulated challenges. Faculty mentor and coach these student teams, yet little research is available to them on the students' motivations, perspectives, and advice for these competitions.

Overview: While student competitions become more popular in construction, little information is available from the student perspective on these activities and why they chose to participate. This presentation provides faculty, administrators, and organizations with the student participants' perspectives on student teams. Drawing from interviews with students who competed in regional, national, and international events, this presentation helps construction educators understand the student perspective of competing on teams, from recruitment, through victory or defeat, to returning to campus to start preparing for next year.

Major Points:

- Student motivations for participation
- Perspectives on competing
- Student team preparation
- Post-competition activities
- Advice for future participants
- Putting student perspectives into faculty practice
- Conclusions and recommendations

Summary: Attendees will understand student perspectives on participating as a member of a competitive team in a variety of events. Armed with these perspectives, faculty, administrators, and organizations will better be able to coach, sponsor, and organize these construction competitions.

Construction

Teaching Through Competing: Coaching Student Competitive Teams in Construction Programs

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Need: In the modern construction industry, teams of builders compete against each other in high stakes matches where winners and losers are determined by the opening of the bid. Student competitions allow participants to experience a similar environment as part of their university construction programs. As these competitions become more numerous and diverse, more faculty are needed to coach the students and enhance the learning process. Additionally, faculty members often have to decide whether the competitions will be approached as a class or an extracurricular activity. By coaching these student competitive teams, faculty can reinforce the undergraduates' student experience and have some fun themselves.

Overview: Although student competitive teams are becoming more popular, little information is available to faculty members being asked to coach these teams. This presentation provides faculty with the challenges that accompany coaching these teams and suggestions on how to best overcome them. Drawing from the viewpoints of three faculty members that have collectively coached teams competing at the regional, national, and international levels, this presentation helps construction educators lead the competitive team, from formation through post-competition activities.

Major Points:

- Student recruitment
- Best practices for preparing and competing
- Extracurricular versus course-based competitions
- Industry involvement
- Post-competition considerations
- Potential pitfalls
- Conclusions and recommendations

Summary: Attendees will understand the challenges and opportunities of coaching a student competitive team in construction, including best practices and potential pitfalls as they relate to the faculty member.

Construction

BIM Teaching Approach in Construction Management Curriculum

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Need: A report published by National Institute of Standards and Technology (NIST) in 2004 suggested the loss of $15.8 billion per year in the construction industry due to poor interoperability and data management, which is approximately 3-4% of the total industry cost. As a consequence, many construction companies have adopted Building Information Modeling (BIM) to improve information flow and data management. BIM can be used as a collaborative platform among various stakeholders of the construction industry at different phases of the life cycle of a facility. Practitioners as well as researchers are of the opinion that BIM has been a revolutionary change in the construction industry that will increase the efficacy of information flow in the industry. As the construction programs of the various universities strive to educate their students for professional success, the offered curriculum should be always updated and modified according to industry expectations. Little is known about the books, course materials, and instructor supplements used to teach BIM at various construction programs, and how these resources or course materials align with the industry expectation.

Overview: The primary objective of this study was to conduct a content analysis of the available syllabi for BIM courses taught in construction management programs. These curricula for BIM or 3D CAD courses were assessed based on the following factors: (1) course level, (2) course description, (3) learning objectives and outcomes, (4) textbook adopted and (5) instructional method. The respective course syllabi were obtained from instructors across the United States. In addition, a questionnaire was sent to the faculty members of construction programs offering course(s) in BIM. The programs were selected from the ASC (Associated Schools of Construction) member institutions offering courses in BIM or its variants.

Major Points:

- Importance of BIM courses in Construction Management Program Curricula
- Variation in the course descriptions and learning outcomes of the BIM courses offered in various ASC member institutions.
- Discussion on the different instructional methods adopted in the different member institutions.
- Provide suggestions on the future directions of BIM education in Construction Management Programs

Summary: Audience will gain insight on the variations in instructor qualifications and expertise, course description, course objectives, and learning outcomes of the BIM and 3D CAD courses taught in the US. Attendees will understand the varied approaches taken in teaching university-level BIM courses. The materials and instructional methods are covered as they relate to the faculty member in a technology program.

Construction

Decision Support of Markup Value for the Construction Industry through Statistical Model

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Need: The markup value included in a bid is usually the outcome of a complicated analysis that requires experience. It entails taking into account different factors that could be internal and/or external. However, the precedence of one factor to the other and its effect on a decision to bid varies due to the dynamic nature of the industry and the complexity of the projects. Consequently, accurate estimation of markup values through the assessment of the different factors and their associations is essential.

Overview: In an effort to facilitate markup value decision making, research in the construction industry developed expert systems, mathematical models, and machine learning (ML) models. Although those studies resulted in significant contributions, none of them utilized Statistical Modeling to identify and quantify the significant factors upon which such a crucial decision is based. Therefore, the current research task proposes a framework for (1) defining a list of factors that affect the markup value in the construction industry; (2) quantify the importance of these factors on such a decision through statistical modeling; and (3) identifies associations between these factors to hierarchies them based on their significance.

Major Points:

- Markup value estimating challenges in the construction industry
- Methodologies for assessing markup value estimates in the construction industry
- Identified factors that affect markup value estimates
- Statistical model development methodology
- Achieved results
- Discussion and derived conclusion
- Future work recommendations

Summary: Attendees will (1) develop an understanding of the challenges faced due to uncertainties in markup value estimates; (2) gain knowledge about the factors that affect such estimates and latent associations between them; and (3) expand their knowledge about new uses of statistical modeling to the benefit of the construction industry.

Descriptor:
Learn about challenges faced due to uncertainties in markup value estimates, the factors that affect such estimates and latent associations between them, and find out about new uses of statistical modeling that can benefit the construction industry.

Construction

Integrating Environmental Value Engineering into the Sustainable Building Model

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Need: The advent of sustainability in the building industry has led construction practices to become more involved in the ramifications on the environment. Eco-friendly programs such as LEED, (Leadership in Energy and Environmental Design), has developed ratings systems for project efficiencies in energy and sustainability, Generally accepted analysis such as Value Engineering and Life-Cycle costing may find the most economical alternative, a relatively new methodology called Environmental value engineering, (EVE), enlightens the user to the environmental impact through a 10 phase analysis. Environmental value engineering assessment, (EVE), takes the environmental impact of those materials, processes, and products from formation to disposal. This analysis uses four production and consumption phases: Environment, (E), Fuel Energy, (F), Goods, (G), and Services, (S), that evaluates the environmental contribution and impact of built environment alternatives.

Overview: As resources continue to shrink, the competition between built environment alternatives will continue to escalation. This presents a problem as societal needs continue to infringe on the environment. The focus of this research and presentation is to show the methodology of how Environmental Value Engineering, (EVE), can analyze the inputs of energy for those materials and alternatives through each phase. More concisely, the use of environment, fuel energy, goods and services within each phase as it is being analyzed using EMERGY input tables from natural resource extraction to disposal.

Major Points:

- Integration of sustainable concepts within an Environmental Value Engineering Assessment.
- Results of assessment of two building alternatives in wall construction using EVE analysis.
- Development of a general model for EVE assessment for any alternatives.
- Assessment of cost-savings techniques in the building process.

Summary: Attendees will have the opportunity to see a completed EVE assessment and the development of a methodology that can be used as a generic template for use in determining environmental impact. Additionally, this model will incorporate comparison models used for sustainable building in the construction industry.

Construction

Uncertainty-Based Line-of-Balance Scheduling Method

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Need: The Line-of-Balance (LOB) is a popular scheduling technique for projects that involve repetitive tasks throughout the project duration. Examples include projects such as road construction and high-rise building construction. The LOB method, however, produces deterministic schedule, meaning it does not show the range of different potential project outcomes. This results from the fact that the basic scheduling inputs, crew production rates, are estimated using single-point values. The current LOB technique, therefore, lacks the capability to reflect the critical fact that the crew productions change constantly due to various factors.

Overview: In this presentation, how the variability of crew production rates affects schedule outcomes is demonstrated. This will show a more realistic picture of what might be a true project progress. To present a more effective and comprehensive way of incorporating this production variability in LOB, a Monte Carlo simulation technique is applied. The manual and computer simulation results are compared and discussed in terms of their pros and cons.

Major Points:

- Variability and uncertainties in the crew production rates
- Deficiency of the current LOB scheduling technique
- Ways to incorporate the production variability and uncertainties in LOB
  - Manual simulation
  - Monte Carlo simulation

Summary: The presentation will demonstrate why the current LOB does not produce a realistic project picture for planning and how this deficiency can be overcome using simulation techniques.

Construction

Sustainable Health Care for Existing Facilities: Green Globes- Alternative to LEED

Dr. John Reposa,
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Need: In healthcare environments, underuse or misuse of resources can have exponentially adverse impacts on the ROI, compared to most other industries. As 24/7 operations, healthcare facilities affect the environment more than other types of facilities. Therefore, every improvement in operating efficiency becomes especially valuable, both for the environment and in terms of cost-savings.

Overview: Green Globes is an affordable, practical, and effective sustainable building rating system and is a practical alternative to LEED. It has a well-established record with the Veterans Administration, The National Institute of Health recognizes the Green Globes system for assessing and certifying laboratories, and nearly half the states in the nation have officially written it into legislative orders. Comparing its utilization with LEED certification for hospitals the Green Globes system has been shown to save time, and can be completed without need for a specialized consultant.

Major Points:

- What is Green Globes Healthcare
- Brief Comparison of Green Globes to LEED for Existing Health Care Facilities
- Green Globes Simple Online Self-Evaluation
- The Green Globes Certification Process
- The benefits of choosing the Green Globes system

Summary: Green Globes has certified more existing healthcare facilities in the U.S. than any other sustainable building rating certification. The Green Globes system is based on guidelines from recognized healthcare sustainability experts, and their own unique assessment and certification process. Nationwide, Green Globes has certified 150 facilities to date, including Veterans Administration hospitals, clinics, long-term care and assisted living facilities. In addition to the VA work already completed, the VA has placed orders to certify more than 175 additional facilities on 11 separate campuses, which will be certified by early 2012.

Construction

Guiding Principles for EO 13514 Mandate, Compliance Assessment Program for Existing Buildings

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Need: Executive Order 13514, states that by 2015, 15% of each agencies federally owned or leased buildings >5,000 square feet or larger must incorporate the sustainable practices from the Federal Leadership in High Performance and Sustainable Buildings Guidance Document.

Overview: Federal agencies have a variety of options available to evaluate compliance with the Guiding Principles including EPA's Federal High Performance Sustainable Buildings Checklist (contained within EPA's Energy Star® Portfolio Manager), subjective paper evaluations by internal staff, or ad-hoc evaluations by external consultants. The Veterans Administration (VA) has turned to Green Building Initiative (GBI) to develop a means to assess and demonstrate compliance to the requirements of Executive Order 13514, and to apply it to the approximate 180 buildings already undergoing Green Globes certification.

Major Points:

- Five Guiding Principles which federal agency buildings must comply with.
- Overview of options available to evaluate compliance with the Guiding Principles
- Overview of Third Party Assessment.
- GBI Assessment and Certification Process
- Compliance Recognition
- Why Use an Outside Third Party

Summary: The Five Guiding Principles which federal agency buildings must comply are: 1. Employ integrated design principles 2. Optimize energy performance 3. Protect and conserve water 4. Enhance quality of indoor air environment 5. Reduce environmental impact of building materials. The VA has hired GBI to do their assessments as a result of GBI's expertise with sustainability evaluation tools and third-party building assessments. The Green Building Initiative is an ANSI Accredited Standards Developer, and a well-established provider of building sustainability assessment and certification services within the Federal Sector.

Construction

Scheduling Software Requirements for a Varying Size and Type of Contractors, Sub-Contractors and Specialty Contactors

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Need: Students graduating from Construction Management Programs are being hired by a diverse size and field of Contractors, Sub-Contractors and Specialty Contactors. While all of them need to perform some level of scheduling of their work, their needs may vary from using a simple hand drawn bar chart to advance scheduling software packages that share resources among projects. To better serve our graduates and the construction industry we need to know the different scheduling needs of the our industry and the different tools available to support these diverse needs.

Overview: Over the last several years student at three different Universities were require to interview local, regional and national contractors and collect information on the following: 1. What kinds of work do they due, 2. Do they use computers for scheduling, 3. What software packages are they using, 4. Who does the scheduling (Schedulers, Project Mangers, etc.) 5. How often do they update their schedules and 6. How do they determine activities durations for subcontractor's activities.

Major Points:

- Brief Comparison of Primavera P5/P6 to Suretrack/P3 and Microsoft Project.
- Software and maintenance cost to Contractors, Universities, and Students.
- Advantages and disadvantages of using Primavera P5/P6 in a network versus a standalone mode.
- Different needs of Contractors, Sub-Contractors and Specialty Contactors.
- Learning curve of different software for inputting the schedule, resources and cost.

Summary: Almost all the construction companies interviewed were using scheduling software on their projects. Approximately half of the contractors are using Primavera software while the rest where using Suretrack and / or Microsoft Project. About 35 % of the scheduling was being done by a Scheduler, but the majority of the scheduling was being done by Project Managers and / or Estimators. Most schedules were being updated weekly (72 %) while a few were being updated bi-weekly. Most Contractors are scheduling subcontractors from Historical data (67 %) while a few are asking their subcontractors for durations.

Construction

Measurement and Verification in Delivering High Performance Green Buildings

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Need: In light of the rising awareness of environmental sustainability and building operational costs, delivering high performance green building in concert with owner's project requirement (OPR) has been recognized as the mission of building design and construction industry. To ensure the actual achievement of targeted design criteria and system performance metrics, measurement and verification (M&V) have been incorporated in the building delivery system. More recently, the International Green Construction Code (IGCC) associated with ASHRAE 189.1 was created to serve as a framework quantifying the performance criteria for the outcome of delivery process. To be able to fulfill the code requirements, it is therefore imperative for the building industry and academia to remain current with the mandatory practice of measurement and verification.

Overview: In response to the heightened demand for more efficient building performance, the International Green Construction Code (IGCC) was recently formulated to provide both quantifiable criteria and executable guidelines for high performance green buildings. It aims to ensure the building systems are properly designed, installed, and operated; and further the performance criteria for building systems are actually achieved. More specifically, the measurement and verification of indoor environment quality, water consumption, and energy efficiency are considered essential in assessing the building performance. In this presentation, procedures, devices, methods, and quantifiable criteria for measurement and verification will be reviewed, analyzed, and evaluated.

Major Points:

- Measurement and verification (M&V) processes in ASHRAE 189.1
- System delivery: installation, calibration, tuning, balance, verification & operation
- The energy efficiency, consumption, and measurement
- The water efficiency, consumption, and measurement
- The indoor environment quality and performance criteria
- Discussion on the function, devices, and methods of measurement & verification

Summary: The high-performance building is a result of environmentally responsible endeavor with economic benefits and social rightness. To ensure the actual delivery of such buildings, it is crucial for the relevant building system professionals to collect data through measurement and verification (M&V), using proper procedures, devices, and methods to verify achievement of performance metrics specified in IGCC and ASHRAE 189.1. More importantly, measurement and verification have to be performed post occupancy into the phase of operation and maintenance (0+M) in order to further ensure long-term fulfillment of the high performance requirements.

Construction

Building Information Modeling: Tablet Computing and Constructability

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Need: The necessity of Building Information Modeling (BIM) phenomenon to facilitate effective and efficient construction delivery although acceptable in concepts by construction industry has not been translated into ubiquitous usage. Mainstream constructors continue to be concerned by many factors such as legal, propriety trade information, interoperability issues and lack of expertise. This presentation discusses the impact of tablet computing on BIM and constructability.

Overview: Transformation of Building Information Modeling into a tool that can be utilized daily onsite to aid building activities will assure increased constructability, estimate and schedule reliability. Conversion of sophisticated and esoteric BIM software via tablet computing devices into a mobile, exoteric, and intuitive form that can be used by both skilled and semi-skilled craftsman on the job site to aid constructability will reduce RFI's, rework, change orders, conflicts, and disputes.

Major Points:

- Rapid development in BIM application for tablet computing.
- Adobe Reader (IFC)
- Autodesk's AutoCAD WS, DesignReview, Buzzsaw, Bluestreak
- Bentley's Navigator, ProjectWise, and Structural View
- Graphisoft's BIMx,
- Race to develop tablet based applications for construction industry

Summary: Influencing factors such as lean construction, integrated project delivery, and recent trends toward design built will indubitably shape future of construction industry. Building Information Modeling software designers are racing to develop intuitive tablet based applications for construction industry to facilitate BIM integration.

Construction

Rethinking the Future of Portland Cement: A Promise or Threat to the Global Society?

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Need: Concrete products depend almost totally on portland cement as their main ingredient. However, the beneficial applications of cement within the construction industry are not without environmental and health hazards. This presentation will discuss the fact that Portland cement can be a double-edged sword. In addition, because cement is the most active component of concrete and usually has the greatest unit cost, it shows that its selection and proper use are important in obtaining most economically the balance of properties desired for any particular concrete mixture.

Overview: This paper presents a brief overview of the latest in the production, applications and research of the main types of cement used in the construction industry. It will also cover the possible environmental and health hazards associated with its production and use, and how to safeguard against them, as we work our way through the new millennium.

Major Points:

- Historical Background
- Portland cement main types and properties.
- Portland cement production processes.
- Advantages and disadvantages of portland cement.
- Dealing with the hazards associated with portland cement.

Summary: Portland cement is an amazing material that has remarkable benefits to the construction industry through a variety of interesting features, properties, and applications. However, it can be a double-edged sword and attention must be paid to safeguard against its deficiencies. As the global society steps into the future, the construction industry must assess the building materials that are used -- including portland cement, emphasizing their strengths, and finding ways to face any hazards involved in their production or applications.

Construction

Dynamic Architecture: A 21st Century Revolutionary Construction Trend

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Need: It is considered no good attempting to repeat in every aspect the history of the past as we try to meet future needs. Exploring new construction materials, innovative methods, and novel equipment must be a priority in order to open exciting opportunities for those who work in the construction industry, as well as for those who benefit from the buildings being constructed.

Overview: This paper presents a brief overview of the latest development in the research, production, and applications, of the emerging, innovative Dynamic Architecture trend that promises not only to revolutionize traditional construction industry, landscapes, and skylines but also would have a ripple effect waves of change in cost-effectiveness, aesthetic values, environment, green construction, and even culture.

Major Points:

- Historical Background.
- Main features of the 80-floor moving skyscraper; the Da Vinci Tower in Dubai, United Arab Emirates.
- Technologies utilized in constructing the tower.
- Advantages and disadvantages of Dynamic Architecture emerging trend.

Summary: The Da Vinci Tower is expected to be an innovative construction project from many aspects: architecturally, structurally, environmentally, and culturally. It promises to revolutionize traditional construction industry through the new millennium, and alter how people view landscapes and skylines. It will also add new design methods, fresh aesthetic values measures, environmentally friendly buildings, green construction awareness, and a totally new culture of dynamic edifices.

Construction

Hydraulic Excavators vs. Frontend Loaders: Battle of the Earthmovers

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Need: Hydraulic excavators have largely replaced frontend loaders as the earthmover of choice when loading stockpiled materials into trucks for hauling. The justification for changing the equipment type does not appear to have any basis in productivity or economic studies comparing the two choices. Preliminary empirical calculations based on industry provided information do not support improved productivity as being the cause. Whether or not results of more exhaustive productivity and economic studies, planned for this spring, support this change or not, presentation of the findings to construction industry and education programs should be carried out. The ATMAE 2012 Conference would be an excellent venue for this presentation.

Overview: The current use of a hydraulic excavator instead of the time-honored frontend loader to load stockpiled materials gives rise to the question, "Why was this change in process made?" In response, three possible hypotheses arise that might answer this question: 1) Hydraulic excavators are more productive than frontend loaders, 2) hydraulic excavators are less productive than frontend loaders, but total project cost optimization dictates that a less productive machine be used since it is already onsite, 3) hydraulic excavators have replaced the frontend loaders because construction personnel are more familiar with excavators, already own or have leased excavators, and/or need the more versatile excavator onsite for other reasons. The first hypothesis is the most desirable reason for the change. To prove or disprove these hypotheses, however, a two step study is currently underway. The first step, completed in 2011, was to determine the probable productivity of the two equipment configurations based on the empirical procedures presented in the current *Caterpillar Performance Handbook*. The second step of the study is then to validate the empirical results by conducting a time and motion study comparing frontend loaders and hydraulic excavators based on actual field measurements. Should the first hypothesis continue to be false, then further studies exploring the validity of the remaining two hypotheses will be carried out. The work is scheduled for completion by mid-2012.

Major Points:

- A change in earthmovers to load stockpiled materials has occurred.
- Reasons for the change have not been validated.
- Productivity and economic field studies will properly support or not support reasons for the change.

Summary: Preliminary empirical calculations do not indicate that hydraulic excavators are more productive than frontend loaders in loading from stockpiled materials. More extensive productivity and economic studies that verify or contradict the preliminary findings should support whether the change was a good decision or not. When these studies are concluded, both constructors and construction educators will be able to incorporate the findings into their body of knowledge.

Construction

A Construction Bidding Simulation: Tips About Variations That Work and Variations That Don't

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Need: University and community college courses in construction estimating often use a variety of simulations or games to present various aspects of construction estimating situations. Many years ago, I was introduced to a manual simulation that focused on the aspects of adding indirect (overhead) costs and profit to the estimate. Since adopting this simulation for classroom use, I have devised many variations in an effort to correct shortcomings or improve outcomes of the game. Some of these variations have worked quite well; some of them have not. Construction educators who would like to utilize this simulation, along with some of the more beneficial variations, will have the opportunity to learn about this useful classroom exercise.

Overview: Courses in construction estimating often focus on the quantity surveying function of the estimator, and give minimal attention to the determination and addition of indirect (overhead) costs or profit amounts. Often these components of the bid are presented simply as add-on percentages based on ill-defined industry averages. As a result, students develop an erroneous viewpoint of the importance and impact of these elements on the profitability of the company. When confronted with the simulation, they often find themselves adding minimal values for overhead and profit onto their known costs in a focused effort to be the low bidder. Profitability, as a goal, is completely lost to them. Unfortunately, the primary goal of being the low bidder also guarantees bankruptcy as well. The purpose of many of the simulation variations is to prolong the viability of the "student contractors" long enough so they learn some of the lessons of determining a reasonable and adequate overhead and profit amount for their bid.

Major Points:

- A simple construction simulation dealing with overhead and profit add-on is presented.
- The original process of utilizing the simulations is briefly covered.
- Problems encountered with the simulation operation are summarized.
- Variations developed for the simulation are listed, explained, and rated for success.
- Planned future developments are discussed.

Summary: Attendees will learn about a fairly simple, but effective, estimating simulation that allows students to learn about the necessity of including adequate values for overhead and profit if the construction company is to survive and thrive. Variations that have been developed to help the student estimator remain viable long enough to learn the lesson are presented.

Construction

A Study of the Building Information Modeling Implementation and Skill Expectations for New Hires

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Need: In an effort to benchmark implementation of Building Information Modeling, studies have been completed by other researchers in other regions of the U.S.A., primarily East and West Coast, indicating the need for further studies of BIM implementation in other regions of the United States. Defining the regional characteristics of the current AEC industry market is critical for curriculum development.

Overview: The purpose of this study is to determine if regional differences exist in the level and kind of implementation of building information modeling tools. The regions that will be compared are the North Central, Rocky Mountain, and East Coast regions as defined by the Associated Schools of Construction.

Major Points:

- BIM is becoming standard for AEC industries
- More AEC professionals are looking for BIM skills for new hires
- Comparison between industry expectation and BIM content offered at universities.

Summary: Attendees will become aware of the regional characteristics of BIM implementation and the growing need for BIM savvy graduates. The information presented can be used to facilitate integration of Building Information Modeling in four –year programs preparing AEC professionals.

Distance & Online Learning

Distance & Online Learning

Developing Flexible Pedagogical Strategies and Best Practices for Teaching Teambuilding and Facilitation Online within a Technology Management Program

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Need: As more curriculum and content is adapted from the traditional face-to-face environment and transform for online delivery, the strategy is to be more flexible and accommodating to the learners needs as well as maintaining the course's goals and objectives. Beyond the diversity of technological delivery content management systems, many new challenges arise when confronted with traditional technology management subjects that incorporate teambuilding and facilitation pedagogy. In order to address these new challenges in cyberspace, there are many conventional pedagogical principles that can be utilized in this transformation, as well as new best practices for developing online group dynamics and directing facilitation process models.

Overview: The goal of this presentation is to provide examples and strategies for developing best practices for teaching team building and facilitation online within a Technology Management program either through a semi-autonomous hybrid courses or autonomous online courses. The objective is to provide some current guidelines for teaching group management in an online environment that addresses both the face-to-face group dynamics as well as distinctive online models.

Major Points:

- Tips for preparation and facilitating online meetings
- Guidelines for using available tools so team members can create content
- Examples of online content management tools for process control
- Identifying and understanding personality types in online environments
- Conflict resolution in online environments
- Understand the causes of conflict online.

Summary: Facilitators need to cover the process, as much as in the same way they would perform in a face-to-face proceeding. Ensuring that the content is being handled property, and that all are participating changes when we move to online delivery. The challenges for developing online curriculum that presents both conventional dynamics of team building as well as the concepts in online models becomes more complex as curriculum developers address the goals of creating the flexible pedagogy of cyberspace.

Distance & Online Learning

E-Learning in Manufacturing Engineering/ Technology: Challenges and Benefits Faced in Current Manufacturing Technology Courses

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Need: To maintain the manufacturing competitiveness in the rapidly changing industry, manufacturers' demand for trained engineers and technologists is increasing. With this trend, there will also be a need for individuals who would like to pursue B.S. and Master's degrees in engineering, manufacturing and technology fields. The traditional instruction method alone may not be sufficient to produce the number of trained individuals. Many prospective students search for programs that are flexible, accessible, and encompass the quality needed to prepare them for the real world. E-Learning has become an important delivery system for educators and been integrated with educational programs in many institutions. E-learning also has its own challenges that need to be addressed.

Overview: In this presentation, we will discuss the trends, benefits and challenges of E-Learning in manufacturing classes, and particularly the technologies that have been used to make E-learning applicable to the manufacturing major. Some challenges that online manufacturing curriculum might have to face would be the lab components, faculty training, and designing and delivering the course content. The impact of E-Learning on education and learning process of students will be analyzed through a survey to a group of undergraduate and graduate students in the Industrial Technology Department at the University of Northern Iowa (UNI). Examples of current e-classes will be also demonstrated.

Major Points:

- General trend of E-learning in manufacturing engineering/technology education
- Need and benefit to implement E-Learning in Manufacturing Engineering/Technology
- Challenges and possible solutions that E-learning in Manufacturing Engineering/Technology
- Specific educational technologies that have been used to make E-Learning applicable to manufacturing education and how they are implemented.
- Survey assessment: Impact of E-learning on education and learning process of students
- Examples of E-learning offered at technology programs with demonstrating some current offered classes such as manufacturing management and quality control.

Summary: Current technological changes have increased demands for well-trained workers who possess new/advanced technical skills. Today, with increasing use of networked computers, delivering Manufacturing Technology courses through computer and/or internet-based teaching is emerging. Attendees will understand benefits of using and designing online courses in manufacturing/technology education and view the insights from the survey conducted among UNI Manufacturing Technology students.

Distance & Online Learning

Incorporating Experiential Learning and Community Engagement Within in an OL Learning Environment

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Need: There is a growing need to incorporated experiential learning and community engagement as part of technology based curriculums. It becomes problematic to have these elements as part of the distance education environment.

Overview: ISU's automotive program has several upper level Automotive/Technology management course offerings which incorporate experiential learning and community engagement. As part of those course requirements students are required to interview managers, make observations about the retail/maintenance environment, and then prepare a report in addition to discussing those observations with management. Although, there is no quantitative data to support these course requirements as "best practices", the feedback from students, even those who grumble at first, has been very positive.

Major Points:

- There is growing trend to incorporate experiential learning and community engage as part of curriculums
- You cannot assume that students understand the interview process, and without preparatory guidance they will attempt to "wing it".
- Students must develop and have approved questions.
- Students must be guided about how to observe and discretely annotate observation. Focal points included:
  - Parking lots
  - Customer service
  - Store cleanliness
  - Shelf organization
  - Parts laying around
  - How stores/facilities are organized

Summary: Community engagement and experiential learning can be successfully incorporated into the online environment. The aforementioned takes a lot of preparation and there is no data to support any claim of enhanced student performance. However, the feedback and qualitative evidence suggests that this or a similar practice might be beneficially incorporated into other distance courses.

Distance & Online Learning

Integrating Oral Communication and Student Presentations in the Online Learning Environment

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Need: In addition to the technical and managerial competencies that students learn during completion of an online graduate degree, it is essential that communication skills are also improved and evaluated. In the online learning environment, it has traditionally been a challenge to develop oral communication skills due to several factors, such as unfriendly user interfaces. As such, written communication skills are relied upon heavily in the online learning environment. Because web conferencing and video streaming technologies have developed in recent years, it is now easier to integrate oral communication and student presentations into distance education courses. This is an essential development in distance learning, as educators strive to emulate face-to-face interactions in the online learning environment.

Overview: Program graduates do not solely rely on written communication once they move into their careers, therefore, educators should strive for a balance of written and oral communication opportunities in the online learning environment. The development in recent years of applications such as Wimba Classroom and Blackboard Collaborate make it possible to integrate oral presentations and real-time class discussions into online courses. These technologies allow for a broader means of communication between participants, and additional opportunities for evaluation of student skills.

Major Points:

- Online learning has traditionally relied heavily on written communication, while oral communication has not typically been integrated into online coursework
- It is now possible to easily incorporate oral communication into online coursework because of advancements in software applications
- Demonstration of software applications that enable oral communication in the online learning environment
- Examples of specific assignments using software applications that enable oral communication in the online learning environment

Summary: This presentation will emphasize the importance of oral communication in online courses and the advantages of such implementation. The presenter will demonstrate software applications that enable student presentations and web conferencing in the online learning environment.

Distance & Online Learning

Quality Matters: Understanding the National Benchmark for Developing Quality Online Courses

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Need: Nearly 12 million post-secondary students in the United States take some or all of their classes online. By 2014, Ambient Research Firm (2009) predicts this number will skyrocket to more than 22 million. In addition, according to a 2009 Meta study from the Department of Education: "Students who took all or part of their class online performed better, on average, than those taking the same course through traditional face-to-face instruction." With the quantity and quality expectations of online classes increasing, there will be increasing pressure on faculty to deliver more on line classes and enhance the quality experience for students. Quality Matters© (QM) certification process is a continuous improvement model for assuring the quality of online classes through faculty review. The QM rubric has eight categories. Two of those categories, Learning Objectives (2) and Assessment and Measurement (3), focus on aligning course outcomes and assessment. As ATMAE accreditation switches to a Student Outcomes based assessment model, Quality Matters may be a tool that assists faculty with alignment between course objectives, outcomes and assessment.

Overview: Quality Matters © is a continuous improvement model for assuring the quality of online classes through a faculty review process. The Quality Matter's rubric and processes are dynamic and reflect current research and national standards on the best practice in online learning. The Quality Matters process is based on research principles, the promotion of student engagement and learning, and a peer review process. There are eight categories in the rubric. This presentation will give an overview of the Quality Matter's program and process, review the eight QM rubric categories and discuss small actionable steps to begin moving an already established online class to the level of Quality Matters certification.

Major Points:

- Overview of Quality Matters© Certification Program and Process
- Review of the eight nationally recognized categories of a high quality online class based on learner engagement, student satisfaction and strong pedagogy.
- Discuss small actionable items to begin moving an already established online class to the level of Quality Matters

Summary: Attendees will gain an overview of the Quality Matters Certification process and learn how to take small actionable steps to incorporate Quality Matter's recommendations into their current online courses, whether they are interested in earning a certification or just improving their current courses.

Distance & Online Learning

Assessment of an Alternative Teaching, Hybrid Format of a Construction Management Course for Working and Non-Traditional Students

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Need: Online and hybrid courses are being offered increasingly more by colleges and universities. This format type of learning allows non-traditional and working students to continue their non-academic responsibilities with more flexibility to continue undergraduate and graduate studies. How does this teaching format compare to traditional formats? Do students get as prepared as they would in traditional courses? These and other similar questions will be addressed in this study comparing results of the same course offered in both formats.

Overview: The course Construction Management has been offered in both, traditional face-to-face format and in hybrid online/face-to-face format. The students' preparation will be compared in two ways: traditional vs. hybrid format (two separate class groups), and hybrid format (classes taught face-to-face vs. classes taught online in the same class group). Attention and retention of the material presented in both formats will be compared (quizzes, exams) and a survey will also be conducted to students to assess their attitude and preference towards each format.

Major Points:

- Overview of the increasing number of distance learning courses offered now to students
- Need for different teaching formats available to students, especially non-traditional
- Assessment of students' learning on traditional and hybrid formats of teaching
- Analysis of results comparing different formats
- Analysis of students' attitude and preference survey
- Lessons learned and recommendations for hybrid courses

Summary: Attendees will understand the need for offering different teaching formats for non-traditional and working students. How traditional and hybrid formats compare in terms of students preparation and attitudes will be analyzed and discussed.

Distance & Online Learning

Use of Blended Instruction in Teaching Engineering Economy: A Case Study and Demonstration

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Need: Some subjects taught to distant students tend to be more difficult than others, especially those using higher mathematics and spreadsheets. Engineering economy is one of those courses with a high dropout rate when taken by distant students due to the difficulties faced in understanding the subject. By employing a tool to facilitate the distant student, putting the student right into the classroom, would clearly improve the learning experience of the distant student. Lecture capture software, such as Tegrity©, is one such tool, used in conjunction with the appropriate written material, can significantly enhance learning. This brings the on-campus lectures and instruction right to the distant student where they can view the session at their schedule, combining the flexibility of distant students who are employed full time with the advantages of the in-classroom experience.

Overview: This session will be two-fold in its presentation. It will clearly show the process, problems and successes experienced in converting a totally online visual course, engineering economy, to a blended instructional course, using the online visual material as the primary means of instruction, and using Tegrity©, a robust lecture capture software system, as the secondary instructional method. Combining the two dramatically improved the learning experience of our distant learners taking the engineering economy course. The methodology used and the problems encountered will be discussed with sufficient detail such that the audience can walk away with a roadmap of how to implement such a blended instructional course at their institution. Additionally, the lecture capture product Tegrity© will be demonstrated during the presentation, showing the observer how simple yet robust the product is, especially for instruction that relies primarily on using MS Excel to solve problems.

Major Points:

- Outline the prior visual only course used to teach engineering economy.
- Discuss the steps taken to record the lectures and problem solving sessions.
- Discuss how the on-campus course and distant course sections were kept in sync so that the problems working on-campus were the same for the distant students, making a lecture capture process effective.
- Discuss the ancillary issues such as coordination of examinations, and communications with the distant students to insure that both on-campus and distant students were in sync and on the "same page".
- Demonstrate the use of Tegrity© by recording part of the discussion/demonstration and playing it back so that the audience can see the strength and ease of using the software.

Summary: Attendees will understand the need to convert distance courses from an all visual format to a blended instructional method; presented with a road map on how to convert their courses; presented with problems and issue encountered and resolved, and finally given an actual live demonstration of the software using the presentation as the session being recorded.

Distance & Online Learning

The Impact of Instructional Design on Virtual Teamwork

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Need: Due to the growth of online education and the availability of a wide selection of online collaborative tools, the utilization of virtual teamwork is rapidly becoming commonplace among postsecondary institutions, government, and corporations. As a result of the growth of virtual teamwork, instructors must equip students to meet this increasing demand by considering how instructional design affects students' virtual teamwork learning experience and subsequent performance.

Overview: Students' virtual team experiences are affected by many factors, and there are various instructional design features that promote and enhance student learning outcomes. Students should be provided with a variety of synchronous and asynchronous communication tools with practice opportunities for those who have limited experience in the online environment. Instructors should seek ways to encourage or require students to assume leadership roles, such as through the use of a team contract in which teams identify individual leadership roles and responsibilities for each team member. Team contracts may also promote accountability, one of the greatest concerns among team members. In order to further promote accountability, instructors should consider using peer evaluations that ask specific questions about team performance and requires students to justify their ratings of peers. Empowering teams to remove slackers may be a further step toward not only promoting accountability, but also motivating students to be active, contributing members of the team.

Major Points:
- Collaborative technologies
- Varying levels of technical skills among students
- Fostering team leadership through contracts
- Need for team accountability
- Empowering teams

Summary: Attendees will gain an understanding of ways to design virtual team projects that foster trust, manage varying levels of technical skills among students, encourage leadership, and promote accountability.

Electricity, Electronics & Computer Technology

Electricity, Electronics, & Computer Technology (Electronics & Power Technology)

The Cost of Power Interruptions & Outages to Energy Consumers in North America

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Need: Increases in energy/power costs, construction costs, the recognition of conservation and environmental concerns, and the impacts of government and public groups have resulted in the need for more rational and consistent approaches to determining acceptable reliability levels or comprehensive reliability plans. A major aspect of these developments is the evaluation of the customer/consumer costs of power outages or interruptions and new technologies. The presentation will focus on the monetary worth, benefits of electric power system reliability and development of new technologies.

Overview: The North American electric power network is among the most dependable in the world, delivering to most of its customers a nearly uninterrupted flow of power with over 99 percent reliability each year. High reliability is a central guiding principle for the North American electric power supply, and a key requirement for efficient manufacturing, commerce, and industry, as well as a high standard of living. Despite the system's longstanding history of successful operations and customer satisfaction, some highly publicized outages, customer alerts, and requests for load shedding in certain regions have led to changing perceptions and uncertainty about its reliability. There is a growing awareness that continuous power supply and improved power quality are critical underpinnings of the nation's post-industrial, digital economy. Most economies are increasingly based on the continuous real-time flow of information and increasingly dependent on machines controlled by digital components, such as microprocessors. The presentation will highlight on the evaluation of the costs of power interruptions or outages and also assess the benefits of investments in new technologies of the energy sector of the North American economies.

Major Points:

- Power System Availability and Reliability;
- Why Power Interruptions Occur and Preventing Power Outages; and
- Cost of Power Outages; and Potential Benefits of Investments in New Technologies.

Summary: Through careful planning, continuous training and investing in new technology, electric power utilities in North America are always working hard to provide the electricity which is driving force or the back-bone of the exist economies.

Electricity, Electronics & Computer Technology (Energy Issues)

Wireless Network Connectivity for Solar Energy Deployments

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Need: 93 million miles away, 333 thousand times the size of Earth, the Sun provides virtually all the power we need and supports all life forms on earth. Solar power is increasingly popular among various forms of energy production. It is expected that solar power market will triple in the next four to five years. Ongoing government incentives and accelerated cost reductions make solar electricity desirable in many regions of the world. To protect the investments and maximize the economic benefits offered by solar power, users and service providers need an efficient way to monitor, control, and maintain the components in their solar power systems, and thus manage their energy production and consumption. Wireless network connectivity is an excellent technology in these scenarios. It significantly reduces infrastructure costs and can be configured for Internet or cellular data connection for remote monitoring and maintenance.

Overview: In this research, we study and deploy a reliable, cost-effective, low-power, and wireless networking technology called ZigBee to monitor and control a photovoltaics-based solar power system. The wireless communication is based on IEEE 802.15 WPAN, an open global standard. ZigBee is a low-cost, low-power, and mesh-network wireless standard. Low cost allows the technology to be widely deployed in wireless control and monitoring applications. Low power-usage allows long life with small batteries. Mesh networking provides high reliability and extensive coverage. Wireless ZigBee modules (XBee and XBee-PRO ZB) will be embedded into solar inverters and wireless network connectivity will be added to solar energy deployments. A Python-programmable gateway collects data from each XBee-enabled solar inverter in a deployment area. The collected information will be sent over Wi-Fi (can be upgraded to cellular module) data network to an Internet-based server. In addition, we plan to allow users to receive system updates and alerts via webpage, email, or text message service.

Major Points:

- Sustainability and solar energy
- Photovoltaics-based solar power system
- ZigBee wireless technology
- Wireless connectivity for solar energy deployments
- System monitoring and data collection

Summary: In this presentation, we will introduce a laboratory solar power system and explain how to use wireless sensors to monitor and control energy production and consumption. The wireless connectivity provides remote access through reliable ZigBee mesh networks and eliminates the need of wired infrastructure, which is expensive in both cost and installation.

Electricity, Electronics, & Computer Technology (Energy Issues)

Introducing Renewable Energy Courses in the Classroom and Online EECT Curriculum

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Need: In order to sustain our standard of living we need to develop other ways to generate electricity. Current Electricity, Electronics, & Computer Technology (EECT) students will have to deal with this issue for the rest of their careers. Introducing renewable energy into the EECT curriculum will help produce trained engineering technology personnel with the appropriate knowledge base in renewable energy.

Overview: Finding and implementing new cleaner and more sustainable sources of the electrical energy will be the focus of technologists in the foreseeable future. People who will lead the way in the development and implementation of such new technology will be engineers and engineering technologists. Knowledge of the various types of alternative energy and the methods of producing such energy will be critical in finding ways to incorporate newer, greener sources of energy into a wide array of new technologies.

Major Points:

- To sustain our standard of living we need to develop other ways to generate electricity.
- Sustainable sources of the electrical energy will be the focus of technologists in the foreseeable future.
- Infusing renewable energy courses into EECT will create career opportunities, and broadened educational view of the world for undergraduates.

Summary: Infusing renewable energy courses into EECT will create career opportunities, and broadened educational view of the world for undergraduates. There are varying levels of depth that can be placed in learning a topic such as renewable energy. By requiring hands on and timely renewable energy material into the EECT curriculum, a student will be engaged in the material. Introducing renewable energy into the standard curriculum will result in individuals who will be truly able to contribute from their newfound knowledge and ideas. With proper placement in the current program curriculum, the addition of a renewable energy course would be of great value to the student.

Electricity, Electronics, & Computer Technology (Computer Applications & Networking)

Are Biometric Security Systems Biased Toward the Color of the Skin? Methodology for Evaluating Statistical Equivalence in Face Recognition Using Live Subjects with Dissimilar Skin Tones

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Need: Face recognition systems are widely deployed in airports, secured facilities and all sort of organizations. Face recognition systems are designed using proprietary mathematical algorithms that are almost impossible to test in relationship to their effectiveness and efficiency to fairly recognize difference in the skin tone of the subjects. The rush to implement these security systems without proper technical analysis of bias toward the color of the skin might in the short future jeopardize the acceptance by the public of such biometric technologies. Eastern Illinois University and in particular the authors of this study are implementing the first known attempt to study the problem using common design of experiment techniques (DOE).

Overview: Live subjects with strong differences in the color of the skin were used for these experiments. For this particular study white skin tones vs. dark skin were tested. These skin tones were selected for the purpose of determining if skin tone plays a significant/measurable factor in the ability of facial recognition systems in correctly identifying an enrolled subject. A three level Box-Behnken 4 factor design with 27 runs and 3 replications was implemented in order to analyze the different results in both populations. This is an attempt to use a common quality design techniques typically used in industry for quality purposes applied to biometric face recognition systems.

Major Points:

- Biometrics Face Recognition fundamentals
- Design of Experiments
- Statistical techniques applied to test if a Face Recognition System may be biased toward the color of the skin
- Experiment set ups, Biometric Sensors and Experiment Results

Summary: Attendees will be exposed to the fundamentals of Face Recognition systems and how a typical DOE technique used in Industry can be adapted to test if a face recognition system is biased toward the color of the skin.

Electricity, Electronics & Computer Technology (Automation & Control Systems)

Addressing the Threats of Cyber-Terrorism to Industrial Control Systems in an Automation and Controls Engineering Technology Curriculum

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Need: Computer viruses have been confirmed that are specifically developed to attack industrial control system and purposefully inflict damage threatening property and lives. For technology students entering the field of automation and controls a heightened awareness of security is a job reality of the 21st Century that they will have to deal with in their professional career. Students in Automation and Controls Technology programs have a need to be aware of the vulnerabilities of Control systems to cyber attack and security enhancing counter measures that can be taken against such attacks. To address this need a new course targeting control system vulnerabilities and security is being developed at Indiana State University for its Automation and Controls Engineering Technology program. This presentation will report the results of the author's research into what instructional materials should be included in such a course.

Overview: Traditionally, cyber attacks were the problems of computer science or information systems specialists. Computer automated industrial controls systems were purposefully designed to be user friendly and have ease of access, but now cyber attack methods, such as the Stuxnet Worm, have been developed to target PLC and SCADA systems. Such attacks can used by terrorists to damage vital infrastructure or industrial targets, perform industrial espionage, or enable acts of criminal enterprise. This presentation reports the results of the preparation of the authors to develop a course for Automation and Control Engineering Technology majors that will prepare them to deal with the special and specific security issues facing them in the field.

Major Points:

- Understand the potential threats to control systems, and access points for cyber attacks.
- Risk management strategies to reduce the likelihood of successful cyber attacks.
- Mitigation activities and procedures to minimize the impact of a cyber attack.
- Available resources in government and industry to assist in control system security.

Summary: This presentation will present information on the threat of cyber attacks to industrial control systems and methods of defending against such attacks.

Electricity, Electronics & Computer Technology (Automation & Control Systems)

Introducing RFID into the Curriculum of an Engineering Technology Program

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Need: Due to mandates from both government and industry, Radio Frequency Identification (RFID) has become a necessary part of the data acquisition and control technologies that an Engineering Technology (ET) professional should know in order to be competitive in the modern job market. RFID has become a staple technology involved in multiple layers of production planning, inventory control, and computer integrated manufacturing control. Use of RFID technology can assist in reducing costs, increasing productivity, and provide higher levels of efficiency in manufacturing and distribution systems when effectively implemented.

However, successful implementation of RFID requires the ET professional to interact with a wide range of hardware and software components, and integrate these components into an effective system. To prepare individuals to meet this challenge the design of a curriculum in Automation and Control Engineering Technology should include the knowledge and learning experiences necessary to accomplish this task.

Overview: This presentation presents a methodology for technology educators to provide their students with sources of information about RFID that can used to develop classroom learning materials, a method of developing laboratory equipment suitable for providing experiential learning experiences in RFID, and a sample of laboratory exercises to reinforce student learning.

Major Points:

- Sources of information on RFID to develop learning materials
- Basic materials needed for laboratory learning of the fundamentals of RFID operation
- Development of a training system to integrate RFID with automated systems (PLC's & robots)
- Laboratory exercises that can be used to support student learning

Summary: Attendees will understand how to introduce RFID principles and laboratory exercises into an automation course as part of an Engineering Technology curriculum.

Electricity, Electronics, & Computer Technology (Computer Applications & Networking)

Virtual Desktops: From Pilot to Full Enterprise Deployment

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Need: At most institutions, there is a push to reduce the number of physical computer labs while still maintaining the number of applications available to the students. To accomplish this task many institutions are implementing virtual desktop labs. The problem is many institutions do not have the resources to hire outside consultants to help implement a virtual desktop environment.

Overview: The objective of this presentation is to give the attendee a roadmap to implement a virtual desktop environment. The presentation will take the attendee from pilot to full enterprise implementation. The main focus of this presentation is to provide the attendee the experience of administrating a virtual desktop environment and provide them with the tools needed to make intelligent purchasing decisions. The outline of the presentation is as follows:

Major Points:

- Design Goals
- Storage and Servers
- Deployment Strategy
- Virtual Lab Pilot Groups
- Feedback from Pilot Groups
- Administration, Maintenance and Support

Summary: At most institutions there are a push to reduce the number of physical computer labs while still maintaining the number of applications available to the students. To accomplish this task many institutions are implementing virtual desktop labs. This presentation will outline the path one higher educational institution used to implement virtual desktop from pilot to full implementation. The presentation will discuss all major aspects of the implementation from backend storage and server issues to end user feedback and support issues. The goal of this presentation is to share the learning curve that was encountered, allowing others to benefit from the successes and mistakes made by the presenter.

Electricity, Electronic, & Computer Technology (Energy Issues)

Electric Cars

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Need: Electric cars have been around for quite some time, but electric cars are still an emerging technology that is still undergoing development. The use of an electrical cars instead of a traditional gasoline-powered vehicle, energy resources, or hybrid powered vehicle is steady budding. Although, gasoline-powered vehicles are more commonly used, relying on a vehicle that runs off electrical forces instead can be more efficient, less polluting, decrease in expensive gas prices, with less reliance on oil. The use of electric cars has a great deal of advantages over the use of a standard vehicle, but with continued improvements over time this matter can only progress.

Overview: The purpose of this presentation is to provide awareness to those who are interested in the use of electric vehicles. The overall goal is to present a clear understanding as to what consist of electric cars, how they are used, how they are more beneficial, more efficient, economical, and there disadvantages and advantages. The issue that is surfacing amongst electric cars is how beneficial they are to use instead of a standard vehicle and the cost savings.

Major Points:

- Determining why an electric car is a better alternative than the internal combustion engine.
- The negative and positive aspects of an electric car.
- Analyzing how range is factored in traveling distances, city miles vs. short distances.
- The economical and maintenance issues with pertaining to electrical cars.
- How the electric car is ran off of a battery and the downfalls of the battery.

Summary: Even though electrical vehicles have been emerging for over a century, there are still new ideas and improvements that can be made. For starters, the battery of an electrical vehicle and its lifespan is all going to be based on cost and availability. Electric vehicles (EV) outnumbered gasoline-powered vehicles. Majority of electrical vehicles are only driven within city limits and short haul trips, if automaker companies manufacture a electrical vehicle that is capable of traveling long distances, greater speeds, and longs hours-without having to recharge the battery this will increase the sales and production of more electrical vehicles on the road. Another way of improvements would be the recharging methods and time. If automakers and makers of the batteries figure out a way to improve on the significant amount of time spent recharging the battery. It is obvious, that if the batteries that are being installed are larger, can travel greater distances, and more recharging stations readily available worldwide then electrical vehicles sales would increase.

Electricity, Electronics, & Computer Technology (Computer Applications & Networking)

Using Truecrypt Technology to Protect Sensitive Data

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Need: In today's world of removable media, meeting FERPA requirements has become increasingly difficult. Our ability to protect sensitive data, including student information, is more challenging than ever and must be balanced with our need to utilize current technologies, particularly mobile devices. Truecrypt is a simple and free product that can address this issue easily.

Overview: The presentation will describe encryption, both a basic history and a simple description of its mathematical processes, before describing how Truecrypt can be used to protect sensitive data. The presentation will include a demonstration of its installation and use.

Major Points:

- History of Encryption
- Basic encryption schemes
- FERPA and current requirements
- Truecrypt overview
- Installation of Truecrypt
- Using Truecrypt to encrypt data

Summary: Protecting our data is crucial in today's sensitive environment. Both technical and non-technical faculty alike must be made aware of the dangers of data theft. This demonstration will show how easily this can be accomplished.

Electricity, Electronics & Computer Technology (Computer Applications & Networking)

Importance of EPON Network with the New Bandwidth Allocation Algorithm

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Need: With the ever increasing demand for bandwidth intensive applications like video-on-demand, interactive television services, high-definition television (HDTV), and internet telephony, the first mile network, referred to as the last mile network in the earlier stages of its development, has proven to solve the "bottleneck" often experienced between users and the central office. Passive Optical Network (EPON) resolves this bottleneck by providing the user with a fiber optic link to the central office that has advantages such as nearly infinite bandwidth, low cost, easy installation and immunity to electromagnetic interference, and a saving of the need for powered components in the signal path from the user to the central office.

Overview: Ethernet Passive Optical Network (EPON) is an access network that delivers essential services of voice, video, and data communications reliably, while at the same time providing expected guarantees of the delivery of those services in terms of defined Quality of Service measures (QOS). The comparison of QOS performances such as delay, queue size, and packet loss ratio for two dynamic bandwidth allocation (BW) algorithms: Interleaved Polling with Adaptive Cycle Time (IPACT) and a new Cyclic Demand Proportionally Algorithm (CDP) will be presented.

Major Points:

- Overview of three technologies for next generation optical access network
- FTTx (Fiber-to-Home, Curb, Office) deployments scenarios in the first mile network
- New Bandwidth allocation scheme Cyclic Demand Proportionality (CDP) for EPON network is introduced.
- Comparison of Interleaved Polling with Adaptive Cycle Time (IPACT) allocation algorithm and the CDP algorithm as two EPON networks is introduced.
- Some statistical analysis of network traffic for Ethernet Passive Optical Network (EPON).

Summary: This research investigates another factor and its effect on network performance and service delivery: Cycle Demand Proportionality (CDP). By observing the patterns of demand in the network on an individual network unit basis cycle after cycle, deductions regarding load characteristics of some units over others can be made. Decisions can be make about subsequent grant allocations based on this factor and aim to achieve better results in the process. Simulations of EPONs under varying loads incorporating the use of CDP in conjunction with currently used DBA schemes are made and results are analyzed. A major contribution of this research is a new bandwidth allocation algorithm that gives improved performance in terms of packet delay versus offered load. Performance metrics are compared against two common bandwidth allocation algorithms: Interleaved Polling with Adaptive Cycle Time (IPACT) and Cyclic Polling (CP). Additional results also include improvements in packet loss and throughput. The data that represents traffic for this network has two properties, self-similarity and long range dependency. Plotting the auto-covariance, auto-correlation, and variance for this traffic, for various aggregation levels demonstrates these properties.

Electricity, Electronics, & Computer Technology (Energy Issues)

Cost Savings of Computer Power Management Technology Implementation

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Need: Many organizations are not managing the power usage of personal computers; therefore, they are foregoing significant energy savings and environmental benefits. When computer system settings are modified on a PC, the EPA estimates that a $25 to $75 annual savings can be realized for each piece of equipment. When multiplied by all of the computers in an organization, the cost savings and environmental benefits are staggering (Thibodeau, 2009, p. 34).

Overview: During this presentation, conference attendees will develop an understanding of the economic impact of technology by learning to estimate the cost savings of power management strategies in an organization. Conference attendees will learn how to adjust computer settings to influence power consumption and to minimize the impact that the computer has on the financial burden to their organization. Mathematics will be used to develop estimation strategies for calculating the annual power consumption and cost savings when power management strategies are implemented. Internet resources will be shared where real time data relating to the cost of energy in all fifty states can be located. Spreadsheet software that can be used to complete sample calculations and interpret data will be discussed.

Major Points:

- Economic impact of power management strategies to an organization
- Environmental benefits of power management strategies
- Mathematical calculations used to develop estimation strategies for calculating the annual power consumption and cost savings of power management strategies
- Internet resources where real time data relating to the cost of energy in all fifty states can be located.

Summary: Conference attendees will leave the presentation with a firm understanding of the economic impact of power management strategies as well as the environmental benefits. Participants will be prepared to implement these power management strategies in their own organization upon leaving the presentation.

Electricity, Electronics, & Computer Technology (Automation & Control Systems)

The Effect of Fieldbus Network Induced Delays on the Performance of Closed-Loop Control Systems

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Need: Fieldbus networks such as Foundation Fieldbus and Profibus are extensively used in industrial control system implementations due to several benefits. However, network induced delays that may result from the bus arbitration schemes of the messages is an issue that needs further research for these fieldbus networks. The impact of these delays on closed loop control system performance measures such as stability, peak overshoot and settling time needs investigation. This presentation will demonstrate the effect of fieldbus network induced delays on the performance of a control system with Proportional, Integral, and Derivative (PID) controller through the MATLAB/Simulink simulation of a Direct Current (DC) motor.

Overview: Fieldbus networks are all-digital, two-way, multi-drop communication systems that are used to connect field devices such as sensors and actuators, and controllers. The growing demand and popularity of the fieldbus networks can be attributed to several advantages such as reduced wiring, interoperability, and greater system functionality. However, as the complexity of modern fieldbus system continues to increase, the concerns on performance also increases. One of the concerns is the induced delays in the fieldbus network systems due to bus arbitration schemes used. In this presentation, the effect of fieldbus network induced delays on control system performance such as stability and step-response for different PID controller gains are demonstrated using a DC motor model. The delays considered are sensor-to-controller delay and controller-to-actuator delay. The MATLAB/Simulink software tools are used to analyze the effects of these delays. From this study, it is observed that fieldbus network induced delays have an effect on control systems stability and performance as described by the system step response. The results of this performance evaluation are useful to design PID controller gains, and the verification of how sensitive the control loops are under various time delays.

Major Points:

- An overview of the fieldbus networks will be presented
- Causes of fieldbus network induced delays will be explained
- Effects of network delays on closed loop control system performance will be described
- Impact of PID controller gains on networked control systems will be discussed
- The network delays effect is illustrated with simulation of a DC motor control system model using the MATLAB/Simulink software

Summary: This presentation will provide ATMAE professionals an understanding of the fieldbus networks and the delays they may introduce in control systems. The impact of these delays on the performance of a control system with a PID controller will be demonstrated using simulation of a DC motor model with the MATLAB/Simulink software.

Electricity, Electronics & Computer Technology (Energy Issues)

Electric Auto Association Educational Chapters

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Need: Our Society is challenged by Clean Air, Petroleum Shortages, Peak Oil, High Efficiency Electronic Controls, Energy Storage, Controllers, Motors, Regenerative Power, AC/DC, Energy Management, We need to explore avenues that open opportunities for our students.

Overview: The Electric Auto Association promotes the development and use of electric vehicles throughout North America. The EAA has established the special designation of Education Chapter for the purpose of ensuring that students in high schools and colleges have the opportunity to gain theoretical and hands-on experience with the design and development of electric-drive transportation. Procedures for establishing an Educational chapter, responsibilities and support of an Educational chapter will be covered.

Major Points:

- To act as a source of information for the membership, other organizations and the public, on the current state of electric vehicle technology worldwide.
- To encourage experimentation in the building of electric vehicles, particularly to improve energy and resource efficiency, reduce emissions and improve vehicle safety.
- To promote and organize public exhibits of electric vehicles built by members and others for the purpose of informing the public on the progress of electric vehicle technology and conducting public opinion polls.
- To use all media, such as newsletters, web sites, information packages, and other paper and electronic media designed to inform the public and promote the cause of electric vehicles.
- Able to team with existing Chapters
- Workshops- conversions, solar bikes, medium size Eves
- Current Events and EVWorld

Summary: Real world, future technologies. EAA seeks to partner with educational institutions which want to provide this sort of educational experience to their students and encourage the next generation of EV enthusiasts and engineers.

Electricity, Electronics & Computer Technology (Energy Issues)

EPA Annual P3 (People, Prosperity, and the Planet) Award Competition

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Need: Funding new green programs and initiatives is difficult to find. The EPA P3 competition allows institutions to make proposals and get phase one grants of $10,000 and follow on phase two grants of $75,000. Sustainability in the developed and developing world requires scientific and technical innovations to create designs that enable the Earth and its inhabitants to prosper. The award demonstrates the possibilities of innovative designs to simultaneously benefit people, prosperity, and the planet.

Overview: This event was created to bring together professional scientists, engineers, and business leaders around innovations designed to advance economic growth while reducing environmental impact. The appropriate technology program at Appalachian State University has been successful with the following projects:

- Closing the Biodiesel Loop: Self Sustaining Community Based Biodiesel Production
- Students will develop a sustainable education facility to promote and demonstrate small-scale biodiesel processing. This closed loop system design includes: solar thermal heating, wastewater bio-remediation, passive solar greenhouse, methanol recovery, soap making, and composting.
- The Affordable Bioshelters Project: Testing Technologies for Affordable Bioshelters
- Students will design and build affordable greenhouses that are powered renewably to conserve energy and, therefore, reduce the demand for fossil fuels, and allow more food to be grown locally at lower economic and ecological cost.
- The Boone Bicycle Initiative: A Community Based Project to Promote Bicycles as an Alternative Mode of Transportation
- Students will develop and implement a community-based program to encourage the use of bicycles for commuting.
- Closing the Carbon Loop: Growing Algae Using Sustainable CO2 from Bio-waste
- Students are designing and building a sustainable algaculture facility for producing biofuels.
- Fair Trade Ethanol: Fuel Production from Coffee Wastes
- Students are designing and developing a coffee wastewater treatment system to improve the sustainability of coffee production.

Major Points: This presentation will examine the opportunities available

- What is the P3 Award competition?
- What are the categories?
- Who is eligible?
- How does the application review process work?
- Who do you contact in EPA?

Summary: This national competition enables college students to research, develop and design scientific, technical and policy solutions to sustainability challenges. Their designs are helping to achieve the mutual goals of economic prosperity while providing a higher quality of life and protecting the planet. Students and their faculty advisors compete for EPA's P3 Award and the opportunity of up to an additional $75,000 in funding to move their designs to the marketplace or implement them in the field.

Electricity, Electronics, & Computer Technology (Electronics & Power Technology)

A Low-Cost Basic Electronics Laboratory Based on Popular Microcontroller Systems

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Need: A fully equipped electronics laboratory may not be feasible for many institutions. However, basic electronics concepts and automation technology can be taught for very little cost using inexpensive popular programmable microcontrollers.

Overview: This presentation will be an overview of the development of a survey-level electronics laboratory course utilizing popular low-cost easily programmable microcontroller systems. These systems can be powered by simple nine-volt batteries and are programmed via USB connections, enabling the instructor to operate the laboratory in virtually any classroom.

Major Points:

- Fully-equipped electronics laboratories are expensive and may constitute a barrier to teaching basic electronics for some institutions
- Popular microcontroller systems are available that are inexpensive and easily programmed using open-source software
- Concepts in electricity and electronics can be covered in depth without great expense

Summary: Attendees to this presentation will be shown how one instructor at a community college created a survey-level basic electronics laboratory course using low-cost programmable microcontrollers to teach a wide range of electrical, electronic, and automation concepts.

Electricity, Electronic, & Computer Technology (Computer Applications & Networking)

An Emergency Wireless Communication Framework for Vehicular Networks: Are We There Yet?

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Need: The 2012 National Highway Traffic Safety Administration (NHTSA) report claims that in the US alone one person dies in a vehicle crash every 15 minutes. Additionally, traffic congestion and collisions cause losses totaling billions in fuel and lost work hours every year. Various studies have shown that if drivers could get real-time traffic information ahead of time, it could help prevent most of the collisions, helping to save lives, prevent injuries, and reduce the cost incurred due to traffic delays. Existing vehicular information dissemination mechanisms require a driver or a passenger to tune a radio or dial a certain number to get current traffic information. This process is slow and cannot guarantee timely dissemination of information. In this context, wireless systems can provide a better alternative. Devising an automatic wireless based mechanism for communicating traffic information in a timely manner can help drivers make informed travel decisions and avoid hazardous situations.

Overview: The presentation will include an overview of vehicular communications, wireless technologies and applications suitable for vehicular networks such as cellular, WiMAX, Bluetooth, ZigBee, Wi-Fi and ad hoc networks. One of the main objectives of implementing wireless communication systems in vehicular networks is for automatically forwarding emergency messages as quickly as possible. We will discuss how this may be achieved efficiently. Techniques for enhancing performance of vehicular networks while safeguarding security and privacy issues will be presented.

Major Points:

- Overview of vehicular communication networks
- Developing a framework for real-time inter-vehicle communication
- Delivering emergency messages to response units over vehicular networks
- Security and privacy in vehicle to vehicle (V2V) communication
- Advances and applications of wireless mobile technologies

Summary: The need for delivering real-time traffic information to drivers over wireless-based vehicular communication can assist in avoiding traffic congestions and accidents. However, there still are some crucial performance, security and privacy issues to be considered while deploying these technologies. The presentation will address some of these important issues in emergency vehicle-to-vehicle wireless communication.

Electricity, Electronic, & Computer Technology (Computer Applications & Networking)

Connecting the Diverse Perspectives of Internal Auditors and Network Officers for Strengthening Security

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Need: The main goal of both internal security audit and network security is to protect confidential and sensitive data, comply with policies, standards and regulations, and educate users about good computer security practices. For mid-to large-size organizations, and especially at the enterprise level, different offices may be responsible for the roles of internal security audit and of network security. If the two offices do not coordinate their activities with each other, the overall security of the network is affected, since resources and findings are not shared effectively. As prospective employees of such organizations students need to learn how to manage both activities (auditing and securing networks) for improving overall network security.

Overview: The presentation will discuss the perspectives of internal security auditors and network security offices for securing computer networks. Through structured in-class and laboratory activities students in computer networking security classes can learn about the strong connection between internal audit and network security. In order to perform tasks associated with these roles students should be familiar with appropriate software tools and procedures. Various open-source software tools can be used for both internal audit and for securing networks. The presentation will provide information about some of these tools along with ideas for coordinating security deployment across different offices.

Major Points:

- Security-related vulnerabilities in typical computer systems and organizational networks
- Examining the different perspectives of internal security auditors and network security officers
- Achieving joint network security goals through partnership between security personnel
- Open-source and freeware tools for security audit and network security
- Security roles in virtualized/cloud hosting environments
- Developing critical thinking skills while auditing and securing emerging network technologies

Summary: Maintaining and troubleshooting security issues in a computer network requires close coordination between security auditors and network security officers. This presentation will discuss some of the key tools and techniques that can be used for performing security audits and network security. Ideas for strengthening the partnership between the different offices that perform those important computer network related tasks will be discussed.

Electricity, Electronics, & Computer Technology (Energy Issues)

Jobs and Economic Development Impact (JEDI) Model: A Decision Making Tool for Renewable Energy Projects

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Need: Energy crises have become a challenge for global economies. Extensive efforts are being carried out to overcome energy issues and find alternative ways to increase energy production and to meet energy needs. After Japan's nuclear crises, renewable energy has become a more attractive option for scientists, environmentalists, decision makers, and government agencies. When making decisions to launch a renewable project, it is imperative to analyze and understand different aspects of the project, including economic and employment impacts. Since renewable energy projects require huge investment and offer business opportunities for different stakeholders, decision makers intend to assess job and economic impacts of the project activity while considering different renewable energy technologies. Decision making process for renewable energy projects is not limited to producing energy using natural resources but also require projection on potential impacts on local economy, job creation and business opportunities. There is a need for a modeling tool to facilitate decision-making process.

Overview: Job and Economic Development Impact (JEDI) model is a user-friendly modeling tool used for job and economic impact analysis of renewable energy projects. JEDI model provides estimated data for decision makers to analyze jobs and economic impacts of renewable energy projects. This study investigates using JEDI model as an effective tool to conduct economic, job, and financial analysis to facilitate decision-making process. JEDI model applies to various technologies such as biomass, solar, wind, and thermal energy. This study highlights direct, indirect, and induced effects of renewable energy project activities, calculates job and economic impacts, and provides blueprint to facilitate decision-making process considering social, economical, and environmental aspects of the project. JEDI model also provides estimate on local spending on debt, equity payments, tax calculations and lease or purchase payments. It is believed that this study will be highly useful for those who are interested in management and planning of renewable energy projects. It may also open new dimensions of research for students especially in project planning and management. This presentation would encourage technical managers and students to learn modeling tools, prepare feasibility studies, and optimize decision-making process. Since renewable energy sector is an emerging area and thus offer great employment potentials for project planners and managers, it will create further research opportunities for technology students to use modeling tools to analyze different aspects of a renewable energy project.

Major Points:

- Input/output analysis
- Job and economic impact analysis
- Comparative analysis
- Decision making

Summary: Modeling tools provide comprehensive understanding on different aspects of renewable energy projects and facilitate appropriate decision-making and policymaking. Job and Economic Development Impact (JEDI) model provides a tool to estimate the impact of a renewable energy project on regional and local economy, including job creation, income, and local spending. We will analyze the JEDI model and demonstrate that how the JEDI model can be effectively used for decision making on renewable energy projects.

Electricity, Electronics & Computer Technology (Computer Applications & Networking)

Information Security Management: Standards and Procedures

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Need: Information technology has become an integral part of current business processes. Corporate organizations automate their business operations for fast and smooth business transactions. Computerized information systems process thousands of valuable information every day which is also called as corporate asset. Organizational success and failure depends on the privacy and security of corporate asset which is required to gain customer's confidence and business partner's trust. For consistent business operations, business development and reputation in the market, information security management (ISM) is an essential part of information technology. Managing effective information security mechanism is not only required for smooth business operations and financial transactions but also required to comply with various legislative and privacy laws. Various information security policies and procedures have been developed. Current corporate world demands more comprehensive information security management policies and procedures to comply with business needs, customer's expectations, and legal regulations. It is important to develop robust information security management system using best industry practices and internationally acceptable standards. This study investigates information security management standards, procedures and best industry practices to develop extensive information security management plan to protect corporate asset and also comply with regulatory requirements.

Overview: Information is the most valuable and critical asset for any organization, information privacy and security are necessary for continuous business operations and development. Organizations cannot survive with weaker information security management policies in current competitive business world where business secrets of one organization can help others to offer more competitive services or products. This study investigates information security management best practices, procedures, and also investigates standardized approaches to address various information security requirements including data integrity, confidentiality and availability. This study will be highly useful for those who are interested in information security management planning, development, and implementation in corporate sector and will also open new topics of research for security professionals, researchers, and technology students. The presentation would encourage students, faculty members, and security professionals to learn and adopt standardized approaches for information security management and governance. It will further create research opportunities for technology students to find best practices and procedures to align information security management with business goals of the organization.

Major Points:

- Information security management
- Information Security Framework
- ISO Standards (ISO/IEC17799, 27002)
- Information security management best practices
- Future trends in information security management

Summary: ISO/IEC-17799 and ISO/IEC-27002 standards provide roadmap for developing information security management system within an organization. We will analyze ISO/IEC standards and demonstrate how these standards and industry best practices can be effectively used to develop robust information security management policies and procedures.

Electricity, Electronics, & Computer Technology (Computer Applications & Networking)

A Wireless System to Detect Crack Propagation in Concrete Structures

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Need: Detailed visual inspection of the surface of the structure remains a common method for detecting cracks. However, detailed visual inspection requires the use of trained personnel for execution, causing them to be tedious, time consuming, and expensive. By using Wireless Structural Health Monitoring System (WSHM), visual inspection is replaced with a reliable wireless network that can offers an periodic automated method for tracking the health of a structure by combining damage detection algorithms with structural monitoring systems, avoid extreme costs and enhance safety and reliability in civil structures by recognizing the damage before it becomes catastrophic. WSHM is the process of detecting damage while the structure is in use

Overview: Wireless Structural Health Monitoring System (WSHM) has been investigated in recent years. This study investigate the ability of a wireless structural health monitoring system (WSHMs) platform to detect cracks formation and record the propagation of growing structural cracks over long periods of time via the Wireless Access in Vehicular Environment (WAVE) system. The project development is being conducted at the electronics lab of the University of Northern Iowa before it is implemented in the real manufacturing setting.

Major Points:

- Develop a wireless Structural Health Monitoring System, which able to
  - Detect and localize the crack formation in a concrete structure
  - Track the crack propagation in a concrete structure
  - Transmit the data from the site back to the local office through utilizing the Wireless Access in Vehicular Environment (WAVE) system
- Design the sensor readout circuit (s) required for the interface between the wireless nodes and the Concrete structure.
- Analyze and test the project upon completion.
- Investigate for further improvements.

Summary: The presentation will illustrate the use of wireless network to detect crack formation and track the crack propagation. The utilization of this new and less expensive technology has broad applications for construction activities to improve their structural maintenance practices, assessing structural deterioration and performance degradation, and enhance safety.

Electricity, Electronics & Computer Technology (Energy Issues)

A Study of Laboratory Scale Biomass Gasification for Renewable Energy

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Need: Sustainability and environmental protection are two primary duties for every individual that lives on this planet. It is reported that based on current consumption rate, all fossil fuels will be depleted in 1~3 generation(s), and greenhouse gases emission due to burning of fossil fuels will result in "the global average sea level rising from 7 to 23 inches higher than it was in 1990." Those threatening data manifests that a mission of developing a "renewable" and "clean" energy is imperative. Biomass is a major source of renewable energy. Biomass gasification, a technology of turning solid biomass fuels into combustible syn-gases, is proven to be sustainable (any biomass could be its fuels), highly energy conversion efficient (gasifying 1kg woodchips will produce 0.75 kWh electricity) and environment-friendly (with a trace of CO_2 and SO_x emission). Wider application of this technology would be a significant effort for the global energy and environment issue.

Overview: A theory of how to turning solid biomass fuels into combustible syn-gases through gasification will be presented. Definition of biomass, four major processes of gasification, and component of syn-gases will also be included. Additionally, an experimental scale gasifier with a control unit and generator head, will be introduced to exemplify the working principle of biomass gasification. Researches may be explored, for example, to identify appropriate biomass fuels, or to improve gasifier design and fabrication to enhance its energy conversion efficiency. The laboratory scale gasifier will be related to industrial scale gasifiers installed at the Renewable Energy Center at Eastern Illinois University.

Major Points:

- It is imperative to develop a "renewable" and "clean" energy
- Biomass gasification is an ideal solution for the energy shortage and global warming
- Theories and principles of biomass gasification
- Study on an experimental scale gasifier
- Integrate biomass gasification research with the Renewable Energy Center at the university.

Summary: As a renewable energy source, biomass gasification is expected to help reduce the nation's dependency on foreign oil or other fossil fuels. Theories and principles of biomass gasification will be introduced. A laboratory scale gasifier offers opportunities to systematically study on biomass gasification. The study will help identify alternative renewable fuel sources for the region and for the Renewable Energy Center at the university.

Electricity, Electronics & Computer Technology (Computer Applications & Networking)

Challenges in Health Information Technology for Small Physician Practices

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Need: Health Information Technology (HIT) is increasing viewed as one of the promising tools to improve the health care quality, safety, and efficiency. It has been estimated that if HIT is successfully implemented nation-wide, the annual net savings could reach $90 billion out of $2 trillion per year. Evidences suggest however that the adoption ratio of Electronic Health Records (EHRs) was merely 27% in a recent national survey. Physicians in ambulatory care settings are particularly less interested in implementing EHRs. There is a need to examine the HIT challenges faced in front of small physician practices.

Overview: Low adoption rate of EHRs among small physician practices challenges Health IT professionals to discover the causes and hopefully to design and implement a flexible IT infrastructure to accommodate their needs. Three main challenges were identified after extensive literature review. They are financial concerns, interoperability concerns, and security/privacy concerns. This presentation illustrates in details what those concerns are and what they entail for HIT professionals. A conceptual cloud based IT framework was also proposed to help mitigate those three major concerns.

Major Points:

- Health IT (HIT) basics
- HIT challenges in general
- HIT challenges for small physician practices
  - Financial concerns
  - Interoperability concerns
  - Security/Privacy concerns
- Proposed cloud-based HIT infrastructure
  - How it can lower the initial cost and reduce maintenance cost
  - How it can enable information exchange through NHIN and NHIN Direct
  - How it can alleviate security/Privacy concerns

Summary: The audience will learn from this presentation the current status and challenges in Health IT, particularly for small physician practices. This presentation will also illustrate a conceptual cloud based IT model to address those major challenges.

Electricity, Electronics & Computer Technology (Energy Issues)

Energy Efficient LED Lighting Powered By Hybrid Wind and Solar Power

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Need: The State Agency Energy Savings Program provision in Executive Order RP49, signed by Governor Perry in 2005 requires each state agency to develop a plan for conserving energy and establish a percentage goal for reducing consumption of electricity, gasoline, and natural gas. In order to fulfill the Governor's and the State's plan, steps are being taken to achieve percentage goals and generate ideas for ways to increase these goals for reducing electricity consumption at the Sam Houston State University campus. Currently, monthly energy usage is reviewed and audits are conducted to determine opportunities to minimize or reduce energy consumption on campus. A campus education and awareness program has been implemented to help ensure unnecessary building lights are turned off when rooms are unoccupied. Implementation of energy efficient lights such as light emitting diodes (LEDs) will be used to reduce energy consumption.

Overview: A group of students from the technology program (electronics, construction, design and development) is involved in a series of energy projects to help energy conservation endeavors on campus. Students analyzed current night and security lighting technology (HPS-high pressure sodium, HID-high intensity discharge, mercury vapor, and induction) currently in use at campus parking lots, streets, and building site lighting and compiled a summary report to explain inefficiency of current lighting. Students and faculty proposed the installation of several LED lamps (DC and AC) on pilot locations that are powered by solar modules and wind turbines to determine an efficient (cost, lifetime, illumination capacity) LED technology. Physical plant officers offered two different locations and provided light poles, old light fixtures, and service (official auditing and approvals, bucket trucks etc.) for installation. Students built concrete foundations for light pole footings and installed light poles in selected locations. Light poles and light fixtures were retrofitted to install LEDs, a solar module, a wind turbine, and battery packs. Students also studied and reported normal operation time for lighting, local average wind speed, local average sun illumination, the load capacity of light poles, and secure location for batteries and controls.

Major Points:

- Viability of solar and wind system on campus
- Safety of the system
- Determine percentage of energy reduction
- Measure student interest to RE through LED project
- Campus power reduction using LED lighting
- Promotion of renewable energy on campus
- Describe applicability of the system
- Compare several LED

Summary: This student LED street lighting assessment studied the applicability of light emitting diode (LED) luminaires as viable replacements for existing street, parking, and area lighting on campus. The LED technologies were evaluated for lighting performance, energy and power usage, economic factors (cost recovery and net present value), and qualitative satisfaction. The paper will independently demonstrate the performance of a number of currently available products in one specific application. It is not intended to compare manufacturers of LED products against each other. This undergraduate research project is one of the campus-wide efforts to promote energy conservation and use of clean renewable energy resources. All the steps, survey analysis, and student outcomes will be detailed in the paper.

Electrical, Electronics & Computer Technology (Energy Issues)

Energy Harvesting from an Air Conditioning Condenser Exhaust

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Need: Devices that scavenge energy from the ambient surrounding environment have become popular research. For some applications, energy scavenging eliminates the need for batteries or increase the time between battery replacements. Three such forms of ambient energy found in our environment are wind, vibrations, and temperature changes (thermoelectric-Seebeck) effect. Sources of these forms of ambient energy are found in buildings, machines, bridges, staircases, furnaces, indoor and outdoor temperature differences, and the human body. First, and well documented wind turbines which generate power from the wind. An increase in efficiency of generators and high cost of traditional fossil fuel energy sources, have lead to substantial use and commercial development of atmospheric wind powered generators. Other types wind energy powered electric generating systems have used air intakes to drive the turbines.

Overview: Students and faculty in technology program studied overall air conditioning unit to determine potential sources of waste energy found in an air conditioning condenser unit and devised methods described above. Predesign measurements were made to determine operational time based on seasons, vibration levels, temperature differentials, and exhaust fan flow from a condenser. This study used two different size condenser units. A small scale wind turbine was used to capture and convert waste energy. Measurements were taken and compared to calculated potential power to be harvested from the condenser. The level of student participations and findings from this project will be detailed in the paper and presentation.

Major Points:

- Determine amount of energy can be extracted
- Study how viable AC condenser exhaust for energy harvesting
- Viability and safety of the energy conversion from AC condenser
- Determine amount of campus power reduction through this project
- Promotion of renewable energy on campus

Summary: This undergraduate research project is one of the campus-wide efforts to promote energy conservation and use of clean renewable energy resources. All the steps, analysis, and student involvement and outcomes will be detailed in the paper and presentation.

Electricity, Electronics, & Computer Technology (Electronics & Power Technology)

Hardware and Simulation Laboratories for Power Electronics Applications

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Need: Power electronics provide the needed interfaces between the electrical source and the electrical load. As the demands on electrical energy keep growing, the implementation of power electronics with higher conversion efficiency and higher power density has become crucial. Power electronics play an important role in minimizing the use of fossil fuels by improving the energy efficiency and providing interfaces to transfer power from renewable energy sources, such as solar and photovoltaic, to the utility system. There is a wide range of applications and the demand on the workforce in power electronics and power system area is strong. However, most of the power electronics curriculum is theory-oriented and calculus based, and tailored towards pure engineering students. Therefore, development of application-oriented power electronics curriculum is needed for technology or applied engineering programs. Integrating the laboratory into the curriculum is essential to help students to better understand the fundamental of power electronics and gain hands-on experience.

Overview: Power system and electric machines curricular has been developed since 1950s. Nowadays, with the even increasing demands on energy, the vital role of electrical energy system is obvious. However, as wireless communications and computer engineering gained prominence in the past few decades, the energy-related courses has not been able to keep up with the development. Most of courses have not changed in decades and are not able to deliver relevant information that reflects the current industrial practices. For example, traditionally power electronics laboratories focused on thyristor-based rectifiers and converters that are now mostly replaced by switching mode converters using MOSFETs and IGBTs in industrial practice. Here we will discuss the importance of laboratory components and how hardware and simulation laboratories are integrated into the power electronics curriculum.

Major Points:

- Needs for power electronics laboratories
- A nationwide university consortium to revitalize electric power engineering education
- Hardware and Pspice simulation laboratories tailored to engineering technology students
- Outcome and efficacy of the laboratory integrated curriculum

Summary: Laboratories bridge the theory to the practice. This presentation will discuss how hardware laboratories and Pspice simulation laboratories are integrated into a power electronics applications course for a technology/ applied engineering program. Switch-mode based power electronics hardware and Pspice simulation laboratories information will be shared.

Graphics

Graphics

Learners' Development of Spatial Visualization in a 2D versus 3D CAD Class

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Need: Spatial visualization ability (SVA) is of paramount importance to designers and developers. Computer-aided design and drafting (CADD) assists in developing SVA in students. The question remains, however, how different does a 2D versus a 3D CADD class develop this integral part of the brain?

Overview: There are extensive numbers of publications explaining the positive effects of spatial visualization ability on the efficiency or success of a particular task. Particularly, for engineers and architects, initiating, planning, and conducting a successful project in a timely manner demands a higher level of spatial reasoning and visualization. In this study, we use Purdue Spatial Visualization Test (PSVT) to evaluate how different students SVA varies over a semester-long CADD class. Comparisons will be made between 2D-based and 3D-based CADD classes. In addition, we will discuss how transition from a 2D to 3D CADD class may impact the SVA ability. Furthermore, we will conduct a survey to understand the perception of the students, faculty, and working professionals in industry on the subject of teaching drafting and design in 2D or 3D or both.

Major Points

- Developing the SVA in CADD students
- Comparison between the impact of 2D and 3D CADD classes on the SVA of students
- Discussing the perception of students, faculty, and working professionals on teaching CADD in 2D or 3D spaces

Summary: Attendees will understand how different a 2D versus 3D CADD class may impact students SVA. In addition, attendees will be presented and we will discuss the results of a national survey on the perception of the students, faculty, and working professionals in industry on the most effective way to improve students' SVA using CADD tools.

Graphics

RepRap Tabletop 3D Printer: "Bum Rap" or Viable Solution

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Need: Traditionally, 3D printers have been quite expensive. Within the past two years, prices have dropped from over $40,000 to about $16,000, but that is still more expensive than many budgets can afford, especially if we want multiple printers to support class projects. RepRap is a low cost open source desk-top, rapid prototyping system that is capable of producing its own parts and can therefore replicate itself. RepRap kits can be ordered for under $1,000 or the individual parts can be ordered for less than $600.

Overview: During the past year, the presenter was able to purchase two Prusa Mendel RepRap kits. With the assistance of a graduate student to help with the programming, both 3D printers were built and put into service in the CAD Applications Lab for students to use. Since RepRap is an open-source project, you don't receive printed assembly instructions, but are referred to several You-tube videos. RepRap uses additive manufacturing by melting and fusing a plastic filament. Prusa's main goal is to be the purest and simplest 3D printer you can build, therefore it can be continuously updated. The main advantage of the Prusa Mendel is that it's much simpler to build, modify, repair and print parts.

Major Points: The main points described in this presentation:

- The significantly lower cost allows purchase of multiple 3D printers for use in classes
- Students use the technology instead of just watching the teacher demonstrate it
- Students have a better understanding of 3D printing technology since the "works" of the machine are visible during operation and not inside a pretty case
- Anyone can build a RepRap kit, but it takes quite a bit of time
- Be prepared to ask for help, because the program has to be downloaded and "tweaked" for optimum operation
- As an open-source product, RepRap can be continuously updated as technology changes

Summary: The RepRap project is an initiative to develop a 3D printer that can print most of its own components. As an open-source project, all of the designs produced by the project are released under a free software license. The low cost and small size make it an excellent choice for use in Industrial Technology design labs. Having a RepRap printer has made my students more aware of advancing technologies and that they can have hands-on experience with technology, not just read about it.

Graphics

Using 3D Parametric Software (Inventor) to Teach Orthographic Projection Visualization

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Need: Anyone teaching Basic Engineering Graphics can attest to the fact that many (most) of our students have a difficult time learning to visualize the parts they are sketching/drawing in orthographic projection. Often they are just duplicating the pattern of lines we show them or that they see other students creating. Some students eventually learn, while others never really "get it." Over the years, teachers have tried all sorts of techniques to help their students learn the important skill of visualization. Also, as CAD technology continues to shift towards 3D, the skill of visualization is becoming even more important.

Overview: While teaching an Inventor 3D parametric design class, the presenter realized the potential to use this technology to help his Engineering Graphics students develop their visualization skills. 3D parametric software readily allows quick and easy creation/modification of part geometry. Furthermore, color-coding the various faces of the part (or selected part geometry) not only helps students visualize the various orthographic views, but by matching the face colors to the colors of the X,Y & Z axes, students become more aware of the 3 axes. Our drafting texts contain a variety of part geometry appropriate for teaching orthographic sketching and enhancing student visualization skills. It is also very easy to modify part geometry "on the spot" if a student raises a "what if.." question. Student feedback has been extremely positive, especially from students who had taken a drafting course in high school and struggled with visualization.

Major Points:

- It is quick and easy to 3D model the basic parts previously used for sketching practice, so there is no need to create new practice exercises
- Color coding various faces and features of "practice parts" allow students to more easily recognize the shape of various faces and part geometry.
- Once the students complete their sketches it is extremely easy for the instructor to view each face of the part providing students with immediate feedback and enhanced learning

Summary: Visualization is a learned skill that improves with practice. Some students have more difficulty learning to visualize parts and features than others. Based on the informal research in the presenter's Basic Engineering Graphics classes, students significantly improved visualization skills when orthographic projection was taught using color-coded 3D parametric models.

Graphics

Analysis of Students' Scores on the Purdue Visualization Rotations Test and Final Grades in an Introductory Vector Graphics Course

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Need: Do students with discernible spatial visualization skills achieve higher grades within Graphic Communications courses? This research investigated the relationship between students' perceptible spatial visualization ability and their overall performance in introductory vector graphics course with a focus on variables of gender and age as it relates to overall course scores and discernible spatial visualization skills.

Overview: This research utilized a convenient sample group of 35 students (Graphic Communications Majors) enrolled in an introductory vector computer graphics course that covered both conventional and digital technical illustration topics, terminology, and applicable laboratory assignments using vector graphics software (Adobe Illustrator CS5). The course's description stated: A study of illustration software with emphasis upon operational skills and techniques used in creating two-dimensional and three-dimensional illustrations. The results of this research focused on associations between successes and/or limitations within the sample's spatial visualization abilities by utilizing an instrument known as The Purdue Spatial Visualization of Test of rotations (PSVT). The PSVT is a spatial ability test that has been connected to results that demonstrate participants' analytical processing capabilities. In addition, this presentation identifies comparable research on the concepts of spatial ability and learning.

Major Points:

- Gauges students' analytical visualization skills, the Purdue Spatial Visualization of Test of rotations (PSVT) which measures both spatial visualization and mental rotation.
- Examines individual results as measured in a percentage of correct and compared to their final overall course scores. Those comparisons were statically analyzed for possible significance based on age and gender.
- Contributes, based on observations, toward the promotion of further research and curriculum development that exposes students to an appropriate learning environment that could develop stronger visualization skills.
- Inquires whether enhancing a student's visualizations skills translate to greater comprehensions in areas of strategies in STEM education?
- The observations of this research, females that scored better in their final grades showed a relationship to their scores on the PSVT. Was this observation a reflection of greater spatial visualization skills examined, it is recommended that more research may determine a connection

Summary: This research investigated relationships between a sample's variables and any discernible evidence of those participant's spatial visualization skills and their overall performance in introductory technical graphics course. In looking at comparable research on gender and spatial ability, the results of this research found differing results. In the almost all the results reported, based on this sample, there was little to no evidence of a difference in the visualization skills and gender, yet gender did have a role in their Final Grades. That the significance tests for Two-Sample T tests and the Nonparametric both confirmed the observations found in Summary Statistics presented to be presented. The average for the PSVT was even for both groups and the females on average scored higher in the course in regards to Final Grades.

Graphics

Characteristics of Student Success in Engineering Graphics Assessment

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Need: This presentation will examine secondary student performance in an engineering graphics assessment, with an inquiry into implications for post-secondary assessment. The goals of the research include providing input to secondary educators with respect to engineering graphics competencies and assessment techniques.

Overview: Each year, the Worldwide Youth in Science and Engineering (WYSE) organization conducts an Academic Challenge® for high school students in Illinois and Missouri to promote study and interest in engineering and science disciplines. The Academic Challenge is in the form of a series of exams in various topics, including engineering graphics. Students are assigned by school size into four categories, and compete in a regional event, with winners proceeding to a sectional event, and eventually a state finals event. The topic distribution for the engineering graphics exam includes fourteen topical divisions, as well as pictorial, orthographic, and sections spatial visualization problems. The exams are revised each year, with previous exams available as study guides for current year competitors. This research examines student performance over the past decade as revealed by mining the annual individual question data collected for the state finals exam.

Major Points:

- Overview of the WYSE Academic Challenge, divisions, and exam logistics
- Overview of the student demographics
- Overview of the topic categories and types of spatial visualization problems
- Characteristics of the available data
- Student performance data results
- Conclusions and implications for further research

Summary: Over the past decade, secondary students have exhibited various levels of success in engineering graphics assessment. Of key interest is whether or not a correlation exists between secondary-level success in isolated activities such as the Academic Challenge exam and post-secondary success with assessment instruments such as the ATMAE Engineering Graphics specialty certification exam.

Graphics

Pecha Kucha for Graphical Portfolio Presentations

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Need: The Pecha Kucha methodology is a great fit for our ATMAE theme, *Strengthening Our Connections*. Pecha Kucha was developed about a decade ago as a means of allowing individuals to exchange ideas, exhibit work, and network with others. In 2004, Pecha Kucha Nights began in a few cities in Europe, and has since been embraced in phenomenal fashion worldwide. This presentation seeks to broaden awareness within the ATMAE community, and promote the methodology as a viable means of enhancing the educational experience.

Overview: With a Pecha Kucha, a presenter narrates a collection of 20 slides for 20 seconds each, keeping the presentation to 6 minutes and 40 seconds. A Pecha Kucha Night usually consists of a dozen or so presenters. This presentation examines elements of success of students who were required to participate in a Pecha Kucha Night as a culminating experience in a senior-level rendering and animation course. The presentation will include a summary of Pecha Kucha influence worldwide, and how this mode of presentation has strengthened connections through professional and social engagement and exchange of ideas.

Major Points:

- A Pecha Kucha history and timeline
- Pecha Kucha nights worldwide
- Pecha Kucha examples from YouTube®
- Pecha Kucha and Bloom's taxonomy
- Student response to Pecha Kucha in a computer-aided rendering and animation course

Summary: Student success can be enhanced by engaging students in a culminating experience such as a Pecha Kucha. This new and innovative approach to exchanging ideas, exhibiting work, and networking has the potential to engage students in all aspects of the cognitive domain of Bloom's taxonomy.

Graphics

An Innovative Teaching Initiative using **Processing©** OpenSource Language for Imparting Graphics Education to First Year Engineering and Technology Students

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Need: Currently there is a need to reduce the increasing dependence on commercial software for teaching introductory graphics principles to students. Open Source programming languages (PL) are not only easily accessible but also significantly reduce the financial implications for the universities and hence the students. The specific PL, **Processing**© has been chosen in consideration of the imminent need for a Graphics tool that can offer advanced functionalities with relatively lesser jargon and an easy learning path for beginners.

Overview: This proposal puts forth the design and implementation of an introductory CG (Computer Graphics) course using a Java-based OpenSource PL that contributes to the domains of Graphics and Teaching Innovation. **Processing**© is used to teach basic programming and graphics concepts to first-year engineering/technology students. This proposal delineates how to use this OpenSource platform to design and implement a freshman-level graphics course in the disciplines of engineering and technology.

Major Points

- The programming syntax of Processing is relatively straightforward and the language is easily understandable by a beginner-level student. This reduces the cognitive overload and facilitates easily understanding Graphics concepts.
- Students can develop intermediate level graphic applications in a relatively shorter time period and with lesser complexity. This stimulates their interest in utilizing relating Graphics for Engineering and Technology applications.
- This proposal also explains how Processing can serve as a bridge to facilitate the subsequent transition to more advanced programming and Object-Oriented (OO) languages like Java and C-Sharp as Processing itself is built on OO principles.

Summary: The proposal explains an innovative course structure that exploits the advantages of the OpenSource platform and explores the reduction of the gap between learning and executing by using Processing, which is easily comprehensible by first year students in engineering and technology. Students created beginner to intermediate-level graphic applications in the disciplines of engineering and technology. The use of comparatively lesser amount of code relative to programming language such as Java and C++ presents a 'result-oriented approach'. Even though **Processing**© was used as a medium for teaching introductory graphics concepts, the use of a graphic software also had another notable advantage. Using graphics illustration served as an effective means to communicate programming notions. Notable results from the earlier semester, especially with respect to student perception of the new pedagogy are presented.

Graphics

Computer Animation Rendering Techniques

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Need: With technology advancing, computer animation is more accessible to learn and manage. While computer animation has become more mainstream, the production aspect remains highly technical and complex. Since computer animation is time based, this process is incredibly time consuming to render many frames. The process required to render computer-animated material can take a long time. In this presentation, I will show some of the best techniques and practices to get efficient, high quality rendering without compromising time.

Overview: The following presentation follows the production of a 9 minute computer animated short film entitled "Death to the Different" (2010) and compares the rendering processes with another computer animated short film "Junkboxx" (2012) which was produced by a professor at a Midwest University. The presentation explains key areas in the rendering process that lengthened and shortened the rendering of each frame. By doing so, the process of creating computer animated short films can be completed in a reasonably timely manner.

Major Points:

- Defining where rendering fits in the computer animation pipeline
- Best hardware practices
- Current methods of rendering
- The time required to render based on particular settings
- Methods and tips to increase productivity in rendering

Summary: Attendees will better understand computer animation and the very technical process of rendering. By understanding the settings, rendering can be completed faster without compromising quality of the final computer generated images.

Graphics

Developing an Interdisciplinary Curriculum for the Commercial Photography Program

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Need: More and more, students are requiring degrees that are interdisciplinary to prepare them for the real world. This need was addressed with the curriculum that was designed for the Commercial Photography program at Southeast.

Overview: The presenter worked with the departments of Business and Mass Communication to offer courses, in addition to technical photography courses, that are needed for a student to be well versed in the field of commercial photography, including courses in marketing and advertising, two fields very closely related to Commercial Photography. This collaboration has led to collaboration with the department of Mass Communication for a particular course where students take various roles working on an advertising campaign. Also as part of the curriculum, students learn industry software, which is essential for improving craft and technical skills. Technologies such as Flickr.com, blogs, apps, Google Docs, and Delicious.com are used in the classroom to build a community of photographers.

Major Points:

- Addressing the need for an interdisciplinary program for Commercial Photography majors
- Collaborating with other departments on campus to develop an interdisciplinary degree program for Commercial Photography
- Using web technologies to build a sense of community among students

Summary: Students are attracted to the program because they take courses in marketing, advertising, entrepreneurship, graphics, video, and photography. Particular attention is given to lighting and printing technologies. Graduates are well rounded, and are prepared with skills to enter into a career in photography or imaging. The introduction of web technologies and apps also helps photographers develop skills for marketing their work online, including Flickr.com. In addition, the program invites guest photographers to come speak to the students about working as a commercial photographer. Students who are interested in a particular area of photography are encouraged to reach out to professionals who are working in their area of interest. Guest speakers are invited according to the interests of degree seekers.

Graphics

A Study of New Graphic Communications Job Titles and Descriptions Caused by New Technologies

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Need: The causal effect of new technologies in the graphic communications industry is the reshaping of job descriptions and titles. In the past the industry had job titles representative of current practices based on technologies of that time era. "Typesetters" and "Strippers" are no longer job titles of today— these jobs have been replaced with new titles emerging from new technologies. This effect impacts colleges and universities preparing students for employment with companies, in that they need to know what is required in these new positions.

Overview: New technologies in the graphic communications industry are not only changing the way we do business but also how we prepare for the future. With the increase in digital communications, graphic communications providers, specifically printers, have found new ways to enhance their offerings with short run digital presses, variable data printing capabilities, fulfillment services, etc. This has brought a change in the job skills required for the workforce, new job titles, and changing job descriptions. This presentation looks at the changing titles and descriptions in the industry and the impact on universities that prepare students for the industry.

Major Points:

- Identification of industry job titles caused by new technologies.
- Outlook for new jobs.
- Action plan for implementation into graphic communications courses of study.

Summary: The presentation will summarize an industry survey that addresses what new/different job titles and job descriptions result from the changing technologies in the industry. It will also summarize what universities can do to address the changes and better prepare students for the future. Digital technologies have generated new job titles and descriptions that were not in existence ten or more years ago. As new technologies are introduced, job titles, descriptions, and qualifications are being redefined. Educators need to be aware of these changes to better prepare students for a rapidly changing industry.

Graphics

Youth Technology Programs: High School Students Learning in Graphic Communication Programs

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Need: The Youth Technology Programs (YTPs) were offered in the summers of 2010 and 2011 for underrepresented populations of high school students who had an interest and/or curiosity in technology. The YTPs were designed to increase the number of students who pursue and succeed in careers related to science, technology, engineering, and mathematics (STEM), by offering programs to students in grades nine through twelve. The academies were geared towards attracting nontraditional students into the technology field. The need to increase the number of nontraditional students in STEM and related fields is apparent because of data supporting the underrepresentation of women and minorities among professionals in these careers. Ultimately, the programs' goal was to provide a pipeline of diverse students participating in STEM school programs.

Overview: The Youth Technology Programs were a one-week summer academic and residential experience where high school students explored technology through hands-on and problem solving activities and team-based projects in the School of Technology at North Carolina A&T State University. The purpose of the YTPs was to increase students' awareness in the areas of electronics, video communications, computer aided drafting and design, construction technology, social media, etc. Presented will be a follow-up on where the participants are currently in their academic career.

Major Points:

- Promote interest in technology programs through the development of summer camps by educating high school students about technology careers.
- Help high school students understand technology by engaging them in challenging technology activities to develop their problem solving and critical thinking skills through hands-on activities.
- Improve high school students' awareness of technology and the role of technology in their lives.
- Develop high school students' ability to communicate effectively in a technological world.
- Create a marketing strategy in order to promote the projects and technology programs as vital sources of education, research, and service within the profession of technology.

Summary: Students learned and understood technology principles and engaged in technology activities. Participants also visited laboratories and learned about the many technology programs at North Carolina A&T State University. Faculty coordinated lectures in laboratory settings allowed students to improve their problem solving and critical thinking skills through hands-on activities.

Graphics

Quality Attribution of UV Wide-Format Inkjet Printing on Building Materials

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Need: In the World Printing Trends report, it is estimated that digital printing has tremendous growth potential; and with the additional impacts of global green trends, environmentally-friendly inks are enjoying greater prominence. This study examines the print quality performance characteristics of eco-friendly UV inks for wide jet printer production of architectural design materials. The project will determine the various UV wide jet printers and ink combinations prominent across Taiwan for various architectural design materials print quality performance.

Overview: Digital printing possesses the tremendous competitive advantage of permitting low quality, multiple designs, and customized production; in combination with eco-friendly UV inks, it facilitates more widespread adoption of such print media, thus expanding the range of product application possibilities. This study examined the five major UV wide jet printer systems and ink combinations on Taiwan, across three of the most common architectural design material products(glass, acrylic and melamine plywood) for their print performance characteristics. The research findings can inform an evidence-based approach to UV wide jet printer production of customized architectural design materials for industry reference, thereby enhancing the digital printing market's applications scope.

Major Points:

- UV wide print market status and industry trends
- UV wide jet printing and print product quality characteristics overview
- Research methods and analysis of the findings

Summary: This study explored five combinations of UV wide jet printers and inks, across three of the most prevalent architectural design material applications to delineate four dimensions of print quality characteristics (Solid Ink Density, Print Contrast, Dot Gain and Color Gamut). The findings may robustly contribute to industry participants' production processes, to inform their understanding of different architectural design materials' print quality characteristics, permitting maximally efficient optimization of printer and ink combinations.

Graphics

Reservoir Volumes at Stringtown, Handyville and Sailor Springs Fields

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Need: Three dimensional graphics are central to exploration for petroleum and natural gas because of the manner in which 3D graphics facilitate visualization of subsurface structures. In addition to 3D modeling, however, exploration also requires estimates of reservoir volume. This is because reservoir volume necessarily limits potential hydrocarbon quantities. Volume determination is challenging because reservoir structures don't have regular geometric shape; volume estimation is critical because it determines whether or not to invest in further exploration. Integrating volume estimates into typical 3D graphic modeling provides a means of responding to industrial information requirements.

Overview: This work discusses an on-going legacy map conversion project for oil fields in the Illinois Basin. The initial project concept was to digitize 2D legacy maps and then develop 3D graphic models that would facilitate subsurface visualization. During this project, it became obvious that the mathematical process used to convert 2D drawings to 3D models might be used to generate volume estimates as an integral part of the map conversion process. The traditional paradigm for volume estimating employs contour areas scaled from 2D graphics; a 3D graphic model substitutes a volume estimate based on the gridded surface of the 3D model. This research describes volume estimates at three different oil fields. At each field, volume estimates were made using contour areas digitized from 2D graphics. In addition, reservoir volume computation was integrated into 3D graphic modeling. Volume estimates resulting from both methods were then compared.

Major Points:

- 3D graphics provides both enhanced visualization and a means to estimate subsurface reservoir volume
- Volume estimates made from a 3D graphic model are more precise, and just as accurate, as volumes computed by traditional methods.
- Estimates of subsurface volumes can be integrated into a 2D-to-3D map conversion process at little additional cost.
- Teaching of the volume estimating process and its inclusion in traditional university courses is both appropriate and necessary to development of expected professional skills.

Summary: Attendees will understand how volume estimates based on 3D graphics can be integrated into an on-going project in legacy map conversion. Use of 3D graphics and the associated mathematical model provide volume information that is both more precise, and just as accurate, as that provided by traditional methods. Inclusion of volume estimating procedures in university course work is both timely and appropriate and could be substituted for traditional but outdated methodology.

Graphics

Integrating Variable Data Printing in the Graphics Industry and the Engineering and Technology Classroom

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Need: Variable Data Printing (VDP) makes it possible to print content that is unique and relevant to each individual. Unlike typical mass mail marketing, VDP has the potential to reduce the volume of mail produced by direct mail marketing. According to Farquharson (2007), many printers have indicated that the concept is too new to grasp. With rising cost in shipping and postal rates, this new technology becomes an attractive option for modern print providers. Technology and Engineering faculty as well as professionals in the graphics industry need to immerse themselves in the development, use, and integration techniques for VDP.

Overview: During this presentation, conference attendees will be introduced to Variable Data Printing (VDP). A brief historical overview describing the development of VDP will be provided. The robust database which is often considered the heart of the VDP process will be described and illustrated graphically, and sample printed pieces will be shared with the audience. VDP products that are currently on the market will be described. Political campaigns and large firms that are using VDP will be discussed. The rewards of VDP and digital print will be shared with the audience.

Major Points:

- Introduction to Variable Data Printing (VDP) and a brief history describing it's development
- Robust database considered the heart of the VDP process will be described and illustrated graphically
- Sample VDP pieces will be shared with the audience
- Political campaigns and large firms currently using VDP will be highlighted
- The rewards of VDP and digital print will be shared with the audience

Summary: Conference attendees will leave the presentation with an understanding of Variable Data Printing (VDP) The audience will have the opportunity to view sample VDP pieces. The conference attendees will leave with an understanding of the rewards of VDP and digital print and how it can benefit those involved in the graphic and manufacturing industries as well as those in the engineering and technology classroom.

Graphics

Customizing Online Connections: Open-Source Tools for Developing Interactive Websites

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Need: Website users expect a personally customized online experience. With the exponential growth of organizational websites, developers have to deliver dynamic web content for distinguishing themselves from the competition. There is thus a need for migrating static web content to customized websites using appropriate server or client side software. In order to do this competitively businesses need to rely on standards-based open-source solutions and technologies such as Apache, PHP and MySQL. Graphic communications management and computer network technology students will benefit from opportunities for developing web-based applications using these technologies.

Overview: The presentation will discuss the ongoing development of a course related to dynamic web content. Typical procedures for installing and configuring web services will be outlined using open-source software technologies as a teaching tool. The high degree of customization possible while designing web applications also improves students' critical thinking, creativity and communications skills.

Major Points:

- The need for customizing users' experience and connection with a website
- Using Apache server software to setup a Web server on a Unix-like computer system.
- Database-driven interactive websites using MySQL.
- Integrated PHP open-source tools for combining web hosting, databases, scripting, administration of websites
- Using graphics tools, templates and in-built auditing tools for website development

Summary / Conclusion: The presentation will discuss ideas for facilitating learning about customizing websites using dynamic content. It will include readily implementable methods for adding interactivity to websites using open-source software. Samples of content management systems used as part of student projects will be demonstrated.

Graphics

Revamping a Web-Design Course Based on Advisory Board Members' Suggestions to Keep Abreast With Changing Technology and to Meet Industry Expectations

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Need: The graphics field is heavily dependent on technology. Technology changes at the lightening fast speed not just in the area of graphics but also in the fields where graphics are used. It is important to keep up with the changing technology, make designs compatible across all platforms, listen to advisory board members, make quick changes in the curriculum, and teach students the latest graphics technology to make them prepare for the industry.

Overview: This presentation discusses the implementation of advisory board members' recommendations into the existing Web design course. Previously the Web design course was limited to create Web sites for standard computers. It did not cover creating Web sites for mobile devices and incorporating social media into Web sites. With the growth of mobile devices the advisory board members emphasized on teaching how to create Web sites for mobile devices. As a result the Web design course was revamped to introduce advisory board members' suggestions.

Major Points:

- Introduction
- Advisory Board Members' Suggestions
- Scope of Creating Media for Mobile Devices
- Challenges in Implementing Suggestions
- Comparison between Old and New Web Design Courses
- Summary and Conclusions

Summary: Attendees will comprehend the role of advisory board members in improving the graphics program. Presenters will explore the changes made to the Web design course to meet industry expectations and discuss challenges that educational institutions face in implementing suggestions.

Graphics

Innovative Graphics Technology Applied for an International Study Abroad Project – Animating Ancient Peru

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Need: The graphics field is constantly changing. Instructors are seeking new and innovative approaches to classroom delivery methods. This session will discuss the development of a unique baccalaureate program in animation technology and how that program used an international study abroad project to introduce students as well as faculty to the new graphics technology of 3D scanning. The application project, Animating Ancient Peru, involved students, faculty and professionals and was a highly successful activity. The session will explain how the application of the technology can lead to the implementation of national and international partnerships.

Overview: Faculty and students from the University of Arkansas Fort Smith (UAFS) traveled to Peru for the purpose of animating and mapping an ancient dig site. This paper details the collection process using the latest 3D scanning technology, the application of the 3D data incorporated in a virtual reality setting, and the production of intelligent maps using geographical information systems. Ground penetrating radar information was applied to the maps to produce projected dig sites. From its inception, the course was destined for success. Students enrolled with various backgrounds from across campus and the curriculum exposed the students to high technology applications foreign to their chosen fields of study. Creative organization of the course and several partnerships with the Peruvian site and professionals provided the participants with an innovative learning experience. Lasting relationships and memories were developed between the site archeologists, the professionals, and the UAFS group.

Major Points:

- Geographical Information Systems (GIS)
- Ground Penetrating Radar (GPR)
- 3D Dimensional Surface Modeling
- Virtual Reality Applications

Summary: Students creating the virtual reality project are currently enrolled in a newly developed baccalaureate program for Animation Technology (BSAT). The program is unique in its delivery mode, application projects, and experiential learning for the participants. The project and the unique program will be featured in this session. Participants in this session will learn of the BSAT program, how to develop and administer a unique program, and how student can become involved in international graphics projects.

Graphics

Video Production for a Virtual Campus Tour using a DSLR Photo Camera

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Need: The world of image recording seems to consist of two isolated realities – video and still photography. Though they are similar in many ways they are worlds apart in others. But these seemingly irreconcilable worlds are converging. We need to understand how.

Overview: This presentation will outline some of the most common challenges that professionals and non-professionals face when making the transition to video technology. The convergence of stills and video continues. An increasing number of Digital Cameras now have video capability.

Major Points:

- Still photography vs. video photography
- Getting the shallow depth of field/ "cinematic look"
- How shutter speed, f-stop, and ISO affects video footage
- Pros and cons of these cameras and why you might choose them for certain types of projects and not others.
- The basic workflow
- Extra gear and accessories for shooting cinema-style with an entry-level or medium-sized budget.
- What to consider when purchasing a DSLR for video production

Summary: Attendees will understand how to utilize the new features provided by the major camera brands to create powerful video presentation using a Digital Single Lenses Reflex Photo Camera

Graphics

What Are the Skills Needed by Flexo Industry Employers from Recent Graduates of Graphic Communication Programs?

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Need: As the print industry adapts to the reality of changing markets, educators need to know what industry expects from students who are recruited from graphic communication programs in 2- and 4- year higher education institutions especially skills related to the fast growing Flexographic print segment.

Overview: This presentation will discuss the results of a Delphi study about positions held and skills needed by recent graduates of graphic communication programs that include Flexography.

Major Points:

- Job titles of recent graduates who are recruited by and employed in flexography-based companies
- Skills required by Flexographic employers who recruit recent graduates from graphic communication programs that include Flexography in their curriculum
- Dialogue with peers from graphic communication programs to discuss the advantages of including Flexography in their program in varying degrees of inclusion

Summary: Attendees will learn what skills are needed by employers in the Flexographic printing industry as well as what positions recent graduates are hired into. Participants will have the opportunity to join in a discussion about the advantages of including Flexography in their graphic communication programs.

Graphics

The Use of Social Networking Media in Strengthening Graphic Communication Connections

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Need: The recent downturn in the economy has placed constraints on the efforts to recruit and retain students and will likely present a significant challenge for the foreseeable future. However, the need to continue with recruitment and retention can not be marginalized due to the difficulties that we now face. Therefore, we must adapt to this era and search out methods to better accomplish our tasks, as well as network with other colleagues in the field and the industry. Currently, there are emerging, and even maturing, internet sites that are commonly referred to as "social networking" (SN) that can easily be employed to reach millions of users worldwide. Most of these SN sites are free to set up and use, and many are already in common use by high school as well as university level students. It is through the use of a few of these carefully selected SN sites that our academic programs can be advertised, and recruitment and retention initiatives can be strengthened.

Overview: This presentation details how SN sites can be employed to strengthen our connections in graphic communication programs. It does not propose that these sites be the sole means used, nor not necessarily to be the prominent means of networking. However, when used properly these SN sites offer a quick and efficient means to reach both current and prospective students. Internet sites such as Facebook (www.facebook.com), YouTube (www.youtube.com) and Twitter (www.twitter.com) are popular examples of these aforementioned SN sites. These sites allow the user to exchange messages, photos and videos with everyone, or among a selected group. Further, there is the option to link and exchange information among the sites. For example, a short recruitment video can be created and uploaded to YouTube. A link to this video can be placed on a Facebook page or be discussed on Twitter. This presentation will give the participants a better understanding how to organize, plan and execute a SN site in order to better improve communication with current and prospective students, industries, and our colleagues.

Major Points:

- Overview of SN sites
- Organization, planning and initial start up
- Coordination of SN sites
- YouTube as a SN recruitment tool
- Conclusions and recommendations

Summary: Participants will receive information on the setup and use of SN sites to strengthen graphic communication connections. Further, the presentation will cover how these SN sites can be linked together, and how they can best be used in the overall effort to better communicate with students, industries, and colleagues.

Graphics

Graph Based Functional Tolerancing of Product Family in 3D CAD System

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Need: To meet the needs for product variety, many companies are shifting from mass production mode to mass customization, which demands quick response to the needs of individual customers with high quality and low costs. The multifunction nature of mechanical components necessitates designers to redesign them each time when their functions change. The geometric dimensioning and tolerancing (GD&T) changes as results of the design change can be very costly and time consuming. It is better to be updated automatically in CAD. There are two issues about putting GD&T to an engineering drawing, tolerance synthesis and tolerance specification. Tolerance specification means specifying GD&T feature control frames on part drawings. Tolerance synthesis is to generate tolerance value in each feature control frame.

Overview: In this paper, a graph-based functional tolerancing scheme in 3D CAD is proposed. In the scheme, a product is generated by applying production rules to the graph of the base product, following customers' or manufacturing engineers' requirements. Functional tolerancing of each component of a product in the family is formulated as a non-linear constrained optimization (or cost minimization) process. Certain critical aspects of the scheme have been implemented in SolidWorks®, by using its API (Application Programming Interface) and C++. LEDA® and MATLAB® have been used to solve the graph and optimization problems.

Major Points:

- Review of current practices of Geometric Tolerancing in 3D CAD
- Graph based assembly information model
- Tolerancing System Design
- Implementation in SolidWorks

Summary: A graph grammar-based mechanical product modeling scheme has been proposed. A product is generated by applying production rules to the graph of the base product, the mechanism. Both base product and end product are represented by graphs with components as nodes and joints between components as edges. The generated attributed graph is a data structure which represents the joint and feature information of the customized product. In the end product, the joints between a component and other components in the product represent the functions concerning how the components are to be related to each other geometrically. Therefore, the joints information can be used in helping designing and tolerancing. The proposed method was partially implemented in SolidWorks to demonstrate its application in a 3D CAD system.

Graphics

Integrated CAD/CFD Analysis of HVAC Fresh Air Intake System Design of an On-Highway Crane

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Need: There has been a consistent need regarding on-highway cranes for a means to introduce outside fresh air into the HVAC system of the driver's cab in order to better de-fog the windshield and side windows when a humid and/or wet outside environment is encountered. An initial design for this system resulted in the air conditioning system expelling hot air in spite of the temperature controls being set to the coldest position. Thus, there was a need to perform an integrated CAD (computer aided design) / CFD (computational fluid dynamics) analysis and graphics visualization to improve upon the existing design.

Overview: In this presentation, we will present the graphical methods used to determine the means by which we are now able to effectively introduce outside fresh air into the HVAC system from a viable location, of which the previous location was not functional, and allow the air conditioning system to function as expected. The existing design of the fresh air intake system was not functional and introduced hot air into the air conditioning system, thus it was required to be re-designed to function properly. With CFD simulation on 3D CAD models, we were able to identify the problem with the existing design, and ultimately we were able to re-locate the intake for the system to a viable location that yielded the best possible airflow. The integrated CAD/CFD analysis approach required minimal field testing of current equipment, thus minimizing the overall cost of the redesign.

Major Points:

- Problem identification and preliminary research.
- Field testing and data logging of various pertinent temperatures
- 3D CAD model creation for use in CFD study.
- CFD analysis of crane front end from 3D CAD model.
- CFD results interpretation and component relocation.
- Final implementation of optimal solution.

Summary: The focus of this presentation is on demonstrating the use of integrated CAD/CFD analysis to solve real-world engineering design problems and how the integrated approach can help save countless hours of physical modeling and mock-ups. The presentation will be of interest to engineering design researchers and professionals.

Graphics

What is Hot in Packaging? Exploring Current Trends in Packaging Production and Technology

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Need: Over the past decade there have been major changes in the world of package design, printing and production. Environmental concerns and new technology have both had a major impact on how packages are manufactured and marketed. It is important that educators stay on top of these changes in order to provide this information to our students, who may eventually land a job in the packaging industry.

Overview: This presentation will examine three main areas of current packaging trends. The first is the environmental impact not only on package production, but also package disposal. The second will look at the current trends in digital technology that are allowing for shorter runs of packaging and very unique packaging possibilities. The third area will examine what is in store for the future of packaging.

Major Points:

- Producing packaging that is sustainable and friendlier to the environment.
- Utilizing the latest digital technology to create new and unique packages.
- Creating packages for 2012 and beyond, what is next?
- Presentation will also include an overview of current package production techniques.

Summary: Attendees will have a better understanding of several current trends in packaging technology. This will include the environmental impact, the digital impact and the future of packaging technology.

Management

Management

Mobile AIDC: Rethinking Bar Codes

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Need: The use of the cell phone as a bar code reader has hit the mainstream. And while cell phone based bar codes are cropping up everywhere, the selection, implementation and printing of the bar codes is not necessarily being done in a logical, supportable or verifiable manner. This presentation will discuss the current state of mobile bar code use, will discuss the concerns of those that help develop bar code standards and will provide suggestions on how companies should approach the use of mobile bar codes.

Overview: For years QR Codes, large square matrix style bar codes, could be seen on bill-boards all over Japan. In recent years, they have started to show up in the United States. These special bar codes were scanned with a cell phone and the user was redirected to a web page for the company who was doing the advertising. Today, one only has to go to Wal-Mart, Lowes, Best Buy – even the ATMAE Conference web page – or any number of other major chains to find various types of mobile bar codes – bar codes designed to be scanned by a cell phone. And while this proliferation of bar code usage is seen as a positive trend by some, there is cause for concern. The Microsoft Tag bar code is proprietary – as is the EZCode symbology used by ScanLife. The problem is that there are no printing standards for these proprietary symbols, resulting in a potential loss of impact when the offending code does not scan. This is being further compounded by companies that are using the error correction that is built into some bar codes to allow for "designer codes". The result is much the same – if there are any problems in printing, the bar code can no longer be scanned. This presentation will inform the participants of what is currently happening in the mobile bar code arena – and will alert them to some of the potential pitfalls.

Major Points:

- Survey of the currently available mobile bar codes
- Discussion of pros and cons of the existing solutions
- Demonstrate the impacts of some of the current implementations

Summary: As mobile bar codes continue to become more prevalent in marketing and advertising, managers, technologists, graphic designers, packaging professionals, engineers – basically anyone involved with the use of the bar code – need to understand the advantages and disadvantages of the varying solutions currently available. This presentation will help prepare the audience for the continued expansion of mobile bar codes – educating them in both the available options and the potential pitfalls.

Management

Sustainability Leadership and its Impact on Creating an Innovative Culture

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Need: With the heightened awareness of sustainability, there is a demand for leaders to effectively promote, practice, and manage sustainability in modern organizations. Although essential, the discussion of leadership within the framework of sustainability is not widely explored. There is a need to continue making the case for sustainability leadership as a critical component for creating an innovative culture within competitive organizations.

Overview: The debate as to whether or not sustainability is critical is drastically decreasing, however, there is still resistance to change within the leadership sphere. This would enable organizational leaders at all levels to fully embrace the concept of sustainability as a viable way to improve organizational performance. Although there has been extensive use of the term "sustainability", little has been done to achieve change in organizational practice that would align sustainability with the strategic plan. The resistance to sustainability practice is partly due the limited understanding of its relationship to certain organizational components that are responsible for promoting innovation. This presentation will discuss sustainability as a pertinent issue for creating an innovative culture at all levels within the organization, and the role of leadership.

Major Points:

- Overview of sustainability: Interpretations, stakeholders' demand, and organizational practice
- Corporate sustainability dimensions, strategies, and leadership
- Impact of sustainability practices on the organizational culture
- Sustainability leadership for creating an innovative culture
- Linking innovation to sustainability at various levels
- Conclusions and recommendations

Summary: The presentation will address the importance of sustainability in competitive organizations. Participants will have an understanding of the important of leadership within the context of sustainability, and its impact on creating an innovative culture that will enable organizations to improve performance.

Management

The Development of a 5S Red Tagging System for Material Inventory in an Educational Manufacturing Lab

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Need: In today's manufacturing industries, lean is more than just eliminating waste and saving money. It is the way a company must operate in order to stay competitive in the struggling economy. This also stands true for teaching-oriented machine shops in educational institutes. As the government tightens its spending, schools receive less operational funding; the educators are forced to explore new ways to keep their facility up to date and appealing to incoming students. One useful tactic to accomplish this is to apply 5S principles for better management of equipment and materials used. The first step of 5S, sort (seiri), is specifically essential to keep the facility safe, clean, and organized, thus it could operate in a lean manner.

Overview: For a manufacturing education program to be teaching lean concepts, they themselves must be lean. This presentation will look into the red-tagging ideas and practices for better material inventory control. We will discuss what a manufacturing education program should consider when leaning out their facility, especially when sorting through excess materials in the machine shop. We will also present the red-tagging system currently under development for material inventory based on the demand and supply of materials.

Major Points:

- The need to practice lean in an educational manufacturing lab
- The nature of material inventory control
- To keep or not to keep: What to red-tag and why
- Red-tagging based on demand and supply of materials
- Ways to repurpose red-tagged items

Summary: The goal of this presentation is to identify ideas and practices on how the red-tagging process can be implemented for better material inventory control, and thus provide manufacturing education facilities a sound foundation to start implementing lean.

Management

A Risk Management Planning Approach for Manufacturing Businesses

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Need: Manufacturing businesses are exposed to several internally and externally generated risks along with disasters from natural calamities and terrorist activities. Given the current globalized and highly competitive market situation, a severe effect of any these risks may cause collapse of the entire business. Although a business does not have control of disasters from natural calamities or terrorist activities, it is possible to identify and control the factors that are responsible for internal risks and several external risks or disasters. Based on this fact, a business needs to study the factors that can influence potential risks, such as, product recall, supply failure, delivery failure, a fatal accident and others, and develop a management plan for containing the risks. This management plan should also include a metrics for evaluating their current and desired risk readiness position and integrating it with their business continuity planning.

Overview: The research will elaborate the importance of risk management in perspectives of business continuity in the globalized market environment. It will cover the manufacturing business risks by classifying them as internal, external, and natural disasters. It will also identify and highlight the controllable operational factors in plant maintenance, product quality, input quality, plant capability, supply management, capacity flexibility, built in safety, and others that can be influenced for inhibiting internal and external risks and mitigating select disasters. To facilitate manufacturing businesses in applying this approach taking an "if-what" analysis the research will derive metrics relevant to risk readiness and create relationship of the metrics with identified operational factors and business performance. The approach will facilitate business operatives in investing resources in their manufacturing, quality, and supply and safety management for creating desired reediness taking trade-of options.

Major Points:

- Importance of risk management plan for business continuity
- Defining business risks as internal, external, and natural disasters
- Outlining business functional risks from occupational safety factors
- Defining business operational factors that can influence risk containment
- Deriving risk management metrics in terms of operational factors
- Formulating functional relationship between metrics and business performances
- Carrying out if-what analysis for facilitating business decision

Summary: This research presents a new risk management approach for manufacturing businesses. The approach considers controllable production, quality, safety, maintenance and supply management factors to influence containment of risks defined as internal, external and natural disasters.

Management

Perceptions and Rankings of Technology Management Competencies

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Need: Without a recognized and accepted body of knowledge for technology management, the discipline of industrial technology, engineering technology, and applied engineering will continue to be confused with other technical disciplines. Clarity regarding the required competencies for an entry-level technology manager is imperative. The critical competencies and body of knowledge should be congruent with ATMAE accreditation standards and the Certified Technology Manager exam. In order for technology management programs to be relevant, their competencies should be recognized and agreed-upon.

Overview: The ATMAE Management Division developed a conceptual model of technology management competencies that has been in review for two years. Using survey research, the perceptions and rankings of the proposed competencies were reviewed by ATMAE membership. This presentation identifies the most critical TM competencies as identified and a revised conceptual model based on research findings. The interpreted results will be used to make recommendations to ATMAE Management Division to compile a TM Book of Knowledge (BoK) and supporting resource material for its membership, and to support the Certified Technology Manager exam.

Major Points:

- Background for the study
- Methodology
- Findings
- Summary and interpretation
- Next steps

Summary: This is a presentation of research on the perceptions of ATMAE membership with regard to technology management competencies, their importance, and relevance to a technology management core.

Manufacturing:

Effective Ways to Manage and Administer the 5th S, Sustain

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Need: 5S sustain is the fifth and final stage of 5S, a lean manufacturing tool for ensuring standardized, efficient operations as well as excellent housekeeping. By implementing 5S within your organization, you work to eliminate the causes of non-value added activities, especially the eight types of waste. This final stage of 5S is most likely the hardest to achieve of all the stages; many organizations failing to achieve it.

Overview: This last stage of 5S is the discipline and commitment of all other stages. Without sustaining, your workplace can easily go back to being unclean and chaotic. That is why it is so crucial for people to be empowered to improve and maintain their workplace. When employees take pride in their work and workplace it can lead to greater job satisfaction and higher productivity.

Major points:

- Strengthen employees' pride in their work and promote stronger communication among staff.
- An audit checklist should be put together for all areas or for each individual area with detailed checks to be made.
- Ensure that the management of the organization follows the principles of 5S in their own areas.
- 5S Audits help sustain 5S efforts are effective if there is actual attention given to them and follow through to correct issues and to celebrate success.
- Foster continues improvement training for your employees on their 5S efforts, through the use of kaizen.

Summary: The most important element of 5S is developing and encouraging total employee involvement. 5S is not a program for a portion of the workforce, everyone needs to embrace 5S. This requires continued training and communication. 5S must become a way of life in the business. There are a number of ways that can be done to make 5S part of the culture of your organization, the first and most important one is to lead by example.

Management

Protecting Innovation

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Need: Intellectual Property (IP) management is a key component of technology management, especially in the area of applied engineering. New and improved machines, parts, tools, and even processes can all be protected with IP. A well-formed IP portfolio can serve not only as a sword to prevent others from stealing your ideas, but also as a shield to discourage them from suing you. Proper technology management can strengthen connections with a company, department, or organization by ensuring that it has channels in place for encouraging and capturing innovation. In addition, major changes to the U.S. patent laws under the recently enacted America Invents Act may require the reevaluation of current IP strategies.

Overview: This presentation will provide an overview of various techniques and strategies for developing and protecting innovation through technology management. In particular, the presentation will provide information on best practices for companies, departments, and organizations who want to encourage, capture, and protect innovation through IP law. The presentation will also cover the current state of U.S. patent law following the recently enacted America Invents Act and what changes can be expected under the new laws.

Major Points:

- IP strategy is a key component of technology management.
- Many types of innovations can be protected through IP.
- Management plays a critical role in implementing and maintaining an IP program.
- A comprehensive IP program can ensure that proper channels are in place to encourage, capture, and protect innovation.
- The recently enacted America Invents Act may require the reevaluation of IP strategy.

Summary: Attendees will understand the importance of protecting innovation through IP law and will come away with tips and techniques to help do so. In particular, the presentation will provide examples of types of innovations that can be protected with IP as well as detailed information on developing programs to encourage and capture innovation and expected changes to the laws under the recently enacted America Invent Act.

Management

Using Modularity and Cross-Enterprise Technology in Large Organizations to Achieve Cost Savings and Improved Performance through Innovative System Integration

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Need: A shift in resource availability and slowing economic growth projections are forcing large companies and organizations to reevaluate processes for advanced technology implementation. Entities with many diverse geographically separated and isolated business groups increasingly realize the untapped potential for cross-sector utilization of technology expertise, systems and processes. Declining budgets demand innovative performance initiatives that connect existing assets and expertise across the organization to achieve higher levels of productivity and interoperability at lower cost.

Overview: Productivity and interoperability are key characteristics required for technology integration in very large organizations such as the Department of Defense and government agencies. Large enterprise processes for innovation are among the most challenged due to legal, regulatory and political constraints. Despite initiatives and senior leader edicts demanding innovation, the ability to coordinate diverse sub-organization use of existing technologies and expertise in large entities suffers from the reality of "zero-sum" competition. Contractual legal obligations and powerful interests compound barriers to innovation. Ironically, these same large organizations maintain vast resources of technology, expertise and systems that hold the most potential for innovative efficiencies that promise exponential return on investment. A case study for system integration of "plug and play" communication capabilities on the B-2 Stealth Bomber presents innovative management principles relevant to efficient use of technology in large organizations.

Major Points:

- Identifying resources within large organizations – "be interested, get connected"
- Accepting limited objective integration of existing systems – "one thing is good enough"
- Leveraging modularity, standards and interchangeability – "plug and play"
- Skipping the middle men – "getting to the boss"
- Generating excitement through progress - "make them believe"
- Reaping unanticipated benefits – "the epiphanies"
- Paradox of innovation – "inefficiency for efficiency's sake"

Summary: A case study is presented demonstrating innovation within the Department of Defense through integration of a "plug and play" communications system on the B-2 Stealth Bomber. Management principles for achieving innovation within large organizations are explored through context of this case study and relevant technology management literature.

Management

Modeling Supply Chain Dynamics Using Intelligent Objects

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Need: The use of object-oriented modeling is common in supply chain simulation. There are many object-oriented modeling tools available in the market today. These tools come with standard libraries from which the modelers can select objects to describe the entities in the supply chains and their relationships. A well-known limitation with these tools is that the objects are difficult to modify and require the modelers to have deep knowledge of object-oriented programming languages. Thus, there is a need for a modeling tool that supply chain managers can use to create complex objects and models quickly without requiring programming.

Overview: In this presentation, we present the use of intelligent objects for modeling dynamic behaviors of today's complex supply chains. A prototype supply chain model is developed to demonstrate the use of intelligent objects. Simio, a graphical object-oriented, multi-paradigm platform is used for the modeling of the prototype supply chain. The Simio platform is based on intelligent objects. Using this platform, first we build basic objects to represent various entities of the prototype supply chain such as producers, warehouses, retailers, customers, etc. Next, using the process modeling features in Simio, we add intelligence to the basic objects and create new objects with complex behavior. Finally, we build the model by combining the intelligent objects. The strength and limitations of this approach are also discussed.

Major Points:

- Discussion on object oriented and process oriented modeling paradigms.
- Overview of Simio – a simulation modeling framework based on intelligent objects.
- Modeling of a prototype supply chain.
- 3D visualization of the simulated model.
- Presentation and analysis of simulation results.

Summary: The focus of this presentation is on demonstrating the application of intelligent objects based modeling to supply chain simulation using a practical case study. The presentation will be of interest to engineering management professionals.

Management

The ATMAE Lean Six Sigma Certification Exam: Who, What, When, and Why

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Need: Although there are a multitude of lean and six sigma-related exams on the market, none are inexpensive enough for most students attending college nor cost effective for program assessment. In addition, none of these exams provide a detailed breakdown of how well an examinee performed on the exam.

Overview: This presentation will focus on how a new ATMAE online exam can effectively measure an examinee's knowledge of lean and six sigma concepts so employers can have confidence that they are hiring applicants who are competent in this area. In addition, this presentation will review the content that is covered on the exam.

Major Points:

- Brief overview of the need for lean and six sigma competent employees
- Overview of the need and assessment implications of this exam
- Outline of the content addressed by this exam
- A timeline for the inception of this exam
- Review of the format, delivery method, and data analysis provided with this exam

Summary: As lean and six sigma quality become heavily integrated into most organizations such as manufacturing, health care, and office management, an inexpensive assessment measure becomes increasingly more important for educators to track their effectiveness in preparing their graduates for employment. This presentation focuses on how the ATMAE lean six sigma exam is being developed and when it will be available for use.

Management

Measurement of Quality-Based Risks In The Bulk Material Supply Chain

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Need: The bulk materials supply chain presents several challenges in terms of quality management. The identification, quantification, and evaluation of quality-based risks in bulk material supply chains have been shown to be especially problematic because of the high volume and large-scale aggregation of products from multiple sources. Limited research has examined the options for measuring quality-based risks in this context. Increasing legislative compliance requirements and a lower risk tolerance from stakeholders has highlighted the need for the development of a robust approach for measuring quality-based risk in the bulk material supply chain. Such a process would also have application for quality management systems in conventional supply chains.

Overview: This presentation will discuss the challenges of identifying, calculating, and assessing risks to quality goals within the bulk material supply chain. Factors considered in the development of a process map to graphically depict quality-based risks will be shared. Identification criteria, measurement metrics, and evaluation standards will be discussed from a quality perspective. Implications for the bulk material supply chain will also be shared.

Major Points:

- Quality management challenges unique to the bulk materials supply chain
- Factors considered in the development of identification criteria and measurement metrics to identify and quantify quality-based risk in the bulk materials supply chain
- Development of a process map to graphically depict risks and their impact on the supply chain
- Implications for quality managers and supply chain professionals

Summary: The audience will learn about the process used to identify, quantify, and evaluation quality risks in the bulk material supply chain. Use of the process map will be discussed from a quality management perspective. Implications for industrial practice will be shared.

Management

Sustainability in the Airport Setting: Analysis of the Sustainability Challenges and the Resulting Practices in Efforts of Creating a Sustainable Environment

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Need: Aviation related activities at airports have grown exponentially over the past few decades, demonstrating a strong growth rate. Incidentally, activities at these airports to sustain the economic wellbeing of the society could result in the degradation of the natural environment. In turn the environmental impacts may play a part in the constraint on air transportation growth in the nation affecting both the economy and the society. For this reason the issue of sustainability in aviation has increased in importance, influencing regional thinking and policy making at commercial service airports.

Overview: True sustainability encourages responsible use of resources, ensures profitability for the business enterprise while being mindful of the ecological footprint to the local environment. This ensures the business has a future and continues to contribute to the financial welfare of stakeholders, the employees, and the community as a whole.

Major points:

- Analysis of what sustainability entails
- Sustainability in the airport setting
- Identification of the main sustainability challenges facing airports
- Policies and programs governing sustainability issues at airports

Summary: Attendees will understand that it is possible to contribute to the sustainable development of immediate communities and society while reducing detrimental environmental challenges for the sake of future generations. They will also understand that sustainability is achievable without stifling human development.

Management:

Airport Management: An Overview of Airport Finance and Budgeting

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Need: Airport management centers around one of the most exciting technologies of the twentieth century, aviation. From a business perspective, local airports provide the marketplace where sellers (airlines, fixed base operators, flight instructors) meet their customers (the travelling public, aircraft owners, etc). However few resources exist and the responsibility to finance, develop, protect, maintain and safely operate the airport asset becomes a great burden to those who manage them.

Overview: In some cases airport capital development financing has been disciplined by the interplay of airports and airlines among other procedures employed in airport financial management. Airport management involves the application of strategic concepts in order to budget and finance the everyday operation of these establishments as well as complying with many mandates imposed on their operations by the Federal government, while keeping their customers happy.

Major points:

- The complexities involved in managing airport business connections
- Airport ownership and management
- Exploring legitimate questions as they relate to airports
- Airport Finance and Budgeting, and Federal mandates
- Airport management strategies for the future

Summary: Attendees will understand the complex relationships that exist between airports, local businesses, the communities they serve as well as the part they play in financing this great enterprise. They will gain some insight of the airport as a business, a place where public infrastructure and private investment intersect, yet is understood by very few. They will leave with a new appreciation of the men and women who run this great enterprise.

Management:

Six Sigma Roadmap to Enhance Business Productivity: DMAIC versus DMADV

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Need: Six Sigma is an important strategy for any business field to improve the quality of the output. Productivity measures provide a means to managers to ascertain, plan control and improve efficiency at different levels of organization. This helps managers set improvement targets and goals for organization's long term strategic plans and in developing appropriate competitive approach. The central idea behind Six Sigma is that if you can measure how many 'defects' you have in a process, you can systematically figure out how to eliminate them and get as close to 'zero defects' as possible.

Overview: Today, Six Sigma is used as an all-encompassing business performance methodology, all over the world, in organizations as diverse as local government departments, hospitals, the armed forces, banks, and multi-nationals corporations. Six Sigma is certainly a very big industry in its own right, and Six Sigma is now an enormous 'brand' in the world of corporate development. Productivity is used to assess the extent to which certain outputs can be extracted from a given input. That is to ensure higher quality under low cost.

Major Points:

- Develop skills and understanding of DMAIC {Define, Measure, Analyze, Improve and Control}, towards implementing the six sigma concepts.
- To develop an understanding of the Principles and concepts of six-sigma to increase organizational efficiency by improving quality, reducing waste, and defects.
- Develop skills and understanding of DMADV {Define, Measure, Analyze, Design and Verify}, towards implementing the six sigma concepts.
- Review basic statistical tools (SPC) and techniques and understand the foundation for Six Sigma.
- Understand and manage Six Sigma statistics through practical and application examples.

Summary: No organization can continue to work for long without using some efficiency measures, and their performance is influenced by the nature of output measures used. The author of this paper is seeking to make clear the similarities and differences between these two methodologies to improve a company's operational performance by identifying and eliminating 'defects' in manufacturing and service-related processes.

Management

Integrated Quantitative Decision Making Tools for Managers

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Need: Today's project managers are constantly faced with technical, financial, and environmental decision situations with uncertainty. Often, these situations are too risky, non-trivial, and complex to be dealt with by only intuition and experience of the managers. These managerial decisions should be based on quantitative, comprehensive, and yet communicable information. To produce such useful information, systematic and analytical methods have been applied in the industry in a non-mathematically modeled decision format.

Overview: In this presentation, various risk and decision situations are described and categorized and quantitative yet easy-to-use analytical decision tools are presented and used for the solution process. Specifically, spreadsheet computer software serves as a main solution platform to support the practical and intuitive analytical decision modeling and analysis process. This hands-on software platform plays a critical role in making decision analysis affordable through various embedded decision features and add-in tools. In this intuitive modeling environment, various industry-based decision situations are modeled and analyzed through multiple decision analysis plug-in tools.

Major Points:

- Various decision quantitative decision situations and tools
  - Intelligence-Based Decision
  - Structured Decision
  - Uncertainty-Based Decision
  - Statistical Decision
  - Optimum Decision
- How these are integrated to make optimum decisions

Summary: Attendees will understand what quantitative spreadsheet-based analytical modeling techniques are, how they are applied, and how they can be integrated to analyze and solve complex decision problems and risk situations faced by project managers.

Management

Critical References and Texts in Technology Management

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Need: Without a recognized and accepted body of knowledge for technology management, the discipline of industrial technology, engineering technology, and applied engineering will continue to be confused with other technical disciplines. Clarity regarding the body of literature in technology management is imperative. The critical references, texts, and their associated competencies should be congruent with ATMAE accreditation standards and the Certified Technology Manager exam. In order for technology management programs to survive and thrive, the critical literature should be recognized.

Overview: This presentation identifies the most critical scholarly journal articles in the field of Technology Management (TM) using mathematical techniques similar to the ones Google uses to identify top-ranking search results. By extracting the citation relationships between articles in three major technology management journals, and characterizing them using graph theory, the relationship between interconnections were uncovered using four algorithms: in- degrees, Google PageRank, Kleinberg's hub scores, and Kleinberg's authority scores. These results identify the most critical references and areas of inquiry within recent TM research.

In addition, a survey was conducted with the professional membership of the Association for Technology Management and Applied Engineering (ATMAE) concerning their use of textbooks and seminal literature in technology management education. The results of this survey will be presented.

The interpreted results will be used to make recommendations to ATMAE Management Division to compile a TM Book of Knowledge (BoK) and supporting resource material for its membership, and to support the Certified Technology Manager exam.

Major Points:

- Need for the study
- Methodology of the research
- Findings
- Summary and interpretation
- Next steps

Summary: This is a presentation of research on the identification of technology management critical scholarly literature using mathematical techniques and the qualitative perceptions of ATMAE professional members.

Management

Bachelor of Science in Technology Management: Preparation of the Online BSTM Program for ATMAE Accreditation

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Need: As the demand for online courses/ degrees in technology programs is increasing, the need for ensuring quality becomes essential. The online Technology Management degree was designed to meet the expanding need for challenging jobs in technology and technology management. The Bachelor of Science in Technology Management (BSTM) program specifically targets Community and Technical College associate degree graduates from technology/engineering-related disciplines.

Overview: As the state and federal funding for higher education institutions decline, colleges depend upon student's enrollment to support their programs. Technology and engineering related programs move toward expanding access to higher education for non-traditional/employed students through offering online/ hybrid courses. With a significant number of online technical programs, maintaining and ensuring the programs quality has become an issue of major concern. Adhering to the ATMAE accreditation standards will increase the quality of technology programs and enhance their visibility. The BSTM goal is to strengthen the program quality using contemporary educational technology and Quality Matters certified instructors. The faculty plan to prepare the program for ATMAE accreditation based on Outcome Assessment method in 2014.

Major Points:

- Enhance the delivery of online programs
- Maintain quality of online programs (Quality Matters)
- Assessment of online courses
- Prepare online programs for ATMAE accreditation
- Future challenges and directions
- ATMAE accreditation of online programs

Summary: This presentation focuses on preparing an online technology management program for ATMAE accreditation. The issues concerning the assessment of online courses will be discussed. The opportunity for ATMAE to accredit the online programs will be discussed

Manufacturing

Manufacturing

Value Steam Mapping: Recreating an Industrial Environment in an Educational Setting

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Need: Recreating industrial environment in the classroom helps students by building skills using the equipment they will find in the workplace. Students can learn to do tasks they will perform and solve problems they might face on the job. In manufacturing, lean manufacturing (LM) technique has been used for improving the overall organizations' performance. Value stream analysis is one tool that can be used for implementing the lean manufacturing techniques. Manufacturing students need to be prepared for applying lean manufacturing concepts in real life cases. Therefore, applying value stream analysis related to product development in educational setting is essential.

Overview: This research aims to apply the technique of value stream mapping in the simulated industrial manufacturing company class (SIMCO) at Indiana State University. In SIMCO, mass production technique is currently used to manufacture products such as diploma frames, clocks, coffee tables, etc. Therefore, there is a need to use lean manufacturing technique in this class to minimize the waste and maximize the flow. Value stream mapping can identify continued opportunities to enhance value, eliminate waste, and improving flow. Four steps will be followed in order to fulfill the value stream mapping: identifying the product, creating a current state value stream map, creating a future state value stream map, and creating an action plan. PQPR (Product Quantity / Product Routing) matrix will be used to identifying which product to focus on. Takt time, production lead time (PLT), and process cycle efficiency (PCE) analyses will be used to evaluate and create the current state value stream map. A cycle time and takt time graphs will be used to develop future state value.

Major Points:

- Applying the value stream analysis related to product development in educational environment is essential.
- Value stream analysis is one tool that can be used for implementing the lean manufacturing techniques.
- PQPR (Product Quantity / Product Routing) matrix helps in identifying which product to focus on.
- Takt time, production lead time (PLT), and process cycle efficiency (PCE) are important parameters for assessing and creating the current state value stream.

Graphical assessments using cycle time and takt time are useful for developing future state value.

Summary: Attendees will be exposed to an example of manufacturing study conducted in educational environment that might be used as a benchmark approach in similar manufacturing classes.

Manufacturing

Sustainable Supply Chain Management: Literature Review, Trends, and Framework

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Need: Sustainable Supply Chain Management (SSCM) is an important strategy that supports organizations in improving their overall performance. The literature review showed that the effects of SSCM strategies are still unclear and may cause positive or negative economic performance. Therefore, a comprehensive definition for the SSCM is needed. Also, exploring the advantages and barriers for SSCM is helpful to clarify some of the ambiguity in this field. Moreover, a review for the trends of SSCM activities is significant. Finally, the ambiguity of this field creates difficulty in implementing SSCM in the industrial environment. Hence, a framework has been introduced to help managers develop effective Sustainable Supply Chain Management.

Overview: This research aims to create a framework that will help managers develop successful Sustainable Supply Chain Management. This framework has been developed by reviewing more than 50 previous studies. A comprehensive definition has been provided. Also, the advantages and barriers of implementing SSCM have been discussed. In addition, an overview for each activity in SSCM has been provided. These activities are sustainable design and packaging, sustainable production sustainable marketing, sustainable transportation, and sustainable purchasing. The importance of technology for the SSCM has been shown. Moreover, the subsequence and the trends of Sustainable Supply Chain activities over the past twenty years have been discussed.

Major Points:

- Investigating the effects and the trends of the Sustainable Supply Chain activities is important for organizations.
- Developing a comprehensive definition for SSCM will clarify some of the ambiguity in the SSCM field.
- Implementing SSCM is not an easy process; different activities should be done by the organizations to develop effective strategies for SSCM.
- The proposed framework simplifies the process of implementing and developing Sustainable Supply Chain in the industrial organizations.

Summary: Attendees will understand the trends of the Sustainable Supply Chain over the past twenty years. The proposed framework can be used in developing and implementing Sustainable Supply Chain Management in any industrial organization.

Manufacturing

An Analysis of the Skills Gap in the Workplace for Students Graduating From Manufacturing/ Technology Management Programs

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Need: Numerous recent studies have addressed the issue of the skills gap between academics and the U.S. manufacturing industry. There is an increasing need to tackle the issue from a broader perspective in an efficient and effective way. Therefore, we will approach the topic from the total quality management (TQM) point-of-view in a systemic way, which includes curriculum, students, teachers, and organizations. In aid of collaborative research, relevant competencies of manufacturing/technology management programs are also revealed in a comprehensive method from previous studies.

Overview: There is a vast range of courses for a Bachelor of Science degree in manufacturing/technology management programs in different ATMAE accredited programs, which causes variation for students' competencies after their graduation. There is a need for identifying essential competencies for students in these industrial technology programs. Thus, academic institutions should develop their curriculum based on common and relevant competencies that meet the contemporary needs of the industry. A review of current literature shows that graduate students lack the necessary skills for the market, and the skills gap is widening in the American workforce. This presentation addresses the issue of the skills gap from two perspectives: educational and organizational. A systemic approach introduced by the total quality management will be taken into consideration for tackling the issue.

Major Points:

- Identify the skills gap for students of manufacturing/technology management programs.
- Introduce an efficient and effective system such as TQM to address the issue of skills gap.
- List essential competencies for manufacturing/technology management programs.
- Identify the importance of education and industry partnership for students and faculty.
- Specify the need for more effective roles in employment and training within organizations.
- Provide a holistic model for the skills gap in manufacturing/technology management programs.

Summary: Attendees will be provided with a systemic approach introduced by TQM for tackling the issue of skills gap in the workplace. This is, especially, applicable for current graduate students from manufacturing/technology management programs. The systemic approach presented may also be applied to other industrial technology programs.

Manufacturing

Holistic Student Professional Development in a Lean Manufacturing Course

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Need: Competency expectations have increased significantly across all sectors of the economy, and the impetus to prepare students for these workplace expectations has never been greater. The manufacturing workforce has become more skilled, and educators need to ensure that we continue to provide workers with the right skills to keep pace with the increasing demands of the productivity-oriented manufacturing sector. The human capital challenge created by the paradigm of lean manufacturing requires a workforce with increased numeracy, team building, and problem solving abilities (Manufacturing Institute, 2009).

Overview: This presentation will focus on a holistic student development approach through competency-based assessment and backwards design. An undergraduate lean manufacturing course was utilized as the backdrop in this pursuit. The 360-feedback process was introduced as the foundation for competency-based assessments. The "holistic" student professional development will be expounded through course competency selection and assessment.

Major Points:

- Competency-based course design
- Exploration of "holistic" student professional
- Competency-based assessments and the 360-degree feedback process
- Results of competency-based assessments
- Implications for workforce professional preparation and future research

Summary: The audience will understand the need for a "holistic" student professional development approach using competency-assessment and backwards design. Specifically, the course design and approach can help provide U.S. manufacturers with the employees they need in order to implement and sustain a lean manufacturing structure vital for competitiveness.

Manufacturing

Ceramic-Metal Composites: Potential for Industry Applications

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Need: Materials are one of the major factors to take into account when designing or building anything. As it has always been a push though out time to improve existing products or roll out ones with more advanced features, there is an ongoing demand for new material development, and often time of man-made, composite materials than those naturally exist. Nevertheless, it takes a specific effort to bring new composites materials from lab specimen to commercial usage. Only when a clear roadmap is laid in terms of product design and manufacturing strategies, along with significant cost-benefit figures, will these composites be adopted by industry and eventually drastically change the products designed with them.

Overview: Ceramic-metal composite, or cermet, is a composite material that has key properties of both ceramic and metal. While designed to provide desired hardness under high temperature but still able to deform plastically when necessary, cermet has not been used as broadly as other composites. In this presentation, we will examine how the attributes of cermet influence the decision-making processes in product lifecycle activities, from the perspectives of materials selection, design analysis, and manufacturability. We will also discuss the potential applications of cermet and its benefits and limitations over known materials currently used in industry.

Major points:

- Overview of what composite materials are and their material characters
- How cermet differs from the other composites and its potential applications
- Pros and cons of cermet in terms of material selection
- How the use of cermet change product design and manufacturing
- Overall benefit to industry

Summary: Modern industry is putting huge effort on new material research and development. Ceramic-metal composites can be part of this move to replace materials currently used. With better understanding of how to design and fabricate products designed with these composites, these materials can be one of the new building blocks for our future.

Manufacturing

Application of CAM Software and Machining Simulation (Virtual Reality) in Manufacturing Technology Courses - Cost Effective and Real-Life Experience

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Need: The application of CAM and machining simulation as a technique for improving production systems is a vital part within the manufacturing industry. The use of virtual reality is not only limited to simulating production systems, but is also applied to product and process design, rapid prototype development, quality improvement, and cost analysis. This paper demonstrates how the manufacturing technology course was customized to incorporate recent trends in virtual reality applications in the industry.

Overview: The manufacturing industry implemented virtual reality as one of the tools for improving production systems, in order to produce higher quality products at a reasonable cost and within a reasonable time. This practice was extended after the industry recognized that the capability of virtual reality is much greater than was previously thought. The aerospace, automotive and shipbuilding industries have begun using virtual reality in robotics, ergonomics, facility and process design, and product lifecycle management (PLM). This paper shows how these aspects of virtual reality have been successfully implemented into a production technology course.

Major Points:

- Development of CAM and machining simulation
- Different applications of virtual reality: Robotics, Ergonomics, Process and Facility Design, and PLM
- Recent trends in the manufacturing industry: Aerospace and automotive
- Modification of curriculum activities: Cost effective and real-life experience
- Work accomplished
- Feedback from the students and industry

Summary: The demand for technologists who are knowledgeable in and capable of using virtual reality as a whole is growing rapidly. Our responsibility is to prepare our students with hands-on experience in advanced technology, coinciding with what the industry wants. Both the industry and the students have established their eagerness to improve the manufacturing technology courses and manufacturing processes, and expressed their sense of fulfillment once this is done.

Manufacturing

Inception of Product Lifecycle Management and Digital Manufacturing System in Industrial Technology Program

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Need: Product Lifecycle Management (PLM) and Digital Manufacturing System (DMS) are relatively new manufacturing methods. They allow industries to design, construct and run a virtual manufacturing facility. The main idea of PLM and DMS is to simulate and validate the entire manufacturing process, from design to production. DMS requires the implementation and collaboration of CAD, CAM, CAE, CIM, CMM, robotics and virtual simulation packages. It will become an essential tool, in that technologists increasingly need to gain knowledge of these tools and applications.

Overview: Producing high-quality products at lower cost and retain consumers' confidence are major goals of the manufacturing industry. PLM and DMS allow them to achieve this goal with reasonable time and effort as long as they have appropriate tools and qualified personnel. Technology students need to understand how and where to use these tools. This presentation shows the basic concepts of PLM, DMS, along with how it was integrated into a industrial technology program.

Major Points:

- Product Lifecycle Management (PLM) and Digital Manufacturing System (DMS): An overview
- Variation and selection of DMS
- Modification of curriculum content and activities
- Impact on the budget
- Students' and industries' reaction

Summary: PLM enables industries to collaborate on new-product conceptualization, design, design for manufacturability, resource allocation, as well as customer service and support. The integration of PLM and DMS into an industrial technology program greatly enhances students' ability to acclimatize to the newer manufacturing environment, and provides industries with highly qualified manufacturing technologists.

Manufacturing

3D Parametric Design, Assembly and Ergonomics Simulation in Production Technology Course: Meeting the Industry Needs

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Need: The application of advanced technology is not only limited to verifying and simulating the manufacturing system, but is also applied to product and process design, pilot model development, quality assurance, cost analysis, and ergonomics. This paper demonstrates how the production technology courses were modified to incorporate recent trends in 3D parametric design (solid modeling), assembly and ergonomics simulation applications in the industry.

Overview: The manufacturing industry implemented 3D parametric design and assembly simulation as one of the vital tools for improving the production system, in order to produce higher quality products at a reasonable cost and within a reasonable time. This practice was extended after the industry recognized that the capability of the advanced technology is much greater than was previously thought. This paper shows how these aspects of visualization and simulation tools have been successfully implemented into manufacturing technology courses.

Major Points:

- Different aspects of 3D parametric design and assembly simulation
- Ergonomics Simulation
- Recent trend in the aerospace and automotive industry
- Modification of curriculum and lab activities: Hands-on and real life projects
- Work accomplished
- Feedback from the industry

Summary: The demand for technologists who are knowledgeable in and capable of using 3D parametric modeling and assembly simulation as a whole is growing rapidly. Our responsibility is to prepare our students with hands-on experience in advanced technology, coinciding with what the industry wants.

Manufacturing

Being the Next Steve Jobs Without Offshoring – MTEC SmartZone

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Need: In the January 2012 State of the Union Address, President Obama attacked offshoring, urging businesses to bring jobs back to the US referencing technology, business start-ups and innovation as the key. He urged Congress to back policies that help "every risk-taker and entrepreneur who aspires to become the next Steve Jobs." Steve Jobs as an innovator, yes, but Apple Computer's manufacturing is done overseas. From what has been revealed of Obama's 2013 fiscal budget plan, changes to the tax code will discourage American companies from searching for cheaper costs offshore and encourage reshoring, as well as supporting education and research that fosters the manufacturing sector. This all seems to make good sense, but the argument is that it disallows American companies to be globally competitive and closer to their customers. MTEC SmartZone offers solutions for technology companies outsourcing engineering work, while supporting technology start-ups.

Overview: MTEC SmartZone is a business incubator mission by the Michigan Economic Develop Corporation to create jobs in the technology sector. As part of the job creation strategy in a rural community, MTEC SmartZone helped Fortune 100 companies, Ford and GE Aviation; create satellite offices near Michigan Technological University. Both companies utilize student talent to provide a low cost alternative to outsourcing engineering work overseas. Why train graduate engineers in other countries when we can train American engineering students and retain that knowledge in the States? This concept has been wildly successful. Companies have found a reliable labor force that work in the same time zone and without language barriers. The students earn money while going to school in the areas they are studying (and become better students for it) and the community retains student jobs here rather than co-op opportunities found in other towns.

Major Points:

- In eight years MTEC SmartZone created 19 technology start-up companies.
- Three start-up companies have moved to stage II (over $1million in sales with over 10 employees)
- Created over 250 technology jobs in a community of 12,000 people (Houghton and Hancock)
- Recruited two Fortune 100 Companies to open offices with four sites in the community
- Opened a support center for entrepreneurs with business ideas in May of 2011. Within five months the center assisted 42 local entrepreneurs, students and professors of which 18 LLC's were created, and 8 are technology companies.

Summary: Managing production across extended supply chains due to costs incurred from supplier reliability and/or transportation has increased interest in reshoring. Also, there is an increased concern to retain intellectual property in certain manufactured products that may be proprietary due to military and/or national security issues or to protect innovations. Attendees at this session will understand how an engineering and technology focused research university encourages innovation and fosters student engineering talent. Relationships like those fostered by MTEC SmartZone encourage cooperation between companies like GE Aviation and Ford Motor Company to leverage university student talent.

Management

Evaluation of Capital Investments in the Global Markets Using the Adjusted-Net-Present-Value Capital Asset Pricing Model

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Need: Most engineering and engineering technology programs teach courses in engineering economics and technology ventures. In many of these courses, student are exposed to several capital asset pricing models (CAPM), which may include payback period, discounted-payback period, return on investment (ROI), and net present value (NPV). While these models are very useful in evaluating capital projects, they seem to be limited in evaluating projects with inherent uncertainties such as projects with unproven technologies, projects located in political unstable regions, or projects located in regions where skilled labor are in short supply. Traditionally, capital projects with uncertainties have been evaluated using tools such as sensitivity analysis, break-even analysis, and scenario analysis. These tools mainly examine the variability in projected cash flows of projects with uncertainties. On the other hand, with adjusted net present value (ANPV), each cash flow stream in such projects is assigned an expected rate-of-return that is commensurate with the risks of the cash flow. This allows for the decoupling of individual cash flows (e.g., capital outlays, revenue, taxes) and their subsequent proper evaluations rather than use a weighted rate-of-return or a break-even analysis or sensitivity analysis to evaluate the project. In this study, ANPV was used to evaluate the economic viability of a phosphate mine in South America and the results were compared with those of the traditional net present value (NPV).

Overview: Manufacturing and industrial technical activities are becoming relatively more global in recent times because of the need for manufacturers to be closer to the sources of raw materials or to obtain manufacturing raw materials that are located in foreign countries. In fact, many universities such as Harvard University and Massachusetts Institute of Technology are now requiring their incoming freshmen to take and pass a foreign language course before graduation because of the globalization of economic activities. Given this scenario, it seems appropriate to introduce students in a manufacturing engineering technology program to the tools they need to evaluate manufacturing projects with uncertainties. The uncertainties may be caused by political instabilities, unproven technologies (such as deep sea oil drilling), or by shortage of skilled labor. In this study, adjusted new present value (ANPV) was used to evaluate the economic viability of a phosphate mine in South America. ANPV allowed for the decoupling of the cash flow streams of the project and their subsequent evaluations with appropriate rate-of-returns.

Major Points:

- Evaluation of projects with uncertainties.
- The decoupling of the cash flow streams to allow for independent evaluation of each cash flow stream rather than use a weighted rate-of-return for evaluation.
- Estimating appropriate rate-of-returns associated with different risk levels.

Summary: This presentation will show how ANPV can be used to evaluate projects with uncertainties, particularly, those projects located in politically unstable countries or in regions with shortage of skilled labor or projects with unproven technologies.

Manufacturing

Strengthening Our Connections – Academia and Industry Working Together

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Need: The American unemployment rate remains above an acceptable level and a need to create more on-shore American jobs remains. With globalization of the labor market, especially the unskilled labor market, many manufacturing jobs moved offshore to havens of cheaper labor. The current administration in Washington, D.C. has made on-shoring of jobs a priority. How can American manufacturing do its part to help accomplish such a task? There is no silver bullet to solve this problem of a shortage of good manufacturing jobs in America. This presentation will highlight several innovative approaches to this very real problem of bringing more jobs back to American shores.

Overview: "Strengthening our Connections" means America must change the way we think about education and industry relationships. Concepts such as active learning, where students take ownership in the design and implementation of their own learning, must be encouraged. More focused manufacturing learning may involve newer concepts such as early childhood education intervention for the sake of manufacturing. Nurture STEM schools where students who have a propensity for the STEM disciplines are encouraged to pursue career paths in these disciplines early in the education process. New manufacturing programs such as Nanomanufacturing and Manufacturing Execution Systems (MES) can be taught along with more mature manufacturing concepts such as Six Sigma, Lean Manufacturing, and Enterprise Resource Planning (ERP). A comprehensive approach to this very complex problem of American job creation will most likely yield the best results.

Major Points:

- Need improved industry/education relationship for collaborative innovative projects.
- Show how collaborations aid in solutions to higher manufacturing/education efficiencies.
- Innovative solutions that promote job creation on American shores.

Summary: Today's competitive global manufacturing environments demand ever increasing workforce education to increase manufacturing efficiencies. Education/industry collaborative innovation efforts are one sure way to increase manufacturing productivity and bring more jobs back to America and keep the jobs that America has already in this country.

Manufacturing

Mass Customization Manufacturing: Does it Really Work?

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Need: Paul T. Kidd, renowned author in the agile manufacturing arena, defines agile manufacturing as the ability to thrive and prosper in an environment of constant and unpredictable change by bringing technology, knowledge, skills, resources and people around clearly identified market opportunities. With the globalization and advancements in information technology, the world has come much closer than ever before. Consumers are demanding customized products with exceptional quality and high performances at prices that they consider are a value for their money. Manufacturing companies are looking for winning strategies that would help them gain an edge over their competitors and are trying to achieve capabilities that would make them unique and difficult to copy.

Overview: With significantly short product life cycles, manufacturers can no longer compete if they produce goods in large volumes with less flexibility between different models and types of products. However, at the same time reduction in volumes could be a trade off to higher cost. Another issue associated with low volume customized products could be increased lead time. One of the key competencies to achieve agility in manufacturing is the ability to mass customize products. With mass customization a rise in cost of the product is expected but the focus is how to keep that cost minimal. This presentation is focused on mass customization manufacturing (MCM), its implementation strategies, and how MCM could become an agility enabler.

Major Points:

- Overview of Agile Manufacturing.
- Definition of mass customization manufacturing (MCM).
- Need for MCM and its benefits.
- Product design for mass customization (DFMC).
- Mass customized products and implementation strategy.
- How MCM relates to lean?
- The new buzzword "reconfigurability" (the word "reconfigurability" is not in dictionary).
- Conclusions.

Summary: The presentation is aimed at educating the audience on underlying principles of agile manufacturing, the concept of MCM, tradeoffs and challenges while MCM is implemented.

Manufacturing

An Agile Supply Chain: A Desirable Capability for Proactive Businesses

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Need: The Council of Logistics Management (CLM) defines supply chain management as "the systematic, strategic coordination of the traditional business functions and tactics across these businesses functions within a particular organization and across businesses within the supply chain for the purposes of improving the long-term performance of the individual organizations and the supply chain as a whole". Supply chain being one of the key domains of a manufacturing enterprise, its strategic management is imperative to the existence of most businesses. Presently global competition has enabled companies to consider changing their practices and capabilities to become effective world-class competitors. The parallel development of agile manufacturing along with supply chain management has led to the development of what is known as an agile supply chain.

Overview: Agility is all about quickly responding to changing market and customer demands. The concept of agility is built around the synthesis of a number of enterprises that each have some core skills or competencies which when brought to a joint venturing operation, could result in new products or services. One of the factors that could strengthen an agile company is its ability to analyze and manipulate its supply chain quickly. It is important that companies develop practical solution to develop agility in supply chain. The agility that arises can be used for competitive advantage, by being able to respond rapidly to changing market environment and emerging business needs.

Major Points:

- Overview of Agile Manufacturing
- Definition of an agile supply chain
- Key characteristics of an agile supply chain
- Proactive supply chain management
- "Reconfigurable" supply chain
- Conclusions

Summary: This presentation is aimed at mapping the key enablers of an agile supply chain.

Manufacturing

Digital Manufacturing and Simulation Curriculum Evolution

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Need: Digital manufacturing has become a common component of industrial technology curriculum. Applications include advanced 3D CAD modeling, manufacturing simulations, and product life-cycle data management of data. This presentation explains the evolutional revisions in our program to better prepare our graduates to understand and apply these technologies in manufacturing careers.

Overview: Our digital manufacturing courses in our manufacturing technology major has evolved significantly this past year due to partner company expectations, transition to semesters and new technologies. The new paradigm has teams of students working with local companies on manufacturing simulation projects over a ten week period. This is partially in response to companies requesting more substantial analysis and recommendations from their projects, which was not possible when projects were completed in 3-4 weeks. It is anticipated that future projects can achieve the level of capstone projects for our students.

Major Points:

- Demonstration of previous excellent projects with student teams in local companies, including Ford, General Dynamics and Honda, plus several automotive tier 1 suppliers.
- Explanation of company expectations and expressed reservations.
- Description of our new digital manufacturing and simulation curriculum utilized in our manufacturing technology major.
- Anticipated future revisions to further enhance this curriculum.

Summary: Attendees will learn from our experiences and company responses to our digital manufacturing and simulation projects. They will see examples of major company projects by student teams to apply these high level technologies over extended time periods, providing greater value for the companies and the students.

Manufacturing

Development of Data Acquisition and Analysis System to Improve the Efficiency of Monitoring the Surface Condition of Machined Part by Utilizing Data Mining Technique

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Need: Considering the many complex and complicated manufacturing operations, it requires higher levels of technology and expertise. Utilizing the conventional machining methods would increase the potential for an increase scrap of the work-pieces. There have been the rising needs of facilitating automated manufacturing machines to improve its productivity and accuracy by adopting novel innovations and changes in the industrial and engineering sectors. It demands to integrate reliable and adequate data collection, analysis and testing systems. This research focuses on how to facilitate continuous improvement, and to provide an advantage of data mining techniques into the automated manufacturing system.

Overview: The presentation provides the overview of the study conducted in the manufacturing laboratory at Central Michigan University. The research involves Computer Numerical Control (CNC) machining and Artificial Neural Networks (ANN) with a goal of developing a system that can determine the in-process surface condition and improve the efficiency of monitoring during the turning operations. In order to improve the accuracy of the data acquisition and analysis system, a novel signal process (wavelet signal process) technique was employed, which facilitates signal decomposition and provides its correlations to surface conditions of the work pieces. The detail statement of data acquisition, statistical analysis, data mining techniques and its outcome will be presented.

Major points:

- Novel data mining techniques
- Artificial Neural Networks
- Training Algorithms
- Sensor Technology
- Data acquisition and analysis system
- Wavelet Signal Decomposition

Summary: This study presents the development of data acquisition and analysis system to improve the efficiency of monitoring the surface condition of machined part by utilizing a data mining technique. Through the analysis of the machine signal data, multiple prediction models were developed to determine the surface roughness of the workpiece. The outcome of this study would lead to integrate an intelligent monitoring system into CNC machines. The full development of this system will promise to enhance the productivity of the machining process.

Manufacturing

Coordinate Measurement Technology - A Comparison of Scanning Versus Touch Trigger Probe Data Capture

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Need: Manufacturers in the United States utilize coordinate measurement machines (CMM's) to insure part compliance to specifications. It is well known that CMM's can precisely measure a variety of geometric shapes made from a multitude of engineering materials. In addition, CMM's can perform the measurements using a variety of methods (discrete point measurement, scanning, optical, etc.). Little is known about the results of various measurement methods on parts of low hardness and high friability such as three dimensionally printed parts made from ZCast®. Due to the increase of end-use rapid prototyped parts, accurate and economical measurement of these parts made from unconventional materials is becoming more important.

Overview: As rapid prototyping (RP) becomes more mainstream, the accuracy of the RP parts produced will also become more important. Due to the nature of many RP materials, conventional measurement techniques may not be viable. This study attempted to determine if there was a difference of measurement between 3D-printed rapid prototyped parts using different probes and part contact methodologies (scanning and touch trigger). Through the use of a coordinate measurement machine and ZCast® parts for measurement, it was determined statistically that there is a difference in cylindricity accuracy between scanning and touch trigger probe technology.

Major Points:

- Current rapid prototyping technologies and part materials
- Coordinate measuring machines and measurement methods
- Experimental design and data collection
- Statistical analysis of data collected
- Recommendations for the measurement of ZCast® parts using a CMM.

Summary: The importance of measurement accuracy is quite well known in the manufacturing world. However, variables that can affect this accuracy when measuring RP parts are not as apparent. Through this study, the method of measurement using a CMM is investigated which begins to fill in some of the voids related to the accurate measurement of RP parts.

Manufacturing

A Classroom Device for Teaching Statistical Process Control and Process Improvement Techniques

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Need: The presenter will discuss the development of a device that can be used to model a process in the classroom when teaching statistical process control (SPC) and fundamental process improvement techniques, as well as advanced techniques such as design of experiments (DOE). The importance of this project is that attendees will learn about a device that is easy to build and to operate, which can improve their ability to teach both SPC and quality improvement techniques. Attendees will also be able to share their own experiences and ideas.

Overview: It can be difficult to access and operate a realistic industrial process in a classroom environment. In order to be most effective for teaching SPC, a process should exhibit both within-group and between-group variation. A typical one-hour time block is a short amount of time to set up and stabilize a process, and then to produce enough output for a sufficient number of subgroups, so that students can observe between-group variation. Additional complicating factors are that the process should be inexpensive to run, its outcomes should be measurable quickly and unambiguously, and it must be safe. In order to teach root cause analysis and other process improvement techniques, such as DOE, the process outcomes should also be subject to a number of control factors and environmental variables. Finally an average student should be able to grasp the essential cause-effect relationships between variables and outcomes. This presentation is focused on the development of a device to be used in the classroom, as well as on suggestions for use, and the results of initial classroom trials.

Major Points:

- Development process for the device
- Tips for use in the classroom
- Initial tests of the device in the classroom
- Building your own unit

Summary: It is challenging to find process-modeling equipment that is ideally matched to the needs of instructors who are teaching SPC and process improvement techniques. This presentation highlights the development, construction, and use of a device that is meant to model realistic production while being optimized for use in the classroom.

Manufacturing

Implementing a "Sustainable Manufacturing and Product Design" Module in a Manufacturing Technology Curriculum

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Need: Since sustainability is an all-encompassing activity, a holistic approach is needed to introduce sustainability in industry as well as in academia. In areas like product design and manufacturing, it is essential to introduce sustainability with an emphasis on applying these concepts in actual design/manufacturing processes. However, adaptation of sustainable design and manufacturing practices are not easy, specifically since unified metrics are needed to measure sustainability. Review of the current state and approaches to incorporate ideas of eco-innovation, lean manufacturing, product lifecycle management (PLM) and product life cycle assessment (PLA) are needed for adaptability to manufacturing technology curriculums.

Overview: In an effort to encompass major factors that affect sustainability in specific sectors, many different frameworks and metrics have been proposed/developed (and are being developed) by researchers and authorities throughout the world. In this presentation, some of the metrics for adaptation in a manufacturing technology curriculum have been described.

Major Points:

- Sustainable manufacturing – current state of available frameworks and metrics
- Review of suitability of these metrics for design and manufacturing process
- Need for the standardization for comparison and evaluations
- Incorporating sustainability metrics in manufacturing curriculum

Summary: The presentation focuses on the issues and challenges in implementing a "Sustainable Manufacturing and Product Design" module in the manufacturing technology curriculum. This implementation was carried out as part of our campus-wide effort known as "Faculty Leadership in Sustainability Education".

Manufacturing

Emerging Technology – The Integration of Safeguarding Control Circuits into Manufacturing Environments

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Need: Over the past several years, a new major technological innovation – Safeguarding Control Circuits has evolved for automated manufacturing systems. This innovation has resulted in the development of a new manufacturing practice for integrating Safeguarding Control Circuits (and their related safeguarding devices) into manufacturing environments. Initially this technology was developed and introduced in Europe. However, recently the American Society of Testing & Materials (ASTM) has formed a new Subcommittee E34.75 specifically relating to the integration of Safeguarding Control Circuits in manufacturing environments. Consequently, ASTM E34.75 will soon become a technological standard in the U.S. and educational programs in manufacturing technology will need to integrate this technology into their curriculums to meet the needs of students preparing to enter the field of automated manufacturing.

Overview: This presentation will: a) provide an overview of Safeguarding Control Circuits, b) discuss the associated control circuit technologies, and c) define potential curriculum and equipment needs for preparing students to enter the field of manufacturing.

Major Points:

- The first component part of this presentation will involve an introduction to Safeguarding Control Circuits and their requirements in manufacturing environments
- The second component part of this presentation will discuss interlocking safety systems and safeguarding control device reliability
- The third component part of this presentation will debate the various types of Safeguarding Control Circuit architectures available
- The fourth component part will introduce innovations in sensors and Safety Programmable Logic Controllers
- The last component part of this presentation will present laboratory equipment that can be developed and used to teach this technology along with associated curriculum needs.

Summary: Emerging technologies relating to Safeguarding Control Circuits are evolving at a much great pace than textbook coverage of this subject area. Consequently, it is important for manufacturing technology programs to begin developing curriculum objectives and materials necessary for preparing students to meet the needs of these new emerging technologies and standards.

Manufacturing

The Emerging Development of Vibration Monitoring & Interpretative Distress Modeling

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Need: The able to identify rotational machinery failure, traditionally involved a keen human ear's ability to hear, discern and interpret problematic noises and shut down machinery before failure occurs. Over the past several years, two technological innovations have evolved which allow electronic test equipment to accurately predict when rotational machinery failure will occur. These two innovations include: a) vibration monitoring and b) interpretive distress modeling. Vibration Monitoring is an electronic testing device that is utilized to monitor excessive vibration caused by loose parts, misalignment, and out of balance parts. This technology utilizes a transducer that records cyclic (vibration) movement of rotating machinery. Interpretive Distress Modeling is a different type of electronic testing device utilized to identify lubrication problems and bearing malfunction of rotating machinery. This testing device monitors the mechanical condition of rotating machinery by detecting high frequency elastic waves (at approximately 100 kHz). Both of these innovative devices have resulted in the development of new manufacturing practices for predicting rotational equipment failure before it occurs. Each device has specific advantages and disadvantages. It is the intent of this presentation to discuss these characteristics and how educational programs in manufacturing technology will need to integrate these technologies into their curriculums to meet the needs of students entering the field of manufacturing.

Overview: This presentation will: a) provide an overview of Vibration Monitoring and Interpretive Distress Modeling, b) discuss the advantages and disadvantages of each technology, and c) define potential curriculum and equipment needs for training students to use these emerging technologies.

Major Points:

- The first component part of this presentation will involve an introduction to Vibration Monitoring and Interpretive Distress Modeling
- The second component part of this presentation will debate the technological advantages of Vibration Monitoring and Interpretive Distress Modeling
- The third component part of this presentation will discuss reliability issues relating to each technology
- The last component part of this presentation will present methodologies for integrating these technologies into manufacturing curriculums.

Summary: Vibration Monitoring and Interpretive Distress Modeling has emerged at a faster pace than subjective textbook coverage. Consequently, it is important for manufacturing technology programs to begin developing curriculum materials necessary for student comprehension and application of these new evolving technologies.

Manufacturing

Sustainable Packaging Alternatives

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Need: There is an international growing concern for the environment. For years, European and other countries have made efforts to reduce, reuse, recycle and become more environmentally conscious. The U.S. is lagging behind the rest of the world in the environmental effort but the interest is now beginning to move forward in most industries, particularly construction and manufacturing. It is important for companies to pay closer attention to the design and development of sustainable packaging alternatives. They also must focus attention on using green materials that are not harmful to consumers or the environment. Green packaging will continue to grow in popularity for many reasons not the least of which will be consumer demand. All packaging materials and processes have distinct advantages and disadvantages. Researchers are investigating new materials and processes for packaging materials that are more environmentally friendly.

Overview: The purpose of this presentation is to share information on sustainable packaging alternatives. Alternatives such as TerraSkin and corn based plastic, just to name a few. This information can be incorporated into your manufacturing curriculum to further enhance the knowledge, skills and values for students to become leaders in the manufacturing industry and responsible members of society. Packaging plays such an important role in manufacturing and students need to understand some of the green alternatives.

Major Points:

- Present current research on sustainable packaging alternatives,
- Discuss advantages and disadvantages of these alternatives,
- Explain how this can fit into your manufacturing curriculum,
- Share case studies on sustainable packaging from manufacturing companies.

Summary: Concern for the environment is growing and the manufacturing industry can play an important role in sustainability and environmental consciousness. Learning about the research, design and processing of different sustainable packaging alternatives will help students make better decisions that will benefit the environment.

Manufacturing

A Configurable Fixture with Cutting Force Compensation

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Need: Many aerospace parts have very complex geometry and require very tight geometric tolerances, high surface finish, and crack-free under surface material quality. The challenge is even more significant when machining parts with thin-wall features. The operation of turning or milling the thin-wall feature is easy to fail mostly due to unsuitable clamping and supporting forces and vibrations. The current fixture design practices for those operations are still trial and error, which induces difficulties in quality control and increases processing cost.

Overview: The goal of this research is to design and construct a fixture that can accommodate parts with different dimensions and can automatically adjust the supporting forces on a part during machining process to achieve the best machining quality and efficiency. The locators and clamps are configurable to accommodate parts with similar geometry but different sizes. The fixture uses a group of pneumatic cylinders as the supporting feature for cutting force compensation. Cutting forces and vibrations are monitored by acceleration sensors mounted on the fixture. The sensor data is fed back to the control unit and processed to control the motion of the pneumatic cylinders. Experiments of machining parts on the fixture were conducted on a CNC milling machine and dimension and geometric tolerances were inspected. The experiment results were used to improve and optimize the algorithm of the control unit.

Major Points:

- Review of current practices of fixture design
- Controller design
- Fixture design and construction
- Analysis of experiment data

Summary: A reconfigurable fixture was developed so that supporting features and clamping features can be adjusted to accommodate parts with different geometry. Based on feedback signals received from the sensors, the clamping and supporting forces of the fixture are adapted automatically during the machining process for better machining quality.

Manufacturing

Industrial Robots with "Eyes" - System Architecture and Analysis

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Need: Manufacturing systems are becoming more autonomous, requiring less operator intervention in daily operations. This is a consequence of today's market conditions, characterized by global competition, a strong pressure for better quality at lower prices, and products defined in part by the end-user. Industrial robots are good examples of flexible manufacturing systems. Manufacturing engineers need to integrate other technologies with the objective of extracting from robots the flexibility they can offer. This research project developed a manufacturing robotic application with a vision system that improves the flexibility and productivity of a computer-integrated manufacturing system.

Overview: This purpose of the research project is to create a manufacturing robotic application with capability of "seeing" parts and identifying different parts within an automated manufacturing system. The research has examined and compared several different vision technologies that can be integrated in industrial robotics systems. In addition, the hardware and software used in the established system will be introduced. The image processing mechanism and programming techniques will be demonstrated. The system performance will be evaluated.

Major points:

- Literature review of the research
- Introduce the procedure and system architecture
- Analyze the system performance
- Discuss of further improvement and study

Summary: This project is a collaborated project with a manufacturing factory. The purpose of the project is to implement a more flexible and productive manufacturing system. The presentation examines the technologies applied in establishing the system, introduces the procedure, and analyzes the performance of the robotics system. The presentation will also address the comparison of different vision technologies that can be applied on industrial robots.

Manufacturing

A Logistic Model-Based Pokayoke System for Monitoring Injection Molding Flash

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Need: The injection molding process is a very common practice in the plastics industry due to its low production cost and high productivity. Although advanced designs and technologies have been employed in injection molding, these technological advancements do not necessarily guarantee hundred percent of parts meeting quality requirement, because many factors such as clamping force, clamping time, melting temperature, etc. impact the process. Flash is one of common problems in the injection molding process. Especially in the modern injection molding industry, injection machines usually are set up to automatically perform large batches of production with little attention from workers. If flash occurs, it could cause a lot of re-work, thereby increasing production costs. There is a need to develop a real time monitoring system that will provide immediate responses to avoid flash for the injection molding production.

Overview: A pokayoke system is a mistake-proofing device, method, or mechanism that is used to ensure quality and eliminate waste by means of preventing defects rather than finding them after they have occurred. A real time pokayoke system was developed through a logistic model that integrated mold vibration signals collected by an accelerometer sensor. This system was able to detect the difference between the vibration signals of the products with flash and of those without flash when they are produced.

Major Points:

- The application of an accelerometer sensor to detect the mold vibration signal in the injection molding process
- Comparison of the vibration signals in the production of molded parts with and without flash
- Identification of the featured vibration signal
- Logistic modeling
- Test of the pokayoke system
- Conclude the feasibility and applicability of the developed data acquisition system for machine condition monitoring

Summary: Real time monitoring of the injection molding process would help plastics manufacturing industries produce products with high quality and competitive cost. By applying an accelerometer sensor, this research developed a pokayoke system that can monitor the flash status of injection molded parts. The pokayoke system's decision-making algorithm was established through a logistic modeling approach. The onsite experimental testing runs indicated that the pokayoke system integrating real time featured machining signal could successfully monitor inject-molded parts' flash status, therefore help prevent defects in timely manner.

Nanotechnology

Nanotechnology

Equipping ATMAE Programs with Nanotechnology Courses: Developing the New White Collar Workforce

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Need: As Nanotechnology advances into the 21st century, post-secondary schools, especially four-year, must be proactive in preparing the new white collar workforce. Developed nanotechnology courses would align with the three concepts of the ATMAE's venn diagram (management, technology, and applied engineering). According to Roco (2003) by the year 2015, he estimates approximately 2 million nanoworkers in the fields of nanotechnology and nanoscience worldwide. However, due to U.S. educational bureaucracy, the majority of nanoworkers will not be in the United States. ATMAE schools have to right tools to develop the unique professional to sustain the viability of nanotechnology in the future.

Overview: The presentation will consist of mapping strategies to develop nanotechnology courses for ATMAE schools as main courses for their curricula. Since nanotechnology will be an enabler to all different facets of businesses, there should be a united effort to ensure every ATMAE graduate has at least has some basic knowledge of nanotechnology.

Major Points:

- Future implications
- The urgency of implement nanotechnology courses (Why???)
- Developing the new workforce
- Administrative and faculty buy-in
- What courses to develop
- Resources for courses
- Future impact

Summary: This presentation is a catalyst to get educators thinking beyond traditional ATMAE-type courses. ATMAE is in the perfect position to assist in creating the ideal workforce for companies that produce nanoproducts. There will be some written testimonies from prominent researchers and businessmen/businesswomen in the field of nanotechnology for this presentation.

Nanotechnology

Use of Flexoelectric Properties of Crystalline Dielectrics in Energy Harvesting or Scavenging Applications

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Need: Energy scavenging applications, such as the use of wearable inserts to generate small amounts of electrical power to recharge batteries in such items as cell phones, have been examined from a number of points of view in recent years, e.g., the proper choice of materials to effect the mechanical-to-electrical conversion of energy, or the novel design of miniaturized electronic circuits to harness the tiny amounts of electrical power in an efficient manner. Conventionally, piezoelectric materials have been the most sought after for these applications because of their ability to use the unique crystal structure of piezoelectrics to create an electric field from mechanical vibrations of either the crystal bulk or its surface. However, the supply of easily adaptable piezoelectric materials with high coupling efficiencies between the mechanical stress and the resulting electrical voltages is limiting the development of energy harvesting and/or scavenging devices. More recently, it has been found that many more ordinary crystalline and even amorphous materials, such as polyvinylidene fluoride (PVDF) films, can exhibit size-dependent, and enhanced, coupling between mechanical forces and resulting electric voltages, through the flexoelectric effect, which converts nonuniform mechanical strains, or strain gradients, to electric fields in the materials. Some predictions have these coupling effects increased as much as 80-100% over typical piezoelectric materials, which should make the design and use of energy scavenging devices more efficient, less space-consuming, and perhaps even less expensive.

Overview: This presentation will develop the necessary framework for analyzing flexoelectric materials and their use in energy scavenging devices and applications. This framework will include the explanation of the physics behind flexoelectricity, the categorizing of the material types that are most suited for the flexoelectric effect, and the dependence of the size of the flexoelectric effect on the typical crystalline grain size of the material (most studies suggest that the highest conversion efficiencies will be demonstrated at the nanoscale level). The final segment of the presentation will show some applications of the flexoelectric effect to some anticipated energy scavenging systems, including a brief introduction to the electronic circuitry needed to realize these systems.

Major Points:

- The difference between the piezoelectric and the flexoelectric effects, as physical phenomena.
- The implication for material selection in energy scavenging/harvesting applications of this difference.
- The role of nanoscale grain sizes in materials in enhancing the size of the flexoelectric effect.
- The incorporation of flexoelectric materials and artfully designed electronic circuitry into energy scavenging systems.

Summary: Attendees at the presentation will learn about the newest trends in nanoscale materials science as it impacts the development of energy harvesting devices and systems.

Nanotechnology

Nano-Diamond Coatings for Light-Weight Engine Components

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Need: Introduction of a protective layer on a metal substrate is an efficient means of minimizing wear and premature failure because it imparts the desired mechanical (increased wear, erosion, and heat checking resistance) and thermal properties (heat insulation) with much reduced cost. Diamond-like carbon (DLC), an amorphous carbon, is one of the most attractive protective coatings. The extraordinary properties of DLC such as chemical inertness, high hardness/thermal conductivity/elastic modulus, low friction coefficient and low wear rate explain the ardent interest shown in the development of these coatings in recent years. Hence, it is an ideal coating for engine components like pistons that undergo a lot of wear and tear. There is a genuine need for a thick and stable DLC coating. Laser materials fabrication is one of the best methods for making a thick and stable DLC coating.

Overview: DLC has established itself as a wear-resistant coating on cutting tools, heat dissipation layer in hybrid integrated circuits, wear-resistant and anti-sticking overcoat for computer disks and corrosion-resistant biocompatible coating for surgical prostheses having excellent tribological properties. Diamond-like carbon (DLC) coatings will be prepared on aluminum 6061 T-91 substrates (that closely mimics the aluminum used in light-weight engine components) with the aid of electrostatic spray coating of ultra-nanocrystalline diamond powders followed by direct laser-sintering technique. A continuous-wave CO_2 laser will be utilized, producing a dense, adherent DLC coating. The evidence of DLC formation and its purity will be obtained by characterizing the samples with Raman spectroscopy, X-ray diffraction and scanning electron microscopy/energy dispersive spectroscopy. Functional evaluation of DLC coatings will then be performed using scratch, micro-hardness, fracture toughness and surface roughness tests.

Major Points:

- Need for a thick coating for light-weight and soft metals like aluminum that undergo wear and tear
- DLC coatings are one of the best towards this purpose
- Laser sintering using CO_2 lasers with nano-diamond powders can create these DLC coatings

Summary: A novel laser sintering technique that uses a CO_2 laser to produce stable, thick DLC coatings on industry-standard aluminum will be performed. The quality of these coatings will then be studied using standard characterization techniques and its functional evaluation performed using wear, scratch and surface evaluation techniques.

Nanotechnology

Using Laser to Attain Nano-Texturing Of Stents

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Need: Stents are widely used in the treatment of heart disease. Metal stents that are coated with polymers have drugs embedded inside the polymer that slowly ooze out and prevent recurrence of cholesterol formation in the heart for a long period of time. The so-called metal platform drug-eluting stents (DES) have improved drug delivery and have profoundly affected the field of interventional cardiology by dramatically reducing the problem of reformation of cholesterol in the arteries after a stent has been placed (called restenosis). There is a need for a technology that can eradicate the need for polymer coatings and at the same time help in storage of drugs on the surface of a stent. Ultrafast laser surface modification on stents is performed to attain nano-texturing that will add substantial value to stent manufacturing by creating nanostructured surfaces that can act as reservoirs of life-saving drugs, eliminate the need for a polymer coating and can extend the stent life inside a human heart.

Overview: For heart patients, stents offer valuable life-saving alternative to other medical techniques. But stents can cause blood clot formation (called thrombosis) inside the blood vessel if certain medications are not present in the stent. Available data suggest that the two major contributing factors for thrombosis are rapid depletion of these drugs and presence of a coated-polymer on the metal stent. A value-added ultrafast laser surface modification nano-texturing process to stent manufacturing using a femto-second laser that would provide the stents with nanostructured surfaces to enhance the drug release characteristics and minimize or eliminate the polymer carrier, thereby preventing thrombosis; and an array of micro-porous reservoirs for storage and supply of drugs continuously for long-term would be presented.

Major Points:

- Need to prevent reformation of cholesterol associated with bare metal stent
- Ultrafast laser surface modification to nano-texture the stents
- Enhance the drug release characteristics with an array of micro-porous reservoirs
- Test the nano-textured profile for morphology and drug delivery tests
- Benefits of the process and comparison to other existing processes

Summary: Laser surface modification on bare metal stents will be performed using a femto-second laser and it will be analyzed how the manufacturing process affects the drug delivery pattern because of the surface morphology change. Morphological and drug testing on the nano-textured surfaces would present potential benefits of this material processing technique.

Nanotechnology

Nanomaterials for Environmental Remediation: Investigating the Value of Solving Big Waste Problems with Small Matters and the Opportunities of Nanoinformatics at Preventing Exposures and Health Risks

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Need: There is general agreement about the uncertainties and risks associated with the handling of nanomaterials in various consumer products and applications, including environmental remediation. The health risk should be addressed by gathering relevant information at the very beginning of these nanotechnologies will prevent past experiences that we have had with products such as DDT and others by giving sufficient tools to agencies that develop and enforce standards and regulations

Overview: Efforts to ensure the protection of workers and the general public against health and safety hazards of nanomaterials during environmental remediation require management and coordination of the toxicity information posed by nanomaterials. Government agencies at all levels, researchers and manufacturers of nanomaterials should access this information for decision-making purposes. Nanoinformatics, which is the science and practice of determining relevance of this information to decision making, provides several opportunities to support standard and regulatory framework as well as safety and health oversight. This presentation will outline the opportunities of nanoinformatics to various actors, in particular state agencies and programs in their efforts to develop nanotechnology in a sustainable way. An emphasis is placed on how to organize available scientific and technological information to meet the needs of government agencies in the face of uncertainties posed by the parameters of nanomaterials that measure their toxicity.

Major Points:

- A framework to understand relevant information needs for safety and health oversight at the state government level
- A preliminary assessment of the nanoinformatics needs for oversight during environmental remediation at the state level
- Examples of nanomaterials that have successfully been used for pilot and full scale environmental remediation
- Potential sources of occupational and non-occupational exposures
- Challenges and opportunities of the nanoinformatics and related tools for occupational and non-occupational exposures control

Summary: The U.S. Environmental Protection Agency has successfully used nanomaterials for environmental remediation at both pilot scale and full-scale operations. It is important that to develop this use of nanomaterials in a sustainable way, local and state government agencies should be empowered with relevant information regarding nanomaterials to support their regulatory and standard setting processes as well as in their oversight functions.

Nanotechnology

Managing Nanomaterials' Safety and Health Risks: The Role of Nanoinformatics in Support of Health and Safety Oversight During Nano-Enhanced Environmental Remediation

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Need: It appears inevitable that nanomaterials will become the dominant and leading products for environmental remediation of complex hazardous wastes in the future. The advantages presented by nanomaterials vs. traditional technologies for this application include their cost effectiveness and shortening the time of environmental remediation operations. The main question however is how to address the challenges brought about by - nanomaterials – a result of the emerging nanotechnology or "manipulation of matter at or near atomic scales". One of these challenges is the lack of information describing the environmental, health and safety impacts of nanomaterials, and hence putting workers and the general public at risk. Such information could be made available and accessible to the government's agencies for timely decision making in this regard.

Overview: Nanotechnology is based on small-scale science. The novel chemical and physical properties of the nanomaterials produced from the emerging nanotechnology have made them potential candidates for various applications. Nanomaterials, also known as engineered nanoparticles have been used successfully for environmental remediation at more than 30 of the U.S. Environmental Protection Agency (EPA) superfund sites. Despite the successful use of nanomaterials for environmental remediation at pilot and full scale, there are still many concerns that nanomaterials could cause significant health impacts to human and the environment. This area of research inquiry is growing locally and globally. Information describing the toxicological, ecological and safety properties of nanomaterials can be generated and organized as part of a large nanoinformatics project to address this shortcoming early into the development of these technologies. Nanoinformatics - the science and practice of determining information relevant to decision making - provides several opportunities to support standard and regulatory framework as well as safety and health oversight. It can also ensure the protection of workers and general public against health and safety hazards of nanomaterials during environmental remediation and ultimately, encourage sustainable development of nanotechnology in the United States. This presentation will outline a framework to understand information and scientific needs of the state government agencies and programs in an effort to develop nanotechnology in a sustainable way. Focus groups, comprising of various experts in this thematic area, were approached via telephone conference calls, internet-based tools, such as webinar and emails, to seek input towards the development of the framework.

Major Points:

- A successful internet-based approach of using focus groups comprising of various experts to develop a framework to understand information needs that describe safety, health and environmental impacts of nanomaterials;
- Information describing health, safety and environmental impacts of nanomaterials which continue to be a limitation to sustainable use of nanomaterials for clean-up operations, and other applications; and
- Strengths and limitations of using online focus groups in addressing an area of inquiry that has relatively small amount of scientific and technological information available

Summary: Management of nanomaterials in a sustainable way requires all stakeholders in the nanotechnology industry to generate information describing health and environment for risk assessment of engineered nanoparticles in an orderly and usable format by the government agencies, particularly at the local level, such as state agencies and programs. Adequate and accessible of such information can support government agencies to protect workers and the general public engaged with research and development as well as the entire supply chain. As we increase the ability of the local government officials and knowledge about nanomaterials interventions through access to information and so will their efforts to provide guidance (e.g. standards and regulations) on the safe handling of nanomaterials throughout their life cycle.

Nanotechnology

One Concept, Multiple Applications

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Need: Educators are finding that in addition to educating students with specific knowledge and skills that their industry customers are looking for employees with some of the traditional soft skills - critical thinking and working in teams for example. Nanotechnology as an enabling technology has an impact in multiple market segments and has also entered the educational arena. Nanotechnology - the ability to observe, measure, study and create at the molecular and atomic scale - can serve as an excellent vehicle to teach skills such as problem solving, critical thinking and design of experiments.

Overview: Companies require employees to have a multiplicity of skills - both technical and non-technical. Two crystal related activities serve as examples and models for teaching the concepts of critical thinking and design of experiments as well as skills and knowledge content to students in electrical, nanoscience, manufacturing and design disciplines. This presentation will provide hands on experience with one of the activities while outlining the many adaptations available to fit different disciplines and knowledge levels.

Major Points:

- Simple activities can be adapted easily to include aspects of non-technical requirements such as critical thinking
- Nanotechnology has applications in multiple disciplines
- Activities and guidelines are available to help educators tailor and implement these activities

Summary: It is necessary for educators to work with industry to prepare employees who are skilled technically but also have skills in non-technical areas. Nanotechnology can serve as a path for educators to use to teach both technical and non-technical content.

Safety

Safety

Matching Capabilities of Unmanned Vehicle Systems to the Situational Needs of Public Safety and First Responders

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Need: Currently, the use of robotic or unmanned vehicle systems to support local and regional public safety organizations is somewhat limited and often viewed as a curiosity. Either the trauma of the event or the perceived lack of impact often overshadow the benefits gained. The robots, sometimes mismatched to the event, may even frustrate the first responders who were expecting assistance. These robotic vehicle systems can provide extremely important support during emergency responses; however, the need exists for a better understanding of system capabilities, situational needs, and improved alignment prior to deployment.

Overview: The research team aims to show the true benefits to incident responders of using aerial, land, and/or marine unmanned vehicle systems in crisis situations. The team discusses actual past events, types of robotic systems used, circumstances around the occurrence, and benefits realized or lost. In 2010 and 2011, an increase in deployments over previous years suggests robotic systems are both maturing and becoming attractive to early adopters. However, their arrival is too late to be of assistance in immediate life-threatening situations. Each crisis has specific situational needs from the point of using robots to assist in that environment. As the systems increase in usability and sensor effectiveness, difficulties in situations often found to be inaccessible or extremely hostile will appear. The researchers highlight the emerging trends in improved technology and promising impact for public safety.

Major Points:

- Using robotic-vehicles as essential tools in emergency responses
- Reviewing where robotic vehicle systems were used globally in the past
- Providing an understanding of capabilities and benefits to be realized
- Understanding the complexity of aligning unmanned systems with emergency situations
- Providing an insight into the success rates and criteria for success

Summary: Attendees will understand the possibilities of using robotic/unmanned vehicle systems to provide support to first responders in times of crisis. They will learn about the past successes of systems, their impact for public safety individuals, and how to determine better alignments for the future. The presentation contributes valuable lessons learned, general insights on the state of the practice, and hopefully encourages further research and accelerates adoption.

Safety

Schools at Risk: Technology Applications to Assist in School's Emergency Management Initiatives

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Need: Efficient technologies in emergency management and response systems are the utmost concerns for both the general public and the academic community. Emergency systems must be improved with effective and efficient technologies in order to meet societal concerns. Systems, such as human-computer interaction, can make emergency response easier, and allow entities to adopt a user-centered systemic approach reducing or alleviating threats. Nevertheless, technological integration with emergency preparedness will help to reduce uneasiness, possible loss, and costs associated with natural and man-made disasters.

Overview: As academic years matriculate, schools (i. e. secondary and post secondary) grow more at risk of natural or man-made incidents. Natural incidents may include adverse winter weather, floods, hurricanes, tornados, tsunamis, etc. Man-made incidents may include school shootings, bombs (threats or attempts), terrorisms, and other forms of school violence. Nevertheless, pandemics such as influenza, H1N1, and other hazardous virus outbreaks must be consider as emergency matters that must be properly addressed. What are measures used to mitigate, plan, response and recover when all these factors are considered? What role does technology play in emergency response initiatives to assist all "at-risk" schools?

Major Points:

- Evaluate those emergency incidents that most impact schools;
- Identify new technologies to be used in emergency management and response systems;
- Evaluate technology's effectiveness in assisting in the mitigation, planning, response and recovery efforts; and
- Provide information on strategies to further enhance technology's integration with emergency management on

Summary: This research will evaluate the integration of technology and activities with recent concerning emergency management. With increasing natural or man-made disasters, schools are becoming more vulnerable, and approaches must be enforced to reflect the current age of technology. Such technological applications and innovations will greatly assist in strengthening effort that will minimize or alleviate potential harm to students, faculty and the campus community at large.

Safety

Developing an University Emergency Response Plan

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Need: Federal and state laws require that written emergency plans be provided for all university departments. This presentation will assist emergency preparedness efforts on university campuses by providing materials that can be used in developing emergency plans.

Overview: Students in our Applied Engineering Technology Programs, especially those in the Occupational Safety and Health, Safety Management, Graphic Communications and Construction Management Programs, will need to know how to implement emergency action plans even though they might not be required to develop one on their own. Because it is essential that a university continue to operate, a continuity of operations plan will also be discussed during this presentation. Contingency planning involves developing understandings of personnel, information systems, supplies and equipment needed should a disaster interrupt normal delivery of university and departmental services.

Major Points:

- Federal and State Requirements
- Emergency Response Organizational Chart
- Emergency Operations Center (EOC)
- Emergency Operations Checklists
- Procedures for Testing Plan & Training
- Evacuation Plan
- Emergency Response: Serious Injury or Illness

Summary: This paper on Developing a University Emergency Response Plan will provide vital information for attendees in preparing an emergency response plan for their university. Preparedness and maintenance of adequate supplies is crucial in the development of an emergency plan and it is quite possible that the university would be required to function without outside assistance for 72 hours following a widespread emergency such as a hurricane, ice storm or earthquake. Roads may be damaged which could make it impossible for you to leave campus and return home. Being prepared for an emergency will help in minimizing the gravity of the situation. It may even save lives!

Safety

Common Data Link in Unmanned Systems for First Responders

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Need: Currently, there is no common data link/open architecture used by federal, state, or local officials in the event of a natural disaster or a domestic operations emergency. The presentation will highlight the need for a common data link, which would reduce the amount of time/lives lost in the untimely event of a natural or manmade disaster. Also being addressed, how results could be affected in the event of a disaster by having trained government officials. This could be done by adding one block of training to the already required National Incident Management System (NIMS) for government officials that are required training.

Overview: The research team examines the need for a standardized common data link in the event of a natural or manmade disaster. The NIMS provides a systematic, proactive approach to mitigate the effects of a natural or manmade incident. The NIMS is essential principles for a common operating picture and interoperability of communications and information management. As the reliability and confidence grow with the use of unmanned systems, they are being relied upon more by national, state, and local governments for assistance during an emergency situation. The time to realize that these systems could be used more effectively is during prior planning. This could be accomplished by standardizing a common data link/open architecture and adding one block of education to already required training.

Major Points:

- A Common Data Link for domestic operations would be extremely beneficial
- An understanding that Unmanned Systems training could save lives/money
- Training would provide a common operating picture for incident commanders

Summary: Operations that speak one language across the spectrum when working with incident commanders will ultimately save lives and mitigate the cost of an incident. By operating an unmanned system platform with one common data link, the command element of an incident will receive timely, accurate, and reliable information.

Safety

What We Have Learned About Experience, Time Pressure, and Difficult Tradeoffs from Experiments with Firefighters in Virtual Reality

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Need: Firefighting is a high-risk environment and optimal fire ground decisions are vital to successful front line fire response. Though the number of structure fires continues to decline and steps have been taken to dramatically increase safety, the fire service has been unsuccessful in eliminating the hundreds of firefighter fatalities occurring every decade on the fire ground. Emphasizing the critical concern over firefighter injuries and fatalities, researchers have suggested that firefighters can keep themselves out of harm's way by *making good decisions*. Enhancing decision-making skills in firefighters, especially in the stressful environment of the fire ground, is critical to breaking this chain.

Overview: The effects of stress on decision-making strategies have not been well documented. Several theories have been proposed to explain how these decisions are made. However, due to the lack of technology, these often fail to address the interaction between stress and decision making in the dynamics of real-time naturalistic conditions. The objectives of this study were to identify the relationships among firefighter experience and decision-making processes, and to determine the relationship between acute stress and these processes in firefighters. Utilizing the highest resolution computerized virtual reality system in the world, firefighters were exposed to life-like scenarios varying in the stressors of time pressure and tradeoff values. Decision-making processes and final decision choice were assessed in real-time, and physiological indicators were used to characterize participant's stress state.

Major Points:

- Comparison between expert and novice performance in decision making process
- Association of physiological stress response to firefighter decision strategies
- Cue identification training needed for expert decision making
- The "tribal learning" process where inexperienced firefighters are learning from experienced firefighters may not be adequate for enhancing decision making skills

Summary: In general, attendees will learn that experience does not guarantee faster and more accurate decisions. Furthermore, experienced firefighters demonstrated higher level of threat-related stress than inexperienced firefighters.

Safety

Smartphone Applications: Implementation into Safety

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Need: There is a need for both companies and educational institutions to reevaluate safety programs for employees and students alike. Safety programs are generally done face to face in a classroom setting, which is valuable for a general overview. However, safety training should not happen one time. Employees and students have questions at all hours and generally require an immediate answer. Smartphones and applications have greater capability and availability for the development safety applications, which can assist employees and students with questions.

Overview: This presentation deals with the potential benefits of developing a smartphone application for companies and educational institutions. Institutions can develop applications that are unique. This gives the ability to be flexible to changing demands. Applications can be linked to websites. When the website is updated, changes are reflected in the application. One of the potential downsides to this is employees or students having access to smartphones during work hours. Finally, future smartphones with different applications can assist with MSDS control, maintenance, and shipping/receiving.

Major Points:

- Benefits
  - Cost
  - Flexibility
- Use of phones for non-work actions.
- Future applications

Summary: Attendees will understand the benefits of implementing a smartphone based safety program. The presentation's topics will include, How the applications can be customized and updated for each institution, what are some of the potential hazards of smartphones being used, and how smartphones could be used in the future not only for safety but for the company as a whole.

Safety

The Role of Poverty in Risk Perception Among Developing Nations Workforce

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Need: Study finds that estimated 1.7 billion people live in abject poverty worldwide. The absence of a socially acceptable level of resources or incomes in developing nation as compared with workers in developed contributes to cultural perception or determinant risks. Poverty pressures workers in developing nations to work in unsafe conditions that kill million of them. Of the world's 2.7 billion employees, about 2 million deaths are attributable to occupational diseases and injuries. Workers in the developing world bear this burden disproportionately in primary and extractive activities such as construction, agriculture, logging, fishing, mining, and rubber plantation – some of the world's most hazardous workplace. The International Labour Organization [ILO] avers that 80% of the global burden of occupational disease and injury were recorded in developing nations with India and China at 37%. World Health Organization (WHO) also reports that safety & health loss costs Africa 58% of its GDP. Fatality rates in some developed nations double than in some nations and in parts of the developing world fatality rates soar to four-fold those in the industrialized nations. Certain hazardous jobs can be from 10 to 100 times riskier in culturally perceived-risk nations where socio-economic conditions define the degree of risk.

Overview: There are currently insufficient data or a scant research between the correlation of risk perception and risk recognition in developing nations, especially where lack of basic human needs, which commonly include clean and fresh water, nutrition, health care, education, clothing and shelter, are prevalent. Risk perception is also a difficult proposition in developing countries because of cultural barriers that impede the understanding of perceptual indicators of danger. This presentation aims at examining cultural risk perception and risk recognition in developing countries using pictorial evidence to ascertain the type of cultural risk perception and the prevalent rate at which it or lack it breeds unsafe conditions.

Major Points:

- Mushrooming death in developing nations' workplace
- The health status of the workforce in every country has an immediate and direct impact on national and world economies
- Developing workers making decision between workplace protection or daily survival
- Culture-risk communications

Summary: Attendees will understand uneven distribution of social and economic burden that define risk in other cultures of the world. The information can be used to contribute significantly to both risk reduction and alleviation of the effects of risk-related crisis in workplace.

Safety

Ergonomics Designs to Rescue Trapped Mines Workers

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Need: Recent global mines disasters, especially miner entrapments in China, USA, and Chile have captured the global attention and served as beacon to find a lasting solution in a technologically abundant world. For example, in the Shanxi province of China, flooded pit trapped 153 miners and killed 40 miners in another province due to an underground explosion. In Montcoal, Virginia, U.S., 25 miners died when methane gas overwhelmed. And in Copiapo, Chile, 33 miners were trapped inside a mine for 69 days when part of the mine collapsed. Sadly, with all of modern society technological advancement, the current emergency response to rescue trapped mines workers has not reduced rescue time to inspire mine workers and public confidence in the mining industry. The motivation for this paper arises from the rather upsetting that, despite technologically fascinated world, modern technology has not been able to rescue trapped mine workers. This presentation is an overview of the recent challenging mine rescue attempts that made our technologically fascinated world looked like primitive society. The objectives of this presentation are to link sound ergonomic innovation and speedy trapped mines workers rescue.

Overview: Recent global mines disasters, especially miner entrapments in China, USA, and Chile have captured the global attention and served as beacon to find a lasting solution in a technologically abundant world. Excellent ergonomic designs can have positive effects on reduced rescue time. In spite of all the technological advancements, inadequate technology to respond to mine entrapments demonstrate the need for innovative and comprehensive solutions to the varied complexities posed by mining accidents, rescues, and recoveries.

Main Points:

- Cursory overview of some of the recent mine disasters
- Global psychological impact of mines disasters
- Conceptual framework to analyze the possible ways to integrate ergonomic intervention through the design

Summary: Attendees will understand why mining disasters and delay in rescues continue to pose unique and often universal challenge. A mitigation model can be used to ameliorate entrapments of mines and others workers.

Safety

Evaluation of Greensboro Lead Safe Program

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Need: Childhood lead-based paint poisoning is the result of poor housing and other conditions accounts for about 0.6% of the global burden of disease [WHO, 2009]. In the U.S., childhood lead poisoning remains a major environmental health problem. U.S. Department of Housing and Urban Development [HUD] introduced Lead-Based Paint Hazard Control Program intended to reduce and/or eliminate lead hazards in low-to-very-low income housing. In 2002, the City of Greensboro was a recipient of HUD grant to stabilize and repair homes with potential lead-based paint. NC A&T State University OSH Program was retained by the City of Greensboro to conduct a field research project to investigate the effectiveness of various methods for the clean-up of lead paint dust in more than 150 houses. This paper aims to contribute to a better understanding of post-abatement homes and the views of those who are recipients of the service.

Overview: Lead paint abatement can be very dangerous if done improperly. Houses built before 1976 in the U.S. may contain lead paint. The total amount of lead on surfaces can amount to levels as high as 20 milligrams per square centimeter of surface area (mg/cm2). Renovations to older housing may disturb lead paint through such common activities as sanding walls and trim for surface preparation, removal of paint for re-finishing, and demolition of walls and components. The chief concern regarding exposure to lead in houses is the possible exposure of young children, especially under 6 years of age. Young children can come in contact with lead paint and dust particles on floors, windowsills, furnishings, etc. When abatement is not done properly, there is the potential for children to receive hazardous exposures to lead.

Major Points:

- Lead usages and hazards
- Lead surface contaminations after cleaning
- Improving the mitigation of the global burden of lead poisoning
- Lead poisoning is the leading environmental health risk in America, particularly in young children
- Analyses of lead dust wipe samples and clients' satisfaction

Summary: Attendees will understand post-lead treated building evolution and the level of satisfaction of those who live in them. Finding presented can be used to improve other lead abatement project.

Safety

Encouraging a Safe University Classroom Environment by Preventing Cyber-Victimization

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Need: Computers and technology devices that were purchased for learning are being used for cyber-bullying and online harassment. Cyber-victimization has unfortunately become part of the college and university life. It can involve online abuse outside of the classroom and inside online courses. Studies have shown between 10 to 20 percent of students at university campuses have experienced cyber-victimization.

Overview: Cyber-victimization, including cyber-harassment, cyber-bullying, and cyber-stalking, is a problem that has grown as the Internet has become practically a necessity of life in the United States and especially at universities and colleges. Studies show that students and faculty not only may become victims of online abuse while at a university, but also while participating in online courses. Instructors of these classes and school administrators need to understand the problems of cyber-victimization and take action to prevent such online abuse from happening.

Major Points:

- Terminology for online attacks
- Similarities and differences between online attacks
- The complexity of balancing prosecution of abusers with the right to freedom of speech
- An overview of studies relating to cyber-victimization at universities
- Advice for schools and instructors for prevention

Summary: Cyber victimization is becoming more common. Instructors and school officials should understand clearly the different types of online abuse. It is also important for instructors and school officials to have an understanding of how the right to freedom of speech relates to online abuse.

Teaching Innovations

Teaching Innovations

Innovative Strategies for Engaging Students in Service-Learning in the Field of Technology

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Need: In any technology-based program, the importance of exposing students to real-world problems cannot be overemphasized. By incorporating service-learning into the Architectural Science curriculum at Western Kentucky University, we are beginning to create critical thinkers better prepared to enter the workforce. We will present the approach adopted, the findings, benefits, and the results of this process.

Overview: The faculty and students in the architectural science program have fostered a relationship with the City of Bowling Green. This partnership has a twofold benefit; students use knowledge that they have acquired in the traditional classroom to solve place-based problems and the community is empowered with ideas on how to use facilities that are vacant, under-utilized and in need of upgrade. The faculty is there to support the students; the students drive the project. This has been a successful initiative and a gap has been bridged between theory and practice.

Major Points:

- Create a partnership between your classroom and the community
- Get local professionals in your discipline involved during the student's problem solving process
- Seek opportunities for public exposure, and internal school exposure
- Present findings to community partners and peers
- Incorporate sustainable practices relevant to the problem being solved

Summary: The partnership between the Architectural Science program at Western Kentucky University and City of Bowling Green has benefitted the community being served and the students have responded more enthusiastically than in the traditional classroom setting. We will provide an insight into creating partnerships between the classroom and community; identifying services that can be provided; how to create an opportunity for students to present their work to industry professionals; and how public exposure can motivate students to produce their best work.

Teaching Innovations

Building Partnerships to Benefit Architectural and Construction Education

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Need: Architecture and construction educators need innovative ways to engage, motivate and expose students to practical situations and problems. The Architectural Science program at Western Kentucky University has partnered with the City of Bowling Green to achieve these educational objectives. We will show how this partnership has created conditions for students to acquire technical skills required in the work place, while the solutions generated from this endeavor have helped the city achieve planning and construction objectives.

Overview: Architectural faculty and students have created a partnership with the City of Bowling Green to provide space planning and construction drawings. In this case study, we will focus on a city facility that is currently vacant and in need of renovation. Students interact with the client to survey planning and construction requirements. The faculty and students then assess the current conditions, analyze potential, propose adaptive reuse, incorporate sustainable approaches and present their ideas. Students are thus able to apply theoretical knowledge to arrive at an optimal solution.

Major Points:

- On site building investigation – creation of as-built drawings
- Interview future users of space – creation of a detailed program for the building
- Analysis of existing conditions and program – creation of renovation / addition construction drawings
- Merge existing with proposed – creation of demolition drawings
- Present findings – creation of presentation materials and renderings

Summary: A partnership has been created between the Architectural Science faculty, students and the City of Bowling Green officials. This partnership has provided students with real world projects, and has provided the city with detailed construction drawing data that is currently being used to cost estimate the project. This presentation will highlight a case study exemplifying the success of engaging students and faculty with city officials to solve construction problems.

Teaching Innovations

Student Professional Development: Competency-Based Learning and Assessment

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Need: The primary purpose of this case study was to detect student professional development using competency assessments. An additional goal was the development of a framework for CBL and assessment that can be utilized in other higher education environments. This is important because direct measures capture the quantitative data necessary for numerical evaluation and reporting, and provide primary evidence of student outcomes achievement, represented by competencies. Competencies are the currency used by the vast majority of employers in the hiring and employee development processes.

Overview: This case study examines the implementation of competency–based learning (CBL) and assessment as a measure of student professional development. An industrial technology undergraduate course at a Midwestern University served as the backdrop. Based on the intended student outcomes addressed in the course, five workplace competencies were selected, and key actions associated with each competency were assessed during the semester. Students participated in initial and final course competency assessments of both self and peers. The results indicate professional growth was detected in specific key action items associated with the five workplace competencies. Additionally, this case study provides a foundational framework for further research studies in competency-based learning and assessment.

Major Points:

- Need for student professional development and competency selection
- Competency-based assessment incorporating 360-degree feedback process
- Course connection to departmental workplace competencies
- Methodology and course design will be presented
- Results, Conclusions and Future Implications will be explored

Summary: The audience will understand the need for student professional development, as well as, the role that competencies and the 360-degree feedback assessment process play. Additionally, a foundational framework for further research studies in competency-based learning and assessment will be presented.

Teaching Innovations

Producing 21st Century Entrepreneurs for a Global Economy - Developing Flexible Curriculum Practices that Promote Innovation in the Classroom

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Need: In the factory era, the goal was to have the highest "PERL" Percentage of Easily Replaceable labor. If you can easily replace most of your workers, you can pay them less. The less you pay them, the more money you make. The goal was to leverage and defend the system, not the people. It is for this reason that it is important incorporate entrepreneurial practices and philosophies that reflect the choices in the modern world. Win by being more ordinary, more standard, and cheaper, or win by being faster, more remarkable, and more human. The system for the 20th Century was a simple formula: do your job, show up, work hard, listen to the boss, stick it out, be part of the system, and you'll be rewarded. The reality is, there are no longer any great jobs where someone tells you precisely what to do. If we can measure it, we can do it faster. If we can put it in a manual, we can outsource it. If we can outsource it, we can get it cheaper.

Overview: The 21st Century graduate needs to be prepared to master modern communication tools, be conceptual and explore abstract awareness, and most of all, provide the connectivity of these elements of the new work place to be attractive to management and clients. And if management attracts, motivates, and retains great talent, then it has more leverage than the competition… a very low PERL. The focus of this presentation is to propose a variety of entrepreneurial exercises and experiences that could be incorporated into curriculum.

Major Points

- Personal and Professional Image Branding, Marketing and Self Promotion
- Product pricing techniques
- Digital Workflows and Organizational Charts, Visualization Exercises
- Oral Business Investment Presentations, Stocks and Charting
- Business Plans and Mission Statements
- Style Guides and Standards Operating Procedures
- Taxes, Accounts Payable, and Salaries

Summary: If you want to teach and promote students to find a job where they get to do more than follow instructions, don't be surprised if they find that job that gets them to do things they were never taught by you in school. If your students want a job where they take intellectual risks all day long, don't be surprised if their insights get them promoted. The 21st Century needs students to be remarkable, be generous, be creative, make judgment calls and connect people and ideas, and we have no choice but to reward them.

Teaching Innovations

The New Frontier of Education: The Impact of Smartphone Technology in the Classroom

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Need: The face of the contemporary classroom is rapidly changing. Innovations in technology affect pedagogy by demanding that instructors constantly stay abreast of modernizations. Such modernizations include computers application updates, smart boards, smart phones, and other technological devices. Instructors must be aware of using these applications to reach all learning styles (i.e. audio, visual, and kinesthetic). Instructors must also be mindful of using such applications as instructional aides that will reinforce learning objectives for the 21st Century learners. Students desire ways that they may become more engaged and have more autonomy over their educational experience. They no longer desire the traditional method of basic lecture. However, students desire applications that meet the interest of their generation through captivating technologies.

Overview: The 21st Century students have limited to no knowledge of life, even in the class room setting) without accessible forms of technology. According to Kamentz (2010), American children now spend 7.5 hours a day engrossing and creating media. This is almost as much time as they spend in school. Amazingly, students tend to multitask across screens to pack 11 hours of content into those 7.5 hours. Since more activities are occurring on Smartphone equipped with audio, video, SMS, and other numerous applications, there must be methods put in place to use such affectively in education—for both instructors and students.

Major Points:

- Evaluate the use of Smartphone among students;
- Make comparison of Smartphone usage between secondary and postsecondary students and discuss how smartphones may be used as an instructional medium;
- Evaluate and identify how smartphones may be used as an instructional aide to reinforce learning objectives; and
- Discuss how smartphones use positively impact pedagogy and student comprehension and application of subject matters.

Summary: The 21st Century learner depends on technology to engage them in the educational process. Basic lecture no longer stimulates their interest and may render low achievement. Instructors must be willing to recognize the best strategy that will engage students. By implementing contemporary technology, it will not only engage students in their work, but it will connect them to unlimited resources that will enhance educational value.

Teaching Innovations

The Process Is the Product: Developing the Critical Thinking Skills of Technology, Applied Engineering and Management Graduates

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Need: Graduates of technology, applied engineering and management programs are expected to demonstrate the ability to solve multifaceted problems from the very first day at the job. Accordingly, there is a need to teach various problem-solving techniques across the curriculum. Graduates and employers alike agree that sound critical thinking skills are needed in most aspects of professional work, such as for evaluating competing product specifications, for conducting online research, or for aggregating key information. Familiarizing students with the critical thinking standards that need to be applied to thinking processes will lead to the development of much valued intellectual traits of integrity, perseverance, and confidence in reasoning.

Overview: Development of critical thinking skills within a discipline is an integral part of the typical technology, applied engineering and management curriculum. It should often be embedded within course activities, thereby making the structure of the critical thinking process itself quite challenging. Through self-paced learning modules, along with repeated practice students can be equipped with a sound foundation in the dynamic thinking process of critical thinking.

Major Points:

- Skills inventory of the 21st century technology, applied engineering and management professional
- Survey of organizational needs related to critical thinking
- Development of self-paced modules for familiarizing students and industry professionals with different aspects of critical thinking
- Activities for strengthening thinking skills so that students can prioritize course content around the fundamental and power ideas, as well as analyze, synthesize and evaluate various issues.
- Rubrics for evaluating student work related to critical thinking

Summary: Strong critical thinking skills will enable graduates to work efficiently while finding reasonable solutions to complex problems, take positions on difficult issues, and make decisions with increased confidence in the face of uncertainty. The presentation will discuss the development of self-paced learning modules related to the critical thinking process that can enables one to identify significant issues for getting to the core of a problem. This includes defining the scope of the work, determining key assumptions, considering multiple perspectives, drawing on concepts and data, developing solutions and considering possible implications. Structured, context-free activities for developing these essential thinking skills will be discussed in the presentation.

Teaching Innovations

Developing an Environmental Sustainability Themed Honors Course: Implications for Developing a Liberal Arts Foundations Program Course

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Need: Professional programs, such as those accredited by ACCE and ATMAE, have a role to play in their institution's liberal arts foundation program. This presentation describes how ACCE and ATMAE affiliated program faculty members can lead a university-wide curriculum development on the topic of environmental sustainability.

Overview: ACCE and ATMAE affiliated professional program faculty members can offer courses through the liberal arts foundations curriculum. This particular foundations curriculum is divided into four basic, core disciplinary areas (humanities, arts, natural sciences, social sciences), one multidisciplinary area in health promotion and physical activity, and two areas of competence: writing and mathematics. A new Honors College and a call for proposals presented a unique opportunity for faculty members associated with accredited ACCE and ATMAE programs to collaborate and offer an honors seminar that focused on environmental sustainability.

Major Points:

- Sustainability of the built environment is one area in which ACCE and ATMAE program faculty members can contribute to an institution's liberal arts foundation program.
- The topic of sustainability is very broad, and therefore requires a focus in order to examine the body of knowledge in an efficient manner in the delivery of a course.
- Sustainability education requires a multi-disciplinary approach.

Summary: Attendees will hear about and will be provided an opportunity to discuss the merits associated with the development of an environmental sustainability honors seminar that has implications for the development of a liberal arts foundation program course.

Teaching Innovations

Practicing Lean Six Sigma in the Classroom: Experiences that Enhance Student Satisfaction and Learning Effectiveness

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Need: Application of industrial Lean Six Sigma (LSS) practices and concepts through teaching methodology can be a powerful tool that enhances academic learning and provides students with direct personal experience with continuous improvement and quality control processes. Using simple industrial simulations and gaming theories to set up laboratory type experiments, knowledge transfer concerning quality and performance concepts can be tested and experienced at a personal level rather than seen as academic only exercises. When the ideas, concepts and application of lean manufacturing bridge the gap between academic concept and practical application, they become tools to be used rather than ideas that are left behind after the next test.

Overview: Lean methodology is largely about reducing waste and bottlenecks. The original concepts behind Six Sigma were focused on reductions in variation and defects. Many problem identification and problem solving techniques were developed as a result and include; cause-and-effect diagrams, value stream mapping, and Pareto analysis, to name but a few. This study experiments with a LSS gaming strategies to optimize student learning experiences, motivation, and achievement by measuring the number of defects and times for task completion. Interim results were presented to students between labs in a dynamic environment allowing them to have a say in the application of processes that would shorten production time while improving quality. The experiment, "Torch Factory Simulation," was added to a graduate course, Production and Operations Management, and focuses on understanding customer requirements, quality filter mapping, Pareto analysis, and process improvement.

Major Points:

- Literature reviews on simulation/gaming theory in classrooms is promising but small.
- Student led problem solving rather than instructor directed actions.
- Student learning progress/effectiveness measured in discrete stages of the simulation over months.
- Direct measures of higher order thinking skills of students implementing LSS tools.
- Laboratory style experiment without the need for separate lab time

Summary: The experiment brings higher-order learning into the classroom through the experiences normally associated with separate laboratory environments, real world experience, or on the job training. It emphasizes the impact of LSS tools in process improvement; and, as an experiment, it allows instructors to directly measure knowledge without the need for yet another test. The presentation will also summarize how the teaching practices developed improved, enhanced and motivated students to think out of the box using technologies (simulations) in the classroom.

Teaching Innovations

Would You Drink This? A Green Manufacturing and Chemical Technology Collaborative Lab Exercise

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Need: Issues of environmental impact cross many disciplines, yet curriculums rarely have the ability to address these intersections in the classroom. Finding a project that meets the academic objectives of multiple disciplines simultaneously is not always easy, especially given course schedules, lab availability and class demographics. This presentation addresses overcoming the obstacles faced in multi-disciplinary curriculum and reports on benefits to such projects.

Overview: Based on a case study in which students created a sustainable bio-filter, used in third -world environments, this presentation will walk through the process of blending two courses from different disciplines for a single project integrated into both curriculums. Manufacturing students led the construction phases, while Chemical Technology students utilized laboratory instrumentation to establish the quality of water both before and after treatment. In this project, instructors worked together to establish desired outcomes, shared in the teaching within their related fields and guided self-directed teams of students including two different programs to complete this project.

Major points:

- Developing mutually beneficial projects for multi-disciplinary experiences
- Managing logistical issues within the confines of schedules and room requirements
- Cross-disciplinary peer mentoring opportunities
- Co-teaching and self-directed teams of multiple programs
- Lessons learned

Summary: Attendees will learn the benefits of multi-disciplinary experiments in collaborative learning environments through the presentation of a case study where students from Green Manufacturing and Chemical Technology work together in building a sustainable bio-filter, found in third-world countries. Presenters will review best practices and lessons learned through the project.

Teaching Innovations

Evaluating Program Outcomes via Decision Making Simulations

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Need: Evaluation of program outcomes is a moving target. Evaluations through exams, quizzes, projects, etc. reflect the knowledge, skills and perspectives students acquired due to the implementation of the variety of learning activities. However, assessment of whether programs lead to shifts in cognitive patterns that will trigger the activation of the knowledge, skills, and attitudes that have been pursued is yet a challenge. For example, will teaching safety components as part of the curriculum lead to a higher safety orientation beyond the framework of the learning program? In this presentation, we will present a methodology that utilizes decision-making simulations to directly assess the impact of learning on program outcomes.

Overview: The Department of Agricultural and Biosystems Engineering (ABE) at Iowa State University (ISU) utilizes a competencies-based evaluation system for program outcomes. Current assessment efforts for program outcomes at (ABE) are perception-based, utilizing ratings on a 5-point Likert Scale. While perception-based evaluations carry merit, these surveys has several deficiencies, such as very low accuracy, bias, and lack of sensitivity needed to measure improvement/derogation in small increments. The assessment with decision-making simulation documents cognitive processes. Subjects are not aware of the procedure associated with analyzing the results of the simulation, thus, bias associated with awareness of the subject to the alma matter is avoided. Furthermore, the analysis of the decision portraits provides more insights on the effect of learning by, not only measure shifts in awareness to the alma matter but also, by understanding the cognitive processes associated with these shifts. Safety awareness is one of the competencies ABE is using to assess program outcomes. Students and supervisors rate this competency level low. In this presentation, we will present the results of implementation of the decision-making methodology above to measure improvement in safety awareness and orientation toward safety following the development and implementations of an online autonomous safety enhancement curriculum.

Major Points:

- ABE at ISU utilizes a competencies-based evaluation system for program outcomes.
- Current program outcome assessments carry merit but are limited in accuracy and are susceptive to biases
- A decision making-based methodology has been developed and implemented to assess impact on competency level
- Implementation of the decision making-based evaluation shows promising results

Summary: Decision making-based methodology was proposed for evaluating program outcomes. The methodology was tested to measure the effect of safety enhancing curriculum on Safety Awareness, one of the 15 competencies ABE is using in program outcome evaluations. The results indicated a significant increase in safety awareness and shift in cognitive processes following implementation of the curriculum. Since ABE measures competencies via supervisory evaluation of graduates, the authors examine the opportunity of developing a longitudinal study for measuring the magnitude of impact of curriculum on outcomes at the workplace.

Teaching Innovations

Implications of Personality Traits and Attitudes Towards Sustainability on Information Technology Education

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Need: There is a demand for information technology (IT) professionals who can incorporate Green IT strategies in how they design their systems. It has been argued that positive attitudes towards sustainability are associated with certain personality traits. However, there is a lack of empirical evidence supporting this proposition. If there are correlations, what are the implications of these personality traits on sustainability education within an information technology curriculum?

Overview: Conference attendees will be presented with the findings of an empirical study that investigated correlations between personality traits and sustainability attitudes to consumer electronics. The personality traits assessed included self-efficacy, locus of control, pro-social, extraversion, agreeableness, conscientiousness, neuroticism, and openness to experience. The study also investigated whether subject sustainability attitudes were influenced by the type of sustainability information being presented to them. Sustainability is more than just the environment. Sustainability also incorporates social and economic aspects. Conference attendees will discover whether subject attitudes towards sustainability are influenced by the presentation of materials that highlight a particular aspect of sustainability. Ultimately, attendees will be involved in a discussion about the implications the findings have on incorporating sustainability into an information technology undergraduate curriculum.

Major Points:

- Developing an assessment of attitudes towards consumer electronics and sustainability.
- Identification of personality traits that are correlated with positive attitudes towards sustainability.
- Implications of personality traits on sustainability education within an information technology undergraduate curriculum.

Summary: Conference attendees will learn about the correlations between personality traits and attitudes towards sustainability based on a recent empirical study. The impact of whether the type of content presented influences attitudes towards sustainability will be shared. Finally, the implications of these issues on sustainability education within an information technology curriculum will be discussed.

Teaching Innovations

An Integrated Approach to Engineering a Collaborative Success—The BajaSAE Kansas Project

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Need: In the real world, successful industry and business areas do not exist in a vacuum nor do they have a "silo" mentality. Collaboration is a key to success. Industry requests that we provide students and faculty with real world opportunities to solve problems, make decisions, develop life skills, plan, and execute solutions. In this presentation, we will present how faculty and students from the College of Technology, Department of Communications, Office of Information Systems, and other university service areas worked with SAE and corporate partners to collaborate on BajaSAE Kansas---from track/competition site construction through live video streaming the event throughout the world

Overview: This presentation highlights Baja SAE Kansas as an example of a collegiate design event that served as a catalyst for integration and collaboration by various technical and academic disciplines. It addresses the collaborative efforts of several groups to hold an international event (25% were international competitors). This integrative approach can be applied to local, state, and regional events

Major Points:

- A collaborative model—providing a model for all to work together (Industry and Academic)
- Programs collaborating together and activities/projects/contributions associated with each:
  - Construction Management – track and site planning/construction (capstone project)
  - Graphics & Imaging – design & printing shirts, brochures, etc.; web/social media & photos
  - OIS, Communications Tech & Eng. Ed – logistics and wireless video stream production
  - Automotive – overall event coordination; track design input; design/build skid-pull equipment
  - Industry partners – heavy site preparation equipment, equipment, vehicles, materials, funds
- Lessons learned regarding integrative approach—future preparations for *BajaSAE Kansas 2014*

Summary: Attendees will understand the necessity and benefits of integration and collaboration in preparing graduates in technology management career fields. The successful model and benefits associated with Baja SAE Kansas can be replicated by other institutions ---from hosting regional competitions to promoting a regional or state-wide event; creating capstone projects; and real world learning.

Teaching Innovations

Performance Tasks: Incorporating New Opportunities for Students to Practice Development of Complex Problem Solving Skills

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Need: Virtually all colleges and universities will name critical thinking as a key objective of their undergraduate education. Yet designing and assessing course projects to help students practice complex problem solving that resembles the range of ways they will apply or transfer what they have learned to real-life situations is no easy task. However, the development and implementation of "Performance Tasks" to any course that includes the explicit teaching and learning of higher order thinking skills—critical thinking—provides the opportunity for students to practice complex problem solving skills.

Overview: Designing course projects to inspire learning and conducting assessment of student learning has often proven difficult and many times ineffectual. In a conventional classroom, a test is used after the teaching has been completed to determine how much of the content students retained. Integrating "Performance Tasks" into courses satisfies the idea that learners need to experience what is being learned in order to truly understand it. Performance Tasks can simultaneously facilitate student learning and measure demonstrated ability. Thus teaching, learning, and assessment all take place as the student performs the task.

Major Points:

- What are Performance Tasks
- Features of Performance Tasks
- Examples of Performance Tasks
- Linking Pedagogy and Assessment Practices

Summary: The development and implementation of "Performance Tasks" to any course that includes the explicit teaching and learning of higher order thinking skills—critical thinking—provides new opportunities for students to practice complex problem solving skills. Integrating "Performance Tasks" satisfies the idea that learners need to experience what is being learned in order to truly understand it. In addition, Performance Tasks provide the critical assessment tool that aligns with active learning strategies because they can be used to simultaneously facilitate student learning and measure students' demonstrated ability.

Teaching Innovations

Being Innovative at Educational Institutions to Prevent Cyber Incivility

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Need: Within schools, face-to-face bullying is a familiar problem. To complicate matters, a new form of cyber incivility known as cyber bullying is becoming common place. School administrators, teachers, and parents need to become aware of cyber-bullying and how it can best be prevented.

Overview: A type of cyber incivility known as cyber-bullying is a growing form of harassment as children use the Internet more frequently. It is a serious problem with key differences from offline bullying, and school administrators need to understand the complex nature of this form of abuse. Students have a right to freedom of speech, which must be balanced with disruption in the school when trying to punish perpetrators. Administrators, teachers, and parents need to become aware of cyber-bullying as well as best practices for preventing it from occurring.

Major Points:

- Awareness of the of cyber bullying problem
- Differences between cyber bullying and face-to-face bullying
- Complexity of monitoring and preventing incidents
- Constitutional rights of perpetrators
- Prevention of cyber-bullying

Summary: Conference attendees will learn how to be innovative at their institutions to prevent cyber incivility. The presentation will increase awareness of the cyber bullying problem, and attendees will learn how cyber bullying is different in many ways when compared to face-to-face bullying. The constitutional rights of perpetrators will be clearly described. Numerous suggestions for how to be proactive in the fight against cyber-bullying will be discussed.

Teaching Innovations

Enhancing Environmental Technology Studies with Service Learning Projects

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Need: Energy usage coupled with the impact on the environment is one of the most important subjects for today's students. Environmental and energy conscious students will benefit in understanding power ratings and energy usage of electrical systems such as electrical equipment and electrical appliances found in most homes and how this use impacts the environment from factors such green house emissions and energy by-products that are delivered to landfills.

Overview: Faculty combined studies of alternative energy such as solar, wind, and bio-fuel with service learning projects conducted by students. Technology students conducted energy saving service learning projects for their communities as part of an environmental technology course requirement. The data from various homes and businesses were gathered and analyzed. The results were presented to other technology students, as well as, the home and business owners. Students conducted research on "green" energy alternatives that were suggested to the owners as possible ways to reduce energy usage.

Major Points:

- Energy conscious home and business owners along with students grasp a better understanding and greater appreciation of the value of the "electric-energy" dollar.
- Project provided students hands-on experience, a comprehensive experience in teamwork, and the opportunity to apply their management and energy technology skills.
- This project ensures a large pool of well-trained students who will be available to enter both the energy and environmental technology sectors.

Summary: This study provided home and business owners with the necessary knowledge to enable them to deal with energy waste in their home or business. Students were better prepared for possible energy and environmental technology jobs, and they obtained a better understanding and appreciation of the value of the "electric-energy" dollar. Energy surveys helped increase the understanding of electric fundamentals for technology students.

Teaching Innovations

Advancing Diagnostic Skills Training in the Undergraduate Technology and Engineering Curriculum

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Need: Advanced technical diagnostic skills are essential for industry, government and the military to enable a smarter workforce to improve our nation's overall competiveness. Diagnostic skill training often employs static decision-trees or overly-simplified rubrics that are time consuming and frequently result in a single process to solve technical problems. Additionally, these skills are almost always assumed to develop with experience.

Overview: The development of advanced diagnostic skills to identify problems in complex technical systems continues to be difficult and time consuming. This presentation will describe a research project that employs concept-mapping, and, rubric and expert feedback to help technology and engineering students develop advanced diagnostic skills. This project is funded by NSF/TUES.

Major Points:

- Theoretical basis for the development of advanced diagnostic skills
- Overview of software development and use to improve diagnostic skills
- Implications for technology and engineering educators

Summary: The advancing diagnostic skills training software developed and tested in this project will enable instructors to integrate diagnostic skills training into existing STEM courses as well as use the products of this research as a model to develop additional diagnostic training modules of instruction as re-usable instructional objects to be placed in a library to share with others. This project is funded by NSF/TUES.

Teaching Innovations

An Interactive Game to Enhance Student Understanding of Materials Management

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Need: Manufacturing technologists and engineers create wealth by adding value to products. Traditionally students read their textbook and work cases or problems covering material in each chapter. We have incorporated a "Master Scheduling Game" which assists students in developing the "feel" needed to be a master scheduler in a job shop or limited production environment. The game challenges student knowledge or, in some cases, explains the "why" regarding materials management. The game challenges student knowledge covered in material management textbooks and shows them how to schedule in a complex working environment to get the most out of their resources. We must use production processes in a way that is most cost effective.

Overview: Operations management works in an environment affected by many factors. There are often many steps in the "supply chain" to achieve the final product. To get the most out of our resources in a timely and cost effective manner we must utilize equipment efficiently and control inventory costs. This game was developed to help students understand the complex relationship between equipment utilization and inventory cost control.

Major Points:

- The game helps develop a "feel" that cannot be easily replaced with a mathematical model.
- The master schedule is the resource document for the manufacturing resource plan.
- The financial cost of inventory control and missed schedules is emphasized.

Summary: The materials management game measurable objectives were to increase the performance and preparation of students as well as increase student participation in active learning. Preliminary results from student participants show increased knowledge of materials management options, expectations, and preparation.

Teaching Innovations

Strengthening Our Connections between Theory and Practice Using Practical Applications in the Machine Shop to Teach Mathematics

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Need: Many students lose interest in mathematics when they are not exposed to practical applications. If students use mathematics in context with real applications, then they often make the connection and begin to understand how useful and necessary mathematics is.

Overview: The machine shop environment is rich with opportunities to use mathematics to produce real-world applications. The student who has lost interest in the study of mathematics can be turned around when given actual hands-on practical applications of mathematical concepts when operating machine tools to produce something real. Trigonometry and algebra have real meaning when the student can manipulate machine controls and can measure his or her results with accuracy.

Major Points:

- Math anxiety is real, but so are applications of math
- When students use hands-on techniques to contextualize mathematics, they see that math is fun
- Examples of trigonometry, algebra, and geometry are plentiful in the machine shop
- Producing objects on machine tools reinforces mastery of mathematical concepts

Summary: Attendees will be shown several machine shop applications that illustrate the importance of mathematics. Methods for demonstrating that mathematical concepts are simple and fun will be discussed.

Teaching Innovations

Confirming Cinderella: One Size Does Not Fit All

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Need: Today's technological society requires more from every student than a basic ability to read, write, and perform simple mathematics. Scores from 2008 VoCATS assessment showed that approximately 60% of the students were reported as technically proficient; leaving the remaining 40% of the students below proficiency level (North Carolina Department of Public Instruction, 2009). Technological literacy is imperative for the twenty-first century. In order to increase technological literacy, technology teachers must be able to meet the needs of diverse learners.

Overview: The technology teachers must be as innovative and progressive as the field of technology. Teachers must be as pedagogically proficient as they are technologically proficient. To meet the needs of diverse learners, teachers must differentiate their instruction. Differentiated Instruction (DI) is a philosophy that governs practices for addressing the needs of academically diverse students. DI is a process that seeks to educate the whole child rather than developing a specific cognitive ability and allows for the curriculum to be administered as a tiered process that engages each learner (Tomlinson, 2001). In a differentiated classroom, teachers first assess student readiness, interest, learning profile, and emotional responses. Second, they modify the content, process, products and learning environment to meet the needs of each student.

Major Points:

- Do Technology Education (TED) teachers understand differentiated instructional components?
- Is there a significant difference between novice and experienced TED teachers in their understanding of differentiated instructional components?
- Do TED teachers use differentiated instructional components?
- Is there a significant difference between novice and experienced TED teachers in their use of differentiated instructional components?

Summary: Attendees will understand what DI is and how it enhances student learning. In addition, through real life examples attendees will know how to practically implement DI in technology courses.

Teaching Innovations

Not Just Busy Work: Reflective Activities Make Connections between Theory and Practice

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Need: Current students need to prepare to work successfully in fields with technology that is constantly evolving, solving problems that do not yet exist. The challenge as educators is to go beyond teaching specific technologies, to help students develop strategies for learning how to think, adapt, and meet the challenges of the future. One technique for doing so is using reflective activities in the curriculum. Reflective activities can address this need by helping students focus on the process of learning and being able to "think on their feet", thinking critically, and experiencing transformative learning.

Overview: The idea of using reflection, self-assessment, or meta-cognitive strategies such as journaling is not new. The topic has been part of educational strategy discourse for decades. What is new, and potentially more beneficial in this area, are the specific activities and technologies that can be implemented in the graphic communications curriculum. For example, reflection papers help students process their readings and prepare for the steps in a lab process. They can also help students evaluate their goals, approach, and results with projects. Tactics such as worksheets and games can provide opportunities for students to verbally and collaboratively share discoveries, connections, and engage in an informal review of course material. Finally, the papers provide a thoughtful evaluation of projects to be put in a portfolio along with the item/s to be displayed.

Major Points: Reflection lends itself well to:

- Preparing students for lab activities by reflecting on steps in a process, safety methods, etc., thereby making the transition from theory to practice
- Providing additional means of engaging in the course, especially beneficial for students who are introverted or quiet during class discussions
- Creating a record of learning for later use when students create a final paper, presentation, or other project
- Providing the ability to view the progression of students' thoughts over time and how their understanding changes, perspectives broaden
- Instructors performing formative assessment of students' progress in assimilating material, in order to make course adjustments if necessary
- Beginning to and/or strengthening the shift towards student responsibility for their own learning.

Summary: Participants in this presentation will be shown examples of exercises that have been used in classes and between classes with students. Presenter will discuss the how, what, and why of reflective activities as they have been implemented. Participants will be invited to share their own challenges and successes for teaching using reflective activities with students.

Teaching Innovations

Teaching Ahead of the Available Teaching Tools – When Technology Outpaces Textbooks and other Teaching Materials

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Need: As students prepare for jobs now and in the future, the knowledge they need to be prepared for those positions is changing more rapidly than ever in the history of time. The traditional ways of observing a need for instruction, then writing texts and publishing teaching materials no longer keeps pace with the preparation needed by the students. These changing skill requirements occur for many reasons, and many occur because of technological advances. One example of these problems is that textbooks cannot keep pace with cyber crime or cyber hacking. Other examples include the growth of technologist level positions in areas such as energy, construction, engineering, environmental science and safety.

Major Points:

- Keeping the industry involved in the process of defining what skills a graduate will have for current position requirements
- Keeping the course material in line with technological and job position requirements
- Keeping textbook and course material/equipment companies apprised of the need for updated materials
- Writing curriculum based upon the expertise of teaching staff
- Incorporate predictive teaching plans

Summary: At Bossier Parish Community College, students in our Technology, Engineering and Mathematics Division are working towards careers where innovation is the norm. To meet the needs of these students and the industries, we have sought the advice of experts, crafted our own curriculum and kept a keen eye to the upcoming trends for the industry. We believe that by making innovation a focus of our programs that we will be able to keep pace with industry advances.

Teaching Innovations

Integration of GD&T and 3D CAD in a Tool Design Class

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Need: Appropriate tool design is very critical for achieving high quality products in shorter time and lower cost, which is the key to standing out in today's competitive global manufacturing environment. Design of gages, jigs, fixtures has been increasingly conducted in 3D CAD systems. Geometric dimensioning and tolerancing (GD&T) is the only industrial standard that is recognized around the world as the only effective way to define part geometry. Thus, integration of 3D CAD and GD&T in tool design class is required to meet the need of the current manufacturing industry.

Overview: The author propose a new tool design class which is based on projects using 3D CAD system to design gages, cutting tools, jigs, turning fixtures, milling fixtures, inspection fixtures, and assembly fixtures. All drawings are specified with GD&T. By completing the class, students gained the knowledge of using 3D CAD to design tools based on the GD&T information on the part drawing and specifying GD&T on the tool parts they designed.

Major Points:

- Current status of tool design class and industrial practice
- Learning outcomes
- 3D CAD and GD&T
- Projects of gages, cutting tools, jigs, and fixtures
- Feedbacks from students and local manufacturing companies

Summary: A tool design class based on projects of real world problems using 3D CAD and GD&T is introduced in detail. Feedbacks from students and local manufacturing companies are reported.

Teaching Innovations

A Case Study of the Barriers and Best Practices for Developing Effective Small Group Collaborative Learning Activities Using Multi-User Video-Conferencing Software

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Need: The purpose of this study is to investigate what barriers faculty and students encounter when trying to incorporate multiuser video conferencing software for collaborative group projects. The intent is to develop a set of best practices while identifying the pros and cons of using this innovative instructional methodology. The study group will consist of students enrolled in Industrial Management courses at the University of Central Missouri.

Overview: Little pedagogical research exists identifying if differences exist between online courses using Internet Video Technology and those that do not use this communication technique. According to Bender (2003) it is beneficial and important to vary the learning activities in online courses. Instructional technologies vary between course, instructor, major and university. With the growth of online degree programs it is necessary for researchers to pay closer attention to this technology and investigate the use of video in online course delivery.

Major Points:

- Does multiuser video conferencing software enhance student perceptions of online courses?
- Would attendance to online courses be affected?
- Will technical difficulties increase?
- Are students more engaged in the class while using video conferencing software?
- What are the pros and cons of using video conferencing software?

Conclusions: Information presented in this study will serve as a reference to help establish a baseline of best practices for online instruction using multi-user video-conferencing software. The goal will be to establish guidelines for faculty to incorporate this innovative instructional method to enhance student learning.

Teaching Innovations

How Can Faculty Make Their Work in the Classroom Compelling?

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Need: The environment around the university has changed profoundly as evident by the technological infrastructure that caters to our every need for entertainment, commerce, work, and health concerns. However, the way education is conducted in university settings remains routed in a pre or post-Gutenberg era that is out of touch with the information age where access is unparalleled. Under this scenario, universities run the risk of losing their purpose because of a misplaced focus on knowledge as a commodity of scarcity—an economic model—as opposed to one of engagement, analysis, and synthesis. How then should teaching change for the 21st century student?

Overview: Faculty in the 21st century have an assortment of technological tools at their disposal for them to use in teaching and learning, but to what extent are these tools used in a pedagogically responsible manner? PowerPoint, the ubiquitous presentation software in the academy, appears to be utilized more as a fast content delivery vehicle, which not only deposits information at students' desks but also relegates them to the role of passive listeners. The paradox of this approach, however, is in sharp contrast with how students use their portable devices to gain information about the world around them.

Major Points:

- Examine a multi-modal approach to instruction.
- Ask faculty to think about how they could utilize technology in more purposeful and creative ways to connect with and engage students.
- Demonstrate some creative and very different ways of utilizing PowerPoint, screen capture and recording software, and iBooks Author to develop instructional content that can be assessable 24/7 by students on multiple platforms.

Summary: Those attending this workshop will gain insights into how technology can be effectively utilized to positively impact teaching and learning by changing the instructional focus from one of knowledge as a commodity of scarcity—an economic model—to one approach of engagement, analysis, and synthesis.

Strengthening Our Connections

2012 Conference Proceedings Papers

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Administration

Administration

An Analysis of the Skills Gap in the Workplace for Students Graduating from Manufacturing / Technology Management Programs

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Abstract
There is a vast range of courses for a Bachelor of Science degree in manufacturing/technology management programs under different ATMAE accredited programs, which causes a lot of variation of students' competencies after their graduation. There is a need for identifying essential competencies for students in these industrial technology programs; thus, academic institutions should develop their curriculum based on common and relevant competencies that meet the contemporary needs of the industry. A review of current literature shows that graduates lack the necessary skills for the market, which means the skills gap is widening in the American workforce. This paper addresses the issue of the skills gap from two perspectives: the educational and organizational roles. A systemic approach introduced by total quality management (TQM) will be taken into consideration to tackle the issue from a broader perspective.

Introduction
American industry is facing a strenuous scarcity of qualified employees (Plunkett, 2010). This scarcity becomes even worse in workplace for technology fields because of the rapid development of technology. In the latest report of the skills gap in U.S. manufacturing conducted by Morrsion et al. (2011), results appeared consistent with the previous studies that a large portion of American manufacturers are still facing a severe shortage of skilled employees. Alarmingly, more than a half of manufacturers predicted the shortage of qualified employees to exacerbate within the next three to five years. Thus, to close the skills gap, a huge responsibility is placed on the undergraduate manufacturing/technology management programs to provide graduate students with the updated and required skills for the workplace. A recent survey of undergraduate catalogs in 60 ATMAE accredited schools revealed a gap between what is required for the workplace and what is included in the academic curriculum (Jones, Smith & Callahan, 2010). Identifying necessary competencies for students in these industrial technology programs is the key for this problem. However, recognizing the issue of deficiency in essential skills for the workplace is not a new matter, it has been the focus of the federal workforce for more than 20 years, and it still hasn't been deciphered (McNamara, 2009). This led us to consider the issue from a broader perspective, which highlights other important aspects than essential competencies. The cause of skills deficiency is not merely relying on individuals as the traditional way of employability but rather on structural problems (Hyslop-Margison, 2005). Therefore, in order to bridge the skills gap, a systemic approach introduced by the total quality management (TQM) point-of-view is taken into consideration for tackling the issue. This structure system stresses four major players, which includes students, curriculum, faculty, and organizations.

Students' skills
The most important factors, which employers are looking for in workplace, are individuals with high skills and great flexibility (Morrsion et al., 2011; Tennant, McMullen & Kaczynski, 2009). These two factors provide clear evidence of the importance of both hard and soft skills, which universities should thrive to equip their potential graduates with. Hard skills are technical skills that individuals learn through education and learning, which are necessary for accomplishing specific jobs. On the other hand, soft skills are more generic skills, which could be applied to any type of job such as problem-solving and multitasking (McKay, 2007). In the manufacturing field, the focus on soft skills has increased recently because of the challenge of intangible problems along with process innovation. Hard skills, on the contrary, have been recognized for a long time because of the nature of manufacturing's needs for technical skills (Williams & Johnson, 2004). It is strictly important to keep a balance between these two types of skills in the manufacturing arena. According to Morrsion et al. (2011) in the skills gap report, the hardest jobs to fill are those that require high technical training such as machinists,

operators, craft workers, distributors, and technicians. While in the same report, manufacturers stated that the most missing skills they require for their current employees are problem solving skills, which are crucial for flexibility. Because of the rapid change of technology and the increasing demand for meeting industry' needs, manufacturing technology programs require more attention on both hard and soft skills at the same time to enhance graduate students ability for adapting change. Today's important technology may become obsolete within just few years. According to Ohmae (2005), nearly half of the technology program graduates from MIT are working in a different field after five years of working.

Competency-based curriculum

The shift process between learning in the education system and work is the most challenging part for our current students (Soares & Mazzeo, 2008). Evers, Rush, and Berdrow (1998) believe that the key solution to help this transition be more effective is to build our education based on a competency-based curriculum. Because knowledge does change rapidly, we have to focus on skills development in order to help students tackle the process of knowledge. "According to John W. Scott, CEO of Bahrain Polytechnic, Design a "universal curriculum" around competencies is one element in order to produce work-ready graduates" (Cornelius,2011). In the manufacturing/management technology programs, these competencies have to be developed while addressing both hard and soft skills as we mentioned earlier. For hard skills, Jones, Smith, and Callahan (2010) conducted a study to find out the educational needs of manufacturing professionals. Among the top essential needs, lean process improvement tools, CAD, CAE, CAPP, or CAM, flexible manufacturing systems, integrated manufacturing systems, Six Sigma, sensor technology, automated material handling, and advanced inspections were the most current required skills respectively. Also, they found these skills are the most projected required skills within the next 10 years. Unfortunately, researchers didn't find any evidence for covering flexible manufacturing and integrated manufacturing systems in the curriculum of ATMAE accredited schools. However, there was good coverage of CAD/CAM while there was little for lean manufacturing, Six Sigma, sensory technology, and automated material handling.

For soft skills, Meier and Brown (2008) identified the importance of different competencies to include in a managerial core for ATMAE baccalaureate programs. They found out the most important competencies, which contribute to job success, are as follow respectively: problem solving, interpersonal communications, written communications, computer literacy, communicating effectively, team work, listening, oral communications, time management, decision making, critical thinking, problem identification, leadership, motivating self & others, and quality management (tools & techniques). From the list, we note that most of the important managerial competencies are soft skills while problem solving is the number one priority, which is augmenting our previous findings.

Faculty development

With the fast expansion of knowledge, faculty are required for continuous development during all their educational life. This is very critical especially for those technical education institutions where theory has to be linked clearly with practice (Bhatia & Bhatia, 2008). Developing a curriculum to match the needs of today's workplace can't be done without updating faculty knowledge and experiences in their fields. Thus, as we need to provide practical experience for students, developing programs that foster teachers' skills such as industry partnerships and projects are a necessity within technology programs (Shaw & Downing, 2003). A good example for the significance of updated teachers' experience is introduced by Jo Anne Freeman, chairman of Industrial and Manufacturing Engineering Department at the California Polytechnic State University (Reis, 1997). She explained how her department implemented the upside-down curriculum where faculty bring their real world experience into the small classes. Clearly, this approach can't be done without an immense and related faculty experience. According to Reis, all faculty in the department have various real-world experience, some of which have ongoing consulting jobs. Students in class work on many practical problems provided by, for instance, General Motors Corporation, Applied Materials Corporation, and San Francisco Airport. "These design problems are messy, iterative problems, often with significant political and social overtones. To tackle them effectively requires exceptional teachers, and here is where real-world experiences can make a difference" (p.273).

Another important aspect that we have to emphasize is the importance of hard and soft skills not only for students but also for faculty development. In the arena of manufacturing/technology management programs, many teachers may acquire the sufficient and updated experience that is related to hard skills, but they also may fail to obtain the essential soft skills to deliver the materials in a proper way to students. Teaching soft skills to students is difficult to measure and a lot of faculty fail to apply it because they simply lack soft skills themselves (Bhatnagar, 2012). Faculty with good communication skills would help guide students not only for the course materials but also for their real-life work in the long term.

Lastly, faculties are required to understand the concept that the need of the new generation of workers is different than baby boomers; therefore, they have to meet their demand of preferences for interactive learning. The new generation has

spent most of their lives with digital technology and may require different strategies for training and learning, and yet teachers use the same approaches they constructed in the past (McNamara, 2009). Astonishingly, the basic structure of learning has not changed even though they have adopted different and new technology tools for education. An abundance of educators add more arduous material to their classes without relevance while very few materials would apply in the workplace (Cornelius, 2011).

Organizational roles

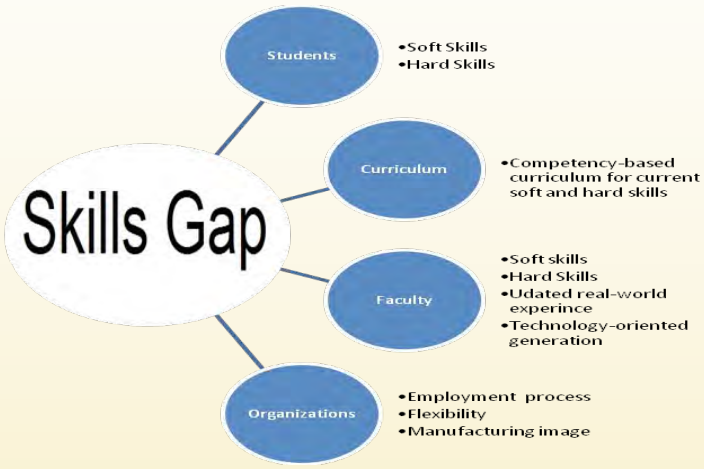
While the role of education is imperative for the skills gap in the manufacturing area as we mentioned earlier, we should also draw attention to the other side of the equation which is the organizational role. There is a need for change in the hiring process and in the work environment. In the skills-gap report by Morrsion et al. (2011), a lot of manufacturers are still following very old approaches for recruiting the required people such as word-of-mouth recruiting. Also, the workplace has an unattractive environment and needs more flexibility to deal with the skills gap problem (Sullivan, 2010). Sullivan addressed the concept of flexible working by, for instance, creating a reword system that takes advantage of the technology-driven skills for the new generation. Also, employers should be flexible to the expectation of those young graduates to the work benefits and rewords. If we look at the 20 industries with the largest projected wage and salary employment declines between 2010 and 2020 as depicted in U.S. Bureau of Labor Statistics (2012), we spot that 11 come from the manufacturing field. Evidence of the skills gap problem becomes even more remarkable when we note that many sources of jobs for less-skilled employees transferred to other sectors from 1992 to 2003 because employees can earn better average wages (Neumark, 2012). "The responsible manufacturing community condemns such practices and offers careers that provide competitive wages, benefits, and opportunities for self-fulfillment and self-advancement" (Committee on New Directions in Manufacturing, 2004, p.79). Instead of sending jobs abroad because of the labor cost, organizations have to take into consideration the total cost of their products and the community commitment of bringing back more jobs to U.S. Good examples of organizations that contributed to entry level labor and at the same time expanded their profits are Ford, General Motors, General Electric, and Boeing (Kochan, 2012).

In addition, organizations take a large responsibility on the role of recreating the image of manufacturing jobs. Moser (2011) stated that there is a poor image about the manufacturing environment in public causing the shortage of skills in the field. There is an outdated misconception that manufacturing careers are a messy and unsafe environment, which in consequence shifts students away to more attractive disciplines supported by the media. Inviting students to be exposed to the modernized workplace that many manufacturers implement would help to ameliorate this fuzzy image.

Need of a systemic approach

There is an increasing need for a holistic and effective long term cooperation between the major players that contribute to the skills shortage in the workplace (Fox, 2003; Morrsion et al., 2011). TQM is a systemic approach that takes into consideration the long term collaboration among those different players (Lawrence, McCollough, 2001). The major characteristic of TQM, which is a good solution for the problem, relies on the basic principle that the root cause of the poor quality and problem is the system and not the individual people. Thus, we propose a structure system that emphasizes the need of collaboration between students, curriculum, faculty, and organizations all together as depicted in Figure1:

Figure1: A systemic approach for reducing the skills gap



Conclusion

Skills gap in the workplace has been an issue for the U.S. industry for a long time and has increased even more recently due to the fast development of technology. Since this issue is very apparent in the manufacturing arena, students graduating from related programs become the focal point. Review of the literature revealed that ATMAE accredited programs lack essential and current competencies in their curriculum, specifically, for the manufacturing/technology management programs. Soft skills such as problem-solving become a priority for employers along with hard skills because the industry needs students who are more flexible and prone to change. Teachers also are required to acquire updated real-world experience to facilitate the development of students' skills. In addition to students, curriculum, and teachers, organizations play a significant role in reshaping the image of manufacturing jobs by inventing a new hiring process and creating a more attractive environment for the workplace. These major players must find a way to collaborate together in a holistic system such as TQM in order to produce quality outcome and reduce the skills gap.

References

Bhatnagar, N. (2012). *Effective communication and soft skills*. India: Dorling Kindersley Bhatia, C. M., & Bhatia, S. (2008). An integrated approach for restructuring higher technical education. *Global Journal of Flexible Systems Management, 9*(2/3), 61-70.

Committee on New Directions in Manufacturing (2004). *New directions in manufacturing: Report of a workshop*. Washington, DC: The National Academies Press.

Cornelius, D. (2011). The education and skills gap: A global crisis. *Techniques: Connecting Education and Careers, 86*(4), 50-55.

Evers, F., Rush, J., & Berdrow, I. (1998). *The bases of competence: Skills for lifelong learning and employability*. San Francisco: Jossey-Bass.

Fox, M. (2003) *Pan-organizational summit on the U.S. science and engineering workforce: Meeting summary*. Washington, DC: National Academies Press

Hyslop-Margison, E. (2005). *Liberalizing vocational study: democratic approaches to career education.* Lanham, Maryland: University Press of America

Jones, M., Smith, R., & Callahan, R. (2010). Perspectives on how academia is keeping pace with the changing needs of manufacturing professionals. *Journal of Industrial Technology, 26*(1)

Kochan, T. A. (2012). A jobs compact for America's future. *Harvard Business Review, 90*(3), 64-72.

Lawrence, J., & McCollough, M. (2001). A conceptual framework for guaranteeing higher education. *Quality Assurance in Education, 9*(3), 139 – 152

Meier, R. & Brown, D. (2008). An exploratory study to identify a common managerial/professional core curriculum for NAIT baccalaureate programs. *Journal of Industrial Technology, 24*(2).

McKay (2007). *The everything get a job book: The tools and strategies you need to land the job of your dreams.* Massachusetts, Avon: F+W Publications

McNamara, B. R. (2009). The skill gap: Will the future workplace become an abyss. *Techniques: Connecting Education And Careers, 84*(5), 24-27.

Morrsion, T., Maciejewski, B., Giffi, C., DeRocco, E., McNelly, J., & Carrick, G. (2011). *Boiling point?: The skills gap in U.S. manufacturing.* Deloitte Development LLP and the Manufacturing Institute. Retrieved from http://www.themanufacturinginstitute.org/~/ media/A07730B2A798437D98501E798C2E13AA.ashx

Moser, H. (2011). Revitalizing manufacturing with skilled worker training. *Manufacturing Engineering, 147*(1), 116-118.

Neumark, D. (2012). Worker skills and job quality. *FRBSF Economic Letter, 1*(13)

Ohmae, K. (2005). *The next global stage: Challenges and opportunities in our borderless world.* Upper saddle river, NJ: Pearson/Wharton School Publishing.

Plunkett, Jack W. (2010). *Plunkett's companion to the almanac of American employers: Mid-size firms 2010.* Houston, Texas: Plunkett Research, Ltd.

Reis, R. (1997). *Tomorrow's professor: Preparing for careers in science and engineering*. New York, NY: Wiley-IEEE Press

Soares, L., & Mazzeo, C. (2008). *College-ready students, student-ready colleges: An agenda for improving degree completion in postsecondary education*. Washington, DC: Center for American Progress. Retrieved from http://www.americanprogress.org/issues /2008/08/pdf/highered3.pdf.

Shaw, R. & Downing, C. (2003) The status of industrial interaction/outreach in industrial technology. *Journal of Industrial Technology, 19*(1)

Sullivan, N. (2010). Millennial mindset. *Employee Benefits, 33*.

Tennant, McMullen & Kaczynski (2009). *Teaching, learning and research in higher education: A critical approach.* New York, NY: Taylor & Francis

U.S. Bureau of Labor Statistics, U.S. Department of Labor. (2012). *Occupational Outlook Handbook: Projections overview.* Retrieved from http://www.bls.gov/ooh/ about /projections-overview.htm

Williams, D., & Johnson, W. (2004). *Hard and soft approaches to manufacturing: which is the most important?*. International Journal of Advanced Manufacturing Technology, 24(7/8), 533-540.

Administration

Designing and Implementing a Senior Capstone Portfolio in a Baccalaureate Automotive Technology Program

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Introduction

Assessment in education has been discussed and studied for many years (Wiggins, 1998). Educational systems have felt pressure from federal and state agencies to assess student outcomes and have accountability for them (Russell, 2006). Goals, standards, outcomes, competencies, assessment and accreditation are now driving curriculum and programs within universities.

Educators and administrators have used many forms of assessment to determine outcomes and competenancies of students. One of these forms has been the use of portfolios (Russell, 2006). The use of portfolios for educational assessment is not new (Mitchell, 1992). Portfolios have many functions, benefits and applications for implementing assessments into university curriculum and degree programs. Mitchell spoke of some of the benefits of portfolios: "Portfolios are the most flexible form of performance assessment" (p. 131). He continued "A portfolio packs a tremendous punch in terms of turning around student attitudes, teachers' ways of working and, ultimately, the school's understanding of its function" (p. 131). Wiggins (1998) described the purposes of portfolios:

> Portfolios can primarily serve instruction or assessment; they can be focused primarily on documentation or evaluation; their contents can be defined by the student or by the teacher; they can be seen as a resume, as a representative sample of overall performance (good and bad), or as a constantly changing exhibit (p. 190).

One specific way portfolios have been applied in degree programs is through incorporation into capstone courses. They have been used in these courses to help identify student competencies (Paquette, 2005). The following describes the process Pittsburg State University's (PSU) Automotive Technology department went through to implement a capstone portfolio within their program.

Motivating Students Using a Capstone Portfolio

During the 2009-2010 academic year PSU's automotive technology department went through a program review process which takes place on average once every five years, depending upon program accreditation cycles. The automotive faculty and the chair conducted an extensive internal review of the two automotive degree baccalaureate degree programs: Bachelor of Science in Automotive Technology (BST) and the Bachelor of Applied Science in Technology (BAS). The BST degree was designed as a traditional degree that students choose when they start the program as an incoming freshman. The BAS degree was designed for students who transfer an associate of applied science degree in automotive, diesel or collision technology.

During the review, the chair and faculty met multiple times with the university's assessment director for direction on the assessment needs in the department. In addition, programs met semi-annually with a national advisory board, comprised of industry representatives that employed the programs' graduates, to receive guidance on the BST and BAS program curriculum.

During the program review faculty were required to answer the following questions related to student outcomes, program assessment and program improvement.

- What do your graduates need to need to know and be able to achieve?
- How is it demonstrated that the students are achieving those results?
- What are the programs doing to improve students' performance?

Over the past several years the advisory board had stated that graduates should be competent in the following areas: writing, speaking, team-work, safety, and automotive management topics. The board also advised that the student's should be employable and able to pass Automotive Service Excellence (ASE) exams.

Documenting Student Outcomes and Results

Through the year long program review process the BST and BAS programs chose to implement a "senior capstone portfolio" that could be used by both programs to measure student outcomes and could guide the programs in making improvement to the curriculum. The faculty and department chair met with the university's assessment director, dean and advisory board while designing the portfolio. The portfolio was revised multiple times and continues to be refined each semester.

Advisory Board Participation and Support

The advisory board was first introduced to the portfolio concept during the October 22, 2009 fall meeting and provided ongoing input during the following six semesters as the programs refined the portfolio. Although many programs have advisory boards, not all boards are provided the opportunity to be actively engaged in curriculum decision making. One outcome was the level of enthusiasm and excitement that the advisory board exhibited during the development of the portfolio. The industry representatives were invigorated by the concept and excited to see the program improvement. One board member stated, "over the course of my eight years at the university, I have never be more excited than now with the implementation of this new portfolio concept."

Development of the Capstone Portfolio

Multiple portfolio concepts were proposed to the board, assessment director and the dean. One of the final proposals had four to five competency areas and required students to pass a minimum of two or three of the areas. But the portfolio eventually evolved to incorporate seven different competency areas. These included Management, Technical, Written Communication, Professional Employability, Safety, Oral Communication and Team Work. See Figure 1 for the portfolio rubric.

Figure 1. AT 699 Senior Seminar Capstone Portfolio Rubric

	Total Possible Points	Total Points Permissible for submission	Competency Area Target	Target's minimum points	
Management Competencies	130	130	70% of AT 690	91	
Technical Competencies	735	250	Pass 2 ASEs	90	
Written Communication Competencies	130	115	70% of ENGL 301	56	
Professional Employability Competencies	170	120	1 internship	50	
Safety Competencies	90	50	Three SP/2 certificates	30	
Oral Communication Competencies	75	60	2 presentations	30	
Team Work Competencies	110	60	2 team work experiences	30	
	1440	785		377	Minimum Required Points

Each of the seven areas provided students the opportunity to demonstrate competencies from those different areas. Students earned points from each of the different competency areas by submitting graded assignments with a "C" or higher letter grade, certifications, or other required artifacts such as a letter of reference or internship evaluation form. The portfolio required a student to achieve a minimum of 377 points or they would not pass their senior seminar class and

therefore not graduate. The rubric does not require that students achieve a minimum number of points in each of the seven competency areas, which was recommended and well received by the advisory board. The advisory board members stated that their specific company would vary from the next company and therefore the industry representatives could look for graduates that were stronger in their area of preference, for example "safety."

The portfolio also provided the programs the opportunity to motivate students to excel in areas that might be of lesser interest to the students such as writing assignments, classroom presentations or ASE exams. The portfolio provides additional motivation to the student that maintains a "D for diploma" mentality. Achieving anything less than 377 points will result in an incomplete grade for the class which will turn into an "F" after six months.

To prevent the student from achieving all 377 points from only one or two categories, a total points permissible for submission was developed with a total of 785 points which can be seen in figure 1. This provided a maximum allowable points for each area.

Implementation of the Portfolio

Implementation of the portfolio began in 2009 when the automotive department chairman visited several different automotive classes and communicated the new portfolio process. The automotive faculty also explained the new portfolio in classes to support the implementation. Specifically in the freshman AT 100 Orientation to Automotive Technology and the sophomore/junior class AT 399 Automotive Professional Development, the portfolio was explained in detail. This process continued through the 2010 academic year. Faculty advisors also started explaining the portfolio to their advisees during their fall 2010 enrollment appointments.

The actual capstone portfolio assignment was to be completed in the senior course AT 699 Automotive Senior Seminar, which is a required course for both the BST and BAS programs. In the fall 2011 semester, a "dry run" was conducted to look for unforeseen problems. This meant the new portfolio was assigned but the students were not required to attain the full 377 points. Several questions were posed during the dry run enabling the faculty to address the issues prior to the full implementation of the capstone portfolio. In the spring 2012 semester, the full portfolio was implemented in AT 699 Automotive Senior Seminar. This required the students to attain a minimum of 377 points to pass the assignment, pass the class and be able to graduate with an automotive degree.

Paper and Electronic Submission of the Capstone Portfolio

The portfolio submission was in a paper notebook form with the seven competencies tabbed. Initially, the PSU automotive programs were encouraged by the administration to use Livetext, an electronic database, for electronic submission of the portfolio. The automotive department went through several training sessions on Livetext and developed the process with Livetext. During the fall 2011 semester, PSU administration decided Livetext would not be supported, so it was dropped as part of the automotive portfolio submission. PSU is now incorporating "Canvas" as the institution's learning management system. This software has portfolio submission capabilities and the department plans to use it for electronic portfolio submission.

Conclusion and Results

As mentioned in the implementation of the portfolio, PSU conducted a "dry run" of the portfolio in the fall 2011 semester of AT 699 Automotive Senior Seminar. Table 1 shows the results of this. Three of the students were able to attain the goal of a total of 377 points.

Table 1. Capstone Results from fall 2011 AT 699 Senior Seminar Class

In the spring 2012 semester, full implementation of the portfolio was completed in AT 699 Automotive Senior Seminar. The students were required to attain the full 377 points to pass the assignment and class and to be able to graduate with an automotive degree. Thirty three of the students obtained the 377 point requirement. One student obtained 65 points and took an incomplete in the class and plans to finish the portfolio in the fall 2012 semester. See table 2 for the results of the spring 2012 semester.

Table 1. Capstone Results from fall 2011 AT 699 Senior Seminar Class

	Management	Technical	Written	Employability	Safety	Presentations	Team Work	Total
Student 1	0	240	90	100	30	15	0	475
Student 2	68	135	66	100	20	0	60	449
Student 3	0	225	104	50	20	15	0	414
Student 4	92	0	82	50	50	0	60	334
Student 5	77	45	47	85	50	0	0	304
Student 6	106	45	90	0	20	15	10	286
Student 7	0	90	0	120	30	0	0	240
Student 8	0	0	115	70	20	15	0	220
Student 9	0	0	67	95	40	0	0	202
Student 10	0	90	23	20	50	0	8	191
Student 11	0	90	0	60	30	0	0	180
Student 12	0	0	14	70	20	0	60	164
Student 13	0	0	86	50	20	0	0	156
Student 14	0	0	79	0	30	15	27	151
Student 15	0	0	0	100	50	0	0	150
Student 16	85	0	15	0	30	0	0	130
Student 17	0	0	65	0	20	0	0	85
Student 18	34	0	0	0	50	0	0	84
Student 19	0	0	19	0	30	0	0	49
Student 20	0	0	15	0	20	0	0	35
Average	23.1	48	48.85	48.5	31.5	3.75	11.25	214.95

Table 2. Capstone Results from spring 2012 AT 699 Senior Seminar Class

During the Spring 2012 advisory board meeting the department chair shared with the board members the results of the Fall 2011 "dry run" capstone portfolio, and some preliminary results for Spring 2012 based upon partial early portfolio submissions. The results once again invigorated the advisory board with enthusiasm to see the programs' improvement. For example, over the past several years faculty have been unable to motivate students to study for ASE exams. The portfolio enabled students to receive between 45 to 60 points for pawssing an ASE exam. On average only 40% of graduating seniors would pass a minimum of one ASE exam. With the implementation of the spring 2012 portfolio, more than 70% of the graduating seniors passed at least one ASE exam.

The portfolio also motivated students who have already received good job offers to excel in other areas in which they were previously not excelling. For example one student excelled in the technical competency, team work competency, and writing competency, however was still below the 377 point minimum. As a result of the portfolio requirement that student broadened his education in the automotive management competency area.

The design and implementation of the portfolio has been challenging over the past three years. Numerous students became frustrated and heatedly expressed concerns with professors, advisors and the department chair. During the spring 2012 commencement one faculty member visited with several graduating seniors including some of the students who

Table 2. Capstone Results from spring 2012 AT 699 Senior Seminar Class

	Management	Technical	Written	Employability	Safety	Presentations	Team Work	Total
Student 1	130	240	100	120	50	40	20	700
Student 2	127	250	55	120	20	14	0	586
Student 3	130	240	50	70	50	30	0	570
Student 4	117	195	89	20	20	30	60	531
Student 5	61	180	57	120	50	15	0	483
Student 6	109	135	68	100	30	26	9	477
Student 7	116	240	29	50	20		19	474
Student 8	130	225	43	0	50	15	8	471
Student 9	57	250	109	20	0	15	16	467
Student 10	113	90	92	50	50	15	27	437
Student 11	95	135	105	50	50	0	0	435
Student 12	90		115	120	50	15	40	430
Student 13	91	250	0	50	20	15	0	426
Student 14	0	225	115	50	20	0	10	420
Student 15	130	0	91	110	50	15	17	413
Student 16	130	45	93	50	40	30	18	406
Student 17	115	45	74	120	0	29	20	403
Student 18	130	0	24	105	50	60	28	397
Student 19	94	90	32	120	40	0	20	396
Student 20	127	0	110	80	50	14	8	389
Student 21	61	180	27	80	40	0	0	388
Student 22	130	45	28	80	30	57	16	386
Student 23	130	0	87	85	50	13	20	385
Student 24	0	250	55	50	30	0	0	385
Student 25	130	0	115	20	50	43	26	384
Student 26	114	90	83	50	30	0	17	384
Student 27		180	85	10	50	40	17	382
Student 28	111	45	78	80	50	0	18	382
Student 29	100		99	110	20	41	10	380
Student 30	77	45	80	120	20	28	10	380
Student 31	117		115	30	50	15	53	380
Student 32	70	135	39		20	56	60	380
Student 33	97		115	30	50	58	27	377
Student 34		45			20			65
Average	**100.91**	**128.33**	**74.45**	**70.94**	**35.88**	**22.78**	**18.00**	**422.03**

were very frustrated with the portfolio. The faculty member shared with the students that the results were a success and that perhaps two to three years from now that the students might have a change of heart and appreciate the rigor of the portfolio, and much to the surprise of the faculty member the students agreed. As a result of the capstone portfolio the spring 2012 automotive baccalaureate graduates clearly had excelled further and achieved more than past automotive graduates.

References

Mitchell, R. (1992). *Testing for learning*. New York: The Free Press.

Paquette, M.D. (2005). A capstone course in a two-year geomatics program. *Surveying And Land Information Science*, 65(3), 223-226.

Russell, M. (2006). *Technology and assessment*: *The tale of two interpretations Greenwich*, Connecticut: Information Age Publishing, Inc.

Wiggins, G. (1998). *Educational assessment*: *Designing assessments to inform and improve student performance.* San Francisco: Jossey-Bass Publishers.

Administration

Designing New Ways for Improving Students Performance on National Certification Examinations to "Strengthen our Connections" with Industry and Industrial Advisory Boards

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Introduction

The National Institute for Automotive Service Excellence (ASE) is the automotive industry's standard for certifying technicians. The industry recognizes the importance of these exams for certifying technicians. Cristofaro (2006) comments on the importance of the exams for transit maintenance technicians:

> In short, one way to accomplish, substantiate or recognize the skills and competencies of our transit maintenance employees is to certify their skills and competencies. In doing so, certification becomes a credential that everyone seeks. For example, doctors, lawyers, paramedics and other occupations require a certification that provides credentials for an individual to perform in that certified occupation. It recognizes the knowledge, skills, competencies, abilities and initiative that an individual has to exhibit in order to earn the status and credential of the occupation. Why should our transit mechanics have anything less? (p. 1)

Bennett (2004) spoke of fleet managers requiring their technicians to be ASE certified. He notes of the professional benefits of the certifications as well as the positive public perception of seeing the ASE plaques being displayed where the customers can see that the technicians are certified. Gary Goms (2010) argues that "there's never been any question of the value of ASE testing" (p.1).

In addition, automotive education has recognized the importance of ASE certification and the importance of having students become ASE certificated as part of their education. Many automotive programs across the United States have their students take ASE tests as part of their program or even as part of their curriculum. Educators have recognized many benefits to having the students certified (Church, 2007). Having students ASE certified can show employers that the students have the knowledge and understanding to successfully start in the industry. It also shows employers, prospective students, parents and administrators that the automotive program is a quality program. And that it is graduating students who can pass a national certification test in a specialty area. However, preparing the students for the tests and motivating them to study and pass them can be challenging.

Problem/Dilemma

Automotive Students Taking ASE Tests but not Passing Them

Since the early 1990's Pittsburg State University's (PSU) automotive baccalaureate programs have required students to take ASE exams. The faculty have advised the students on the importance of passing the ASE exams. ASE also proctors the exams on PSU's campus. Despite requiring students to take the exams, coaching students on the importance of the exams and providing students the opportunity to take the exams on campus, many students did not take the exams seriously and as a result not many ASE tests were passed. The university administration was asked if the automotive program could require the students to pass a minimum number of ASE tests as part of the curriculum. The administration would not allow this as this would leave ASE in partial control of who earns a PSU automotive degree.

Department Needing Results of the Tests

In addition to the concerns of students not taking the tests, or when they did, they did not take them seriously and as a result not many ASE tests were passed; the department and faculty did not have access to their scores. Not having the results of the tests, did not allow the department to know whether the student passed or failed and how well he or she did overall and in each category of the test. Without this access, it was more difficult to determine where improvements needed to be made in the curriculum and in the teaching process.

Methods/Tools to Help Resolve Problem

With these challenges, the PSU automotive baccalaureate programs chose to take a fresh new approach and implemented multiple mechanisms designed to improve student performance on ASE exams. The following strategies were initiated.

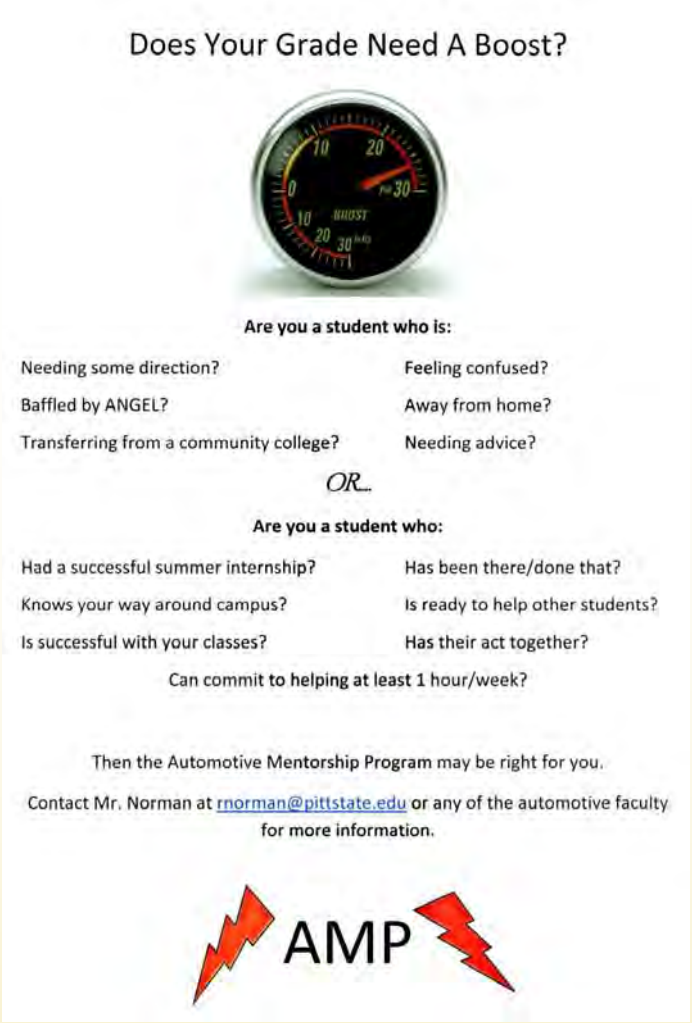
Study Material in Library

ASE study guides were purchased and put in the school library. This provided a free resource for the students so that they could better prepare and study for the tests. The librarian tracked student use of these resources and reported that students frequently used these resources.

Mentor Group

One of the PSU faculty started a mentor group called Automotive Mentor Program (AMP) to help students both in their automotive classes and to prepare for the ASE tests. Successful juniors and seniors in the automotive program offered to help students (typically underclassman) by holding study sessions based on subject areas. For example a study session would be held in an evening for an hour on ASE Test A5 Brake Systems. Different ASE test areas were covered throughout the semester. Figure 1 shows a flyer used to announce these groups.

Figure 1. Automotive Mentor Program Flyer



Prepatory/Remedial Classes

Starting in the fall semester of 2011, PSU started offering ASE Prep Courses for several automotive ASE tests and truck ASE tests. These were 1 hour credit classes and were taught by automotive faculty. These classes covered the information that was on the ASE test for that area. In addition to the technical and diagnostic content being covered; the logistics and process of the test as well as test taking tips were covered.

Grade Bump

Since requiring students to pass an ASE test to graduate was not an option at PSU and students did not readily volunteer their test scores to the department or the faculty, a grade bump incentive was added. This allowed the student to raise their grade in an automotive technical class by one letter grade if they passed the corresponding technical ASE area. For example, if they took the automatic transmission class and earned a B in the course, they could get their grade improved to an A if they took the A2 Automatic Transmission test during the course time frame and passed the test. This motivated the student to sign up for the test during the course while the content was fresh and then study and pass the test. Also, whether the test was passed or not, the student was offered an "extra credit card" to be used in an automotive class for extra credit points if he or she would turn in their test scores. This allowed the department to have access to the student's test results. Figure 2 shows the ASE Examination Policy.

Figure 2. Example of ASE Examination Policy

Bachelor's of Science in Automotive Technology
&
Bachelors of Applied Science in Technology
ASE Examination Policy

Background

The BST/BAS advisory board has strongly recommended that graduates pass ASE examinations. For that reason the department requires students to take two ASE tests in AT 399 Automotive Professional Development and four ASE tests in AT 699 Senior Seminar. If students pass the tests taken in AT 399, then they will only be required to take two additional tests in AT 699 Senior Seminar.

In order to further encourage automotive BST/BAS students to excel and pass ASE exams the program implemented a new policy in January 2009. Students who successfully pass the appropriate ASE exam that corresponds to the appropriate PSU course will be allowed to have their grade raised one letter grade, with the exception of those who have already earned an A, because A is the highest possible grade.

Guidelines

Students must take the ASE exam during the same semester that they are taking the corresponding PSU course, with the exception of the summer. During the summer semester, students may take the ASE test during the fall semester.

Fall semester - Students must submit **all of their original ASE results (with the exam's scores)** to their professor by **the first Friday of the first full week of the spring semester**.

Spring semester - Students must submit **all of their original ASE results (with the exam's scores)** to their professor by **the first Friday of the first full week of the fall semester**. However, graduating seniors must submit their results prior to June 23rd, because it is against university policy to change a grade once a degree has already been posted to a transcript.

Summer semester – Students must submit **all of their original ASE results (with the exam's scores)** to their professors by **the first Friday of the first full week of the fall semester**.

Note: Passing the test prior to taking the PSU class will also allow students to earn a higher letter grade. A grade change will be permanently noted on the transcript, along with a footnote that will state the name of the ASE test that was passed.

ASE Test and corresponding PSU Course

A1 - AT 112 Engine Analysis
A5 – AT 210 Brake Systems
A4 – AT 211 Steering, Alignment & Suspension
A6 or (T6 for DHE students) – AT 215 Automotive Electrical/Electronic Equipment
A6 or (T6 for DHE students) – AT 216 Automotive Electrical/Electronic Equipment Laboratory
A3 - AT 314 Manual Transmission and 4WD Mechanisms
A2 – AT 414 Automatic Transmissions
A7 – AT 510 Automotive Climate Systems
A8 – AT 615 Engine Performance Laboratory

T2 – AT 611 Diesel Fundamentals
T3 & T4 (both required) – AT 630 On Highway Truck Systems
L2 or [(A2, S2, or T2) & (A6, S6 or T6)] – AT 621 Advanced Diesel Electronics and Diesel Engine Laboratory

B3 or B4 - AT 462 Structural and Non-Structural Analysis
B6 - AT 464 Damage Analysis and Estimating
B2 - AT 662 Automotive Finishing and Refinishing

C1 – AT 691 Service Management Seminar

Additional Help:
Our department has requested the KTC library to provide numerous reference books which will greatly assist you in preparing for the ASE exams. Please do visit the library on the second floor in the KTC and check out these reference manuals. You may check them out in the library in 2 hour increments.

If a student passes all 8 ASE areas becoming ASE Master Certified (A1-A8) or (T1-T8) and notifies the department by March 1, then the program will recognize this outstanding achievement during the April College of Technology's awards banquet.

Students may apply for their ASE exams at www.asecert.org ASE offers exams on PSU campus twice a year.
Dr. Tim Dell
Department Chair

Senior Capstone Portfolio

A final incentive was added to motivate students to take and pass ASE tests prior to their graduation. This incentive was the incorporation of the new Senior Capstone Portfolio. It is a required project in the senior class entitled AT 699 Automotive Senior Seminar. It was fully implemented in the spring 2012 semester. For the student to get credit for the portfolio and pass the class, he or she must attain 377 points for the assignment. Table 1 shows the portfolio point break down. Note up to 250 points can be obtained by passing ASE tests. Students can obtain 377 points in the portfolio assignment without passing any ASE tests, but it is difficult to do. This motivates the students to study for and pass at least a few ASE tests for the portfolio assignment. Again, the student must have 377 points for the portfolio assignment, or they do not pass the class and then they cannot graduate with an automotive degree. This encourages the student to take seriously the process of passing some ASE tests.

Table 1. Senior Capstone Portfolio Rubric

	Total Possible Points	Total Points Permissible for submission	Competency Area Target	Target's minimum points	
Management Competencies	130	130	70% of AT 690	91	
Technical Competencies	735	250	Pass 2 ASEs	90	
Written Communication Competencies	130	115	70% of ENGL 301	56	
Professional Employability Competencies	170	120	1 internship	50	
Safety Competencies	90	50	Three SP/2 certificates	30	
Oral Communication Competencies	75	60	2 presentations	30	
Team Work Competencies	110	60	2 team work experiences	30	
	1440	785		377	Minimum Required Points

Conclusions/Results

Based on the concern of motivating students to take ASE tests, study for them and pass them; PSU has implemented several strategies to help encourage students to do so. The results of these implementations have been positive.

The programs began tracking student performance on ASE exams during the fall 2008 semester, table 2 shows the results of this tracking. Prior to the spring 2012 semester, approximately 40% of graduating seniors had passed a minimum of one ASE exam. With the implementation of the senior capstone portfolio and ASE test prep classes, 72% of graduating seniors passed a minimum of one ASE exam. In addition, the average number of ASE exams passed by graduating seniors climbed from a previous high of 1.73 to 2.76.

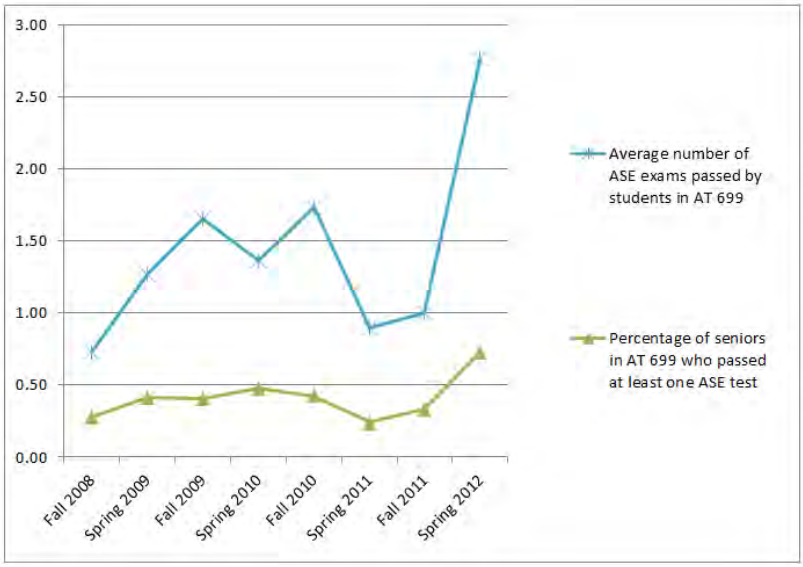
Table 2. AT 699 Senior Seminar Performance on ASE Examinations

AT 699 Senior Seminar ASE results

	Fall 2008	Spring 2009	Fall 2009	Spring 2010	Fall 2010	Spring 2011	Fall 2011	Spring 2012
Number of seniors enrolled in AT 699 Senior Seminar	29	53	32	44	26	29	24	33
Number of seniors in AT 699 who passed at least one ASE test	8	22	13	21	11	7	8	24
Percentage of seniors in AT 699 who passed at least one ASE test	27.59%	41.51%	40.63%	47.73%	42.31%	24.14%	33.33%	72.73%
Number of ASE tests passed by seniors in AT 699	21	67	53	60	45	26	24	91
Average number of ASE exams passed by students in AT 699	0.72	1.26	1.66	1.36	1.73	0.90	1.00	2.76
Note: The program began tracking results in Spring 2009. We had very little information for Fall 2008								

The line graph in figure 3 shows two sharp increases during the spring 2012 semester. During that semester students were offered the opportunity to take ASE prep classes and graduating seniors were held accountable to achieving a minimum of 377 points in their senior capstone portfolio. The capstone portfolio pushed the seniors to a new level of achievement.

Figure 3. Graph of AT 699 Senior Seminar Students' Performance



Overall, PSU has had success in improving students performance on ASE exams. Table 2 and Figure 3 illustrate the positive results from implementing different strategies to motivate students to study and take the ASE tests.

References

Bennett, S. (2004). No technician left behind: Keeping city and county trucks running begins by regularly testing maintenance and repair professionals. *American City and County,* 42-43.

Church, W.M. (2007). (*Benefits of student certification: A study of automotive service managers.*) (Doctoral dissertation). Retrieved from http://scholar.lib.vt.edu/theses/available/ etd-02192007-141742/unrestricted/ChurchCertification2.pdf

Cristofaro, D. (2006). Maintenance testing. *Mass Transit,32*(8), 72-77.

Goms. G (2010). Opinion: ASE certification is a matter of common sense. *(AftermarketNews.)* Retrieved July 18, 2012, from http://www.aftermarketnews.com/Item/75814/opinion_ase_certification_is_a_matter_of_common_sense.aspx

Administration

Changing Program Names – Did It Help?

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Abstract
Shortly after the National Association of Industrial Technology (NAIT) became the Association for Technology, Management, and Applied Engineering (ATMAE), affiliated programs all across the nation began to discuss the ramifications of this change. One prevalent discussion revolved around potential program name changes, particularly those including the phrase "Applied Engineering." To date, approximately eight ATMAE institutions have established program name changes for bachelor's degree programs and many other institutions are still debating the issue. This paper will provide background information regarding the process used to determine program name changes and will highlight feedback regarding the impact of the name changes on ATMAE accredited programs at a regional university.

Introduction
The decision of the National Association of Industrial Technology (NAIT) to change its name to the Association for Technology, Management, and Applied Engineering (ATMAE) sparked an almost instantaneous discussion regarding program names. For many years, graduates of ATMAE programs have been highly sought after by industry, mostly to fill positions classified as "engineering." Programs at other institutions were experiencing similar results with graduates being hired alongside people with traditional engineering degrees, having little or no differences in assigned duties (Land, 2012, page 32). As such, there was a natural inclination to at least consider officially changing the names of existing technology programs to affix the "Applied Engineering" label.

The decision to change program names at one regional university was not easily made. The process was lengthy and the actual approval process even longer. Name changes became official in January 2011 and data has been collected to make some initial evaluations regarding the effectiveness of the name change.

To Change or Not To Change
The question was simple enough. Should a department with several successful "technology" programs endeavor to change program names to include "Applied Engineering" in the title? The answer was far from simple. In a series of departmental meetings the question was subjected to the proverbial microscope. During the course of these meetings two key points emerged. One group recommended immediate change and the other group urging caution. The fact that graduates were filling industrial positions classified as engineering suggested a name change would be in order. The logical conclusion was that a name change could better reflect the careers of program graduates. It was also suspected that potential students might better recognize that the programs would offer opportunities for engineering careers. On the other hand, the overwhelming success of existing programs in placing graduates into the workforce prompted caution. Should the names of programs with extremely high placement rates really be tampered with?

The next step was to involve the Industrial Advisory Council, composed of program alumni and industry representatives, to commence the next round of discussions. Advisory council members discussed and debated these same issues and eventually recommended that the department make plans to move forward with name changes. This group seemed confident that a name change was appropriate. The council was then asked to develop a prioritized list of potential names for the affected programs. The final selection after input from Advisory Council and departmental faculty members was to

pursue program names in Applied Electronics Engineering and Applied Manufacturing Engineering.

The Change Process

Admittedly the approval process at this regional university was much smoother than could be expected on some other campuses because there are no departments offering traditional, professional engineering degree programs. Nevertheless, the proposed changes required routing through the time-consuming curricular processes at the departmental, college, and university levels. Facing no objections at any of these junctures, the University then had to submit the changes for approval to the state governing body for higher education.

The response at this level was more intense. Within days of submission, the department head was forwarded a very specific set of questions raised by the deans of the engineering programs at other institutions in the state. The questions emphasized the deans' concerns that potential students not confuse "Applied Engineering" programs with traditional professional engineering programs. Responses to each question were submitted and after about three months, the name changes were approved by the state. The name changes became effective in January 2011.

Did It Matter?

In an effort to generate some initial analysis of the results of the name changes, the department solicited feedback from a variety of sources. Data was collected from current high school students, high school counselors and teachers, current University students, program alumni, and employers of program alumni via a survey instrument designed for each group. It is recognized that the data gathered is preliminary data and longitudinal study is needed to get a more complete picture of any effect the name changes may have on the programs. Of primary importance was to determine whether the name changes produced any perceptible change, either positive or negative.

The surveys utilized an ordinal scale. In order to establish mean ratings for each question, responses were assigned a number ranging from 1 to 5 with 1 representing the most negative response and 5 representing the most positive. Neutral responses were assigned point values of 3. Since an ordinal rating scale was used, the distinction has to be made that the subjects taking the survey may not feel that the difference between each step is equal but for the purpose of this comparison it was assumed that each step in the ratings scale is equal in each survey instrument. Minitab Version 16 was utilized in analyzing collected data. Specifically, one-way analysis of variance using the Tukey Method for grouping was used as the primary means of comparison.

High School Students and Counselors

To determine how "applied engineering" was perceived in comparison to other typical program names, a group of high school students (grades 7-12) and high school teachers/counselors were asked to complete short survey instruments. Questions were customized for each survey instrument but were intended to measure the respondents' perceptions about "applied engineering" versus "technology" or "engineering technology" in terms of reputation, program appeal, association with 4-year degree programs, and association with 2-year degree programs.

A total of twenty-one high school teachers/counselors completed surveys. Fourteen of the respondents were female and seven were male. Twelve of the twenty-one had at least fifteen years teaching experience. These teachers indicated no statistically significant difference (95% confidence) between "technology", "engineering technology", or "applied engineering" in regards to any of the questions asked with the exception of association with two-year programs. As the data shown in Figure 1 indicates, teachers perceive "applied engineering" to be less associated with 2-year degree programs than "technology" (higher mean reflects greater association). Even though teachers didn't perceive any differences with "technology", "engineering technology", or "applied engineering" being associated with 4-year degree programs, the fact that teachers don't associate "applied engineering" as readily with 2-year programs seems to support the choice of "applied engineering" for bachelor's degree programs.

Figure 1. Two-Year Program Associations

One-way ANOVA: 2 - tec, 2-eng tec, 2-applied

Source	DF	SS	MS	F	P
Factor	2	9.27	4.63	3.91	0.025
Error	60	71.14	1.19		
Total	62	80.41			

Individual 95% CIs For Mean Based on Pooled StDev

Level	N	Mean	StDev
2-tec	21	3.810	0.981
2-eng tec	21	3.048	1.117
2-applied	21	2.952	1.161
Pooled StDev =		1.089	

Grouping Information Using Tukey Method

	N	Mean	Grouping
2-tec	21	3.810	A
2-eng tec	21	3.048	A B
2-applied	21	2.952	B

Means that do not share a letter are significantly different.

One limitation of the data pool is that the respondents represented schools in the region surrounding the University. Since the University has offered bachelor's degrees in technology for at least two decades, it is noted that the survey pool may have more closely related "technology" to 4-year degree programs than high school teachers in other geographic locations might.

Forty eight high school students completed the survey. Responses indicated that "technology", "engineering technology", and "applied engineering" all have the same level of appeal and reputation. Students also made no distinction as to which would be more likely associated with two-year or four-year programs. Earlier research (Brake, Bellamy, Bertsos and Bhatnagar, 2007), suggests that a majority of high school students view technology as dealing with computers. A study by the International Technology Education Association (ITEA) (Rose, Gallup, Dugger Jr., and Starweather, 2004) shows that two-thirds of people surveyed most associated technology with computers and the Internet. Another limitation of this study is that no effort was made to define the terms "technology", "engineering technology", and "applied engineering." It should be noted that if the students in this study hold views about technology that are consistent with the above mentioned studies, these students likely perceived "technology" as being completely different from the other choices and not much can be inferred from the results.

Current College Students

A short survey was administered to students enrolled in selected summer courses within the department. This survey collected the same basic information as the high school student survey. Because of the academic calendar, few students were available to complete the survey. Results from the students that completed the survey (9) duplicated the results from the high school students showing no statistical difference between any of the names for any of the questions asked. Continuing studies that should provide a more complete picture of current college students' perceptions are planned for the fall semester.

Another significant, indirect measure of the perception of the name changes can be taken from the students who were enrolled in a program of study at the time of the name change and have subsequently graduated. These students were given the option of keeping the degree program for which they were initially enrolled or switching their major to reflect the new name changes prior to graduation. Of the sixteen students that met this criterion, fourteen (87.5%) chose to switch to the new program name.

Alumni and Employers

Data from similar surveys of alumni and employers of alumni indicate that these groups do perceive "applied engineering" somewhat differently from "technology" or "engineering technology." Three questions were common to both groups. Both groups were asked to rate the reputation of each degree name, its association with 4-year degree programs and its association with 2-year degree programs. Employers were also asked to rank how likely they would be to hire a person with each degree name for an open engineering-related position within their companies while alumni were asked to rank the appeal level of each program name. A total of twenty alumni and twenty-four employers responded.

Both employers and alumni clearly more closely associate "applied engineering" and "engineering technology" with 4-year degrees than they do "technology." The analysis for each group is shown in Figures 2 and 3, respectively.

Figure 2. Employer Perceptions of Four-Year Program Association

Source	DF	SS	MS	F	P
Factor	2	12.583	6.292	11.34	0.000
Error	69	38.292	0.555		
Total	71	50.875			

Individual 95% CIs For Mean Based on Pooled StDev

Level	N	Mean	StDev
4-tec	24	3.4583	0.9315
4-eng tec	24	4.2500	0.7372
4-applied	24	4.4167	0.5036

Pooled StDev = 0.7450

Grouping Information Using Tukey Method

	N	Mean	Grouping
4-applied	24	4.4167	A
4-eng tec	24	4.2500	A
4-tec	24	3.4583	B

Means that do not share a letter are significantly different.

Figure 3. Alumni Perceptions of Four-Year Program Association

One-way ANOVA: 4 -tec, 4 - eng tec, 4 - applied

Source	DF	SS	MS	F	P
Factor	2	13.433	6.717	9.05	0.000
Error	57	42.300	0.742		
Total	59	5.733			

Level	N	Mean	StDev
4-tec	20	3.4000	0.8826
4-eng tec	20	4.3500	0.8751
4-applied	20	4.4500	0.8256

Individual 95% CIs For Mean Based on Pooled StDev
Pooled StDev = 0.8615

Grouping Information Using Tukey Method

	N	Mean	Grouping
4-applied	20	4.4500	A
4-eng tec	20	4.3500	A
4-tec	20	3.4000	B

Means that do not share a letter are significantly different.

Both employers and alumni agree in their perceptions of how these names are associated with 2-year degree programs. Both groups clearly distinguish "technology" as being more associated with a 2-year program than "applied engineering." Both groups also perceive that "engineering technology" cannot be distinguished from either "applied engineering" or "technology" in the area of association with two-year programs. These data are shown in Figures 4 and 5, respectively.

Figure 4. Employers Perceptions of Two-Year Program Association

One-way ANOVA: 2 -tec, 2 - eng tec, 2- applied

Source	DF	SS	MS	F	P
Factor	2	6.583	3.292	3.38	0.040
Error	69	67.292	0.975		
Total	71	73.875			

Individual 95% CIs For Mean Based on Pooled StDev

Level	N	Mean	StDev
2-tec	24	3.6250	0.8754
2-eng tec	24	3.0833	1.1001
2-applied	24	2.9167	0.9743

Pooled StDev = 0.9875

Grouping Information Using Tukey Method

	N	Mean	Grouping
2-tec	24	3.6250	A
2-eng tec	24	3.0833	A B
2-applied	24	2.9167	B

Means that do not share a letter are significantly different.

Tukey 95% Simultaneous Confidence Intervals

Figure 5. Alumni Perceptions of Two-Year Program Association

One-way ANOVA: 2 - tec, 2 - eng tec, 2 - applied

Source	DF	SS	MS	F	P
Factor	2	16.93	8.47	6.70	0.002
Error	57	72.05	1.26		
Total	59	88.98			

Individual 95% CIs For Mean Based on Pooled StDev

Level	N	Mean	StDev
2 - tec	20	3.850	1.040
2 - eng tec	20	3.150	1.182
2 - applied	20	2.550	1.146

Pooled StDev = 1.124

Grouping Information Using Tukey Method

	N	Mean	Grouping
2 - tec	20	3.850	A
2 - eng tec	20	3.150	A B
2 - applied	20	2.550	B

Means that do not share a letter are significantly different.

Tukey 95% Simultaneous Confidence Intervals

Employers and alumni differ to some extent when it comes to the reputation of the names. Alumni perceive that "applied engineering" and "engineering technology" both have better reputations than "technology" as shown in Figure 6. Employers agree that the name "applied engineering" has a better reputation than the name "technology" but sense that "engineering technology" may or may not improve program reputation. These data are shown in Figure 7.

Figure 6. Alumni perceptions of reputations

One-way ANOVA: rep - tec, rep - eng tec, rep - applied

Source	DF	SS	MS	F	P
Factor	2	11.200	5.600	10.09	0.000
Error	57	31.650	0.555		
Total	59	42.850			

Individual 95% CIs For Mean Based on Pooled StDev

Level	N	Mean	StDev
rep - tec	20	3.4500	0.8870
rep - eng tec	20	4.2500	0.7164
rep - applied	20	4.4500	0.6048

Pooled StDev = 0.7452

Grouping Information Using Tukey Method

	N	Mean	Grouping
rep - applied	20	4.4500	A
rep - eng tec	20	4.2500	A
rep - tec	20	3.4500	B

Means that do not share a letter are significantly different.

Figure 7. Employers' perceptions of reputations

One-way ANOVA: rep - tec, rep - eng tec, rep - applied

Source	DF	SS	MS	F	P
Factor	2	4.333	2.167	4.72	0.012
Error	69	31.667	0.459		
Total	71	36.000			

S = 0.6774 R-Sq = 12.04% R-Sq(adj) = 9.49%

Individual 95% CIs For Mean Based on Pooled StDev

Level	N	Mean	StDev
rep - tec	24	3.8333	0.7614
rep - eng tec	24	4.2500	0.6757
rep - applied	24	4.4167	0.5836

Pooled StDev = 0.6774

Grouping Information Using Tukey Method

	N	Mean	Grouping
rep - applied	24	4.4167	A
rep - eng tec	24	4.2500	A B
rep - tec	24	3.8333	B

Means that do not share a letter are significantly different.

Tukey 95% Simultaneous Confidence Intervals

In the questions that pertained to only one group, employers were emphatic that "applied engineering" and "engineering technology" graduates were more likely to be hired for open engineering positions than "technology" graduates. These data are shown in Figure 8. Alumni were just as insistent that "applied engineering" or "engineering technology" was more appealing than "technology" as a degree program name. These data are shown in Figure 9.

Figure 8. Employer Likelihood to Hire for Open Engineering Positions

One-way ANOVA: job -tec, job - eng tec, job - applied

Source	DF	SS	MS	F	P
Factor	2	9.000	4.500	8.20	0.001
Error	69	37.875	0.549		
Total	71	46.875			

Individual 95% CIs For Mean Based on Pooled StDev

Level	N	Mean	StDev
job -tec	24	3.5417	0.8836
job - eng tec	24	4.2917	0.6241
job - applied	24	4.2917	0.6903

Pooled StDev = 0.7409

Grouping Information Using Tukey Method

	N	Mean	Grouping
job - applied	24	4.2917	A
job - eng tec	24	4.2917	A
job -tec	24	3.5417	B

Means that do not share a letter are significantly different.

Tukey 95% Simultaneous Confidence Intervals

Figure 9. Alumni Perception of Name Appeal

One-way ANOVA: app - tec, app - eng tec, app - applied

Source	DF	SS	MS	F	P
Factor	2	16.533	8.267	15.47	0.000
Error	57	30.450	0.534		
Total	59	46.983			

Individual 95% CIs For Mean Based on Pooled StDev

Level	N	Mean	StDev
app - tec	20	3.2500	0.7864
app - eng tec	20	4.2500	0.7864
app - applied	20	4.4500	0.6048

Pooled StDev = 0.7309

Grouping Information Using Tukey Method

	N	Mean	Grouping
app - applied	20	4.4500	A
app - eng tec	20	4.2500	A
app - tec	20	3.2500	B

Means that do not share a letter are significantly different.

Tukey 95% Simultaneous Confidence Intervals

Conclusion

The data suggest a gap exists in the perception of "Applied Engineering" as compared to "Technology" or "Engineering Technology" that might be based on experience level. In this study, high school students and teachers noted very little difference in their perceptions of the three names. College student survey data were not statistically reliable due to low sample size but mirrored the high school students' perceptions. However, the high percentage of graduating seniors that chose "applied engineering" over "technology" as the name to be registered on their final college transcript supports the assumption that "applied engineering" is in fact perceived to be a more appealing name. Finally, alumni and employers both indicated that" applied engineering" is perceived differently.

This data does seem to strongly suggest that getting engineering in the name of a program in some form would certainly improve the reputation of the program by industry professionals as both employers and alumni (working in the field) indicated a strong preference for "applied engineering" and /or "engineering technology." The study also suggests that there may still be a need to better publicize what technology and engineering really is in the secondary education system, at least in the service region of this particular regional university.

References

Brake, M., Bellamy, A., Bertsos, G., Bhatnagar, K., (2007). Choice of Technology Majors Among High School Students, *Advancing Women in Leadership Journal*.

Rose, L.C., Gallup, A.M., Dugger, W.E., & Starkweather, K.N., (2004). *The Technology Teacher*, 64(1), (Insert).

Land, R., (2012). Engineering Technologists are Engineers, *Journal of Engineering Technology*, Spring 2012.Persistence Factors of Women in Information Technology

Administration

Factors Considered in the Development of Curricular Content in Engineering Technology for Diverse Audiences

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Introduction

Supply chains which handle and process bulk materials such as food ingredients and food stuffs have unique needs and challenges. Bulk material supply chains are characterized by the aggregation of large, homogeneous lots of product intended for a wide spectrum of end uses. Transportation and storage functions are also completed within a large-scale system, which add complexity to the management of these types of supply chains (Thakur & Hurburgh, 2009). Uncertainty and risk management are especially challenging.

The systems approach of engineering technology offers strategies for managing operations, risk and uncertainty in bulk materials supply chains. Furthermore, engineering technology graduates often possess the necessary disciplinary background and skills to potentially assume leadership roles within the bulk materials production system. Yet, the preparation of technical professionals remains largely unfilled in both higher education and in workplace training programs. This paper will discuss the challenges and needs of process industry supply chains, potential engineering technology solutions, and outline the strategies used to define core learning competencies for curricular and training programs intended for several diverse groups of learners. Implications for the field of engineering technology will conclude the paper.

Challenges and Needs of Process Supply Chains

Managing bulk materials from production to consumption is a challenging task. Bulk supply chains are not characterized by the process controls and verification of quality standards which are typical to other industries (Hurburgh & Lawrence, 2003). Normally, bulk material supply chains handle a wide variety of products which have multiple transportation routes, making it difficult to design a standardized system to address system-wide hazards of safety and security (Thakur & Hurburgh, 2009). Furthermore, the wide variety of end uses does not lend itself well to a few universal solutions to manage all of the products within the entire supply chain. Rather, solutions must be developed on a case-by-case basis.

A second challenge of bulk material supply chains involve storage and inventory management. Storage units for bulk materials may contain product from many sources. Once the products are combined (as is the traditional practice for bulk material supply chains), lot identity is nearly impossible to re-establish (Harris, 2009; Thakur & Hurburgh, 2009). Under the blending scenario typical to bulk material handling and process, in the event of a bulk material recall, no feasible way exists to isolate contaminated product. Because the adulterated product cannot be separated physically, all of the product with a potential of contamination must be recalled (Thakur & Hurburgh, 2009; Thakur et al., 2009), leading to a financial loss in many cases. These scenarios present risk and uncertainty to businesses that handle and process bulk materials.

Finally, the stability of bulk biological products may also present a challenge for supply chain managers. Bourne (2004) suggests that the loss of products which are not stored and managed appropriately result in a loss of nutrients and profit. Although technological tools can be applied to both increase the shelf life and to convert perishable products into more shelf products, the potential loss of money and profit are a constant risk in bulk material supply chains (Bourne, 2004).

Additionally, when contamination or adulteration incidents occur, the bulk material supply chain is not well equipped to identify or measure low concentration consumer safety events. Threats occurring to consumer safety from bulk materials are often not large in their initial scope, but the magnitude of the incident may increase rapidly, resulting in a large financial loss for the firm or firms involved. Even with minor incidents, the unique characteristics of the bulk material supply chain make it difficult to isolate and control hazards that do arise (Thakur et al., 2009).

Although prescriptive and control-point based interventions may play some role in a process-based supply chain systems, they cannot address the multi-tiered need for identification, quantification, control and management of bulk material safety and quality risks (Sperber, 2005; Anderson, 2009). A move away from prescriptive-based interventions in favor of a process and systems-based approach has shown promise in the ability to address bulk material and food safety risks (Thakur et al., 2009).

Engineering Technology Can Address Industry Needs

Bulk material supply chains have unique and multi-faceted needs. Foster's (2008) definition of the systems-based approach of quality management involves managing the interacting aspects of supply chains to enhance the performance of suppliers and customers. Laux (2007), Laux, Mosher and Hurburgh (2008), and Laux and Hurburgh (2010) demonstrated that quality management systems could play a positive role in managing process-based supply chains by improving inventory management and managing legislative requirements.

Thakur and Hurburgh (2009) agreed with these findings, and further concluded that a key component of improved performance among all participants in the supply chain is an enhanced system of information exchange, with a specific focus on linking units of output with explicit units of input. Bertolini, Bevilacqua, & Massini (2006) also proposed that successful supply chain systems for bulk materials must facilitate a rapid information exchange between participants. Creating a system conducive to quick information exchange involves the integration of several important factors. Engineering technology programs offer a systems approach for addressing several long-standing quality and safety issues in the bulk material supply chain (Laux & Hurburgh, 2010; Thakur et al., 2009). Process-based activities such as statistical process control, mathematical modeling, procedural and design protocols, and the multidisciplinary integration of theories in management and cost analysis are required components of an ATMAE accredited engineering technology degree program (ATMAE Accreditation Handbook, 2009, p 18). Furthermore, the multidisciplinary focus of engineering technology programs have the ability to produce professionals who are able to design, develop, measure, and evaluate multiple interacting systems. The ability to balance the management of quality with the management of risk allows engineering technology professionals to improve and optimize current bulk material supply chain processes and practices.

Specific to the field of engineering technology, Meier, Williams and Singley (2004) suggest that a systemic model of understanding and evaluation of the practice of supply chain management is needed for significant improvement in the field. Callahan, Amos, and Strong (2004) add that preparation of students to work in this area should expand to include greater coverage of quality-related issues such as capability analysis and statistical process control. A greater exposure to hands-on problem solving, an increase in context and product-specific experiences, and a better integration of statistical theory into a quality environment are proposed by Callahan and Strong (2004) to improve the undergraduate preparation in quality management and quality processes.

A 1999 study by Zagari and Hayes revealed that student perceptions align with faculty thoughts on engineering technology strengths and needed improvements. Those surveyed listed hands-on, practical problems as something they would like to see more of in technology programs. However, Zagari and Hayes (1999) also found that students were overall very pleased with the balance of technical and laboratory courses as well as the multidisciplinary focus of industrial technology programs.

The next section will briefly describe the approach used to develop core learning competencies for students entering the bulk material supply chain workforce. Bulk material supply chain workers come from a variety of educational levels. To ensure a broad representation of perspectives, the opinions of academic and industrial stakeholders were sought. The competencies discussed below are the result of these stakeholder round table discussions.

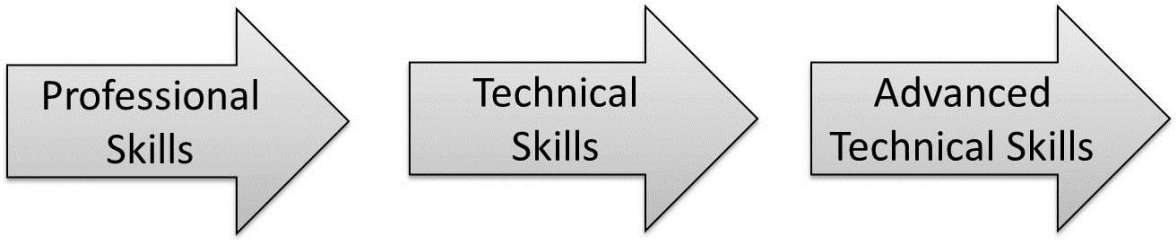
Core Learning Competencies for Engineering Technology Students

The Engineering Technology student today must have a broad based education; yet culminate in advanced and technical instruction to meet the needs of the bulk material, food, and food stuff industry. The pathway to a 4-year degree varies with the college student today arriving in a baccalaureate program through many means: direct from high school, as a returning adult upgrading or revising a career set, or coming through a two-year associate degree program (National Center for Educational Statistics, 2012). Adults already working in the industry may also be in need of re-training programs to better prepare them for challenges that did not exist when they started in their chosen occupation (Patel, 2010).

Core Competencies for College Students

Approximately 40 companies representing the bulk material, food, and foodstuff industry were brought together to help identify competencies for Engineering Technology graduates. At each round table session, the participants were charged with answering two questions:

1) What knowledge should the Engineering Technology graduate possess?
2) What skills should the Engineering Technology graduate be able to perform?



The initial response from industrial and academic stakeholders was that while the specific pedagogical process may differ by group of student, a stronger set of competencies could be created if the classification system was by skill area rather than by student group. The professional skills noted are not unique to bulk materials, food, or foodstuff, or even the technical level of a student. The first list of "professional skills" competencies broadly represents the knowledge and skills required for a student to engage in an occupation or career. The areas of "technical skills" and "advanced technical skills" are more unique to the field of engineering technology and the bulk materials supply chain. Figure 1 illustrates the pathway identified by the round table participants.

The technical skills and knowledge presented are the result of the types of stakeholders present. More specifically, different employers have different needs and their opinions on what workers should know may vary. Therefore, the competencies listed are not necessarily skills needed for every work environment. Nevertheless, the technical competencies represent the broad categorical set of knowledge and skills required for the 21st century STEM professional. These professionals will work in an industry sector that is open to the needs and desires of globalization so that they may tap into a competitive, skilled, and globally-minded workforce.

The "advanced technical" competencies represent the ultimate learning objective for the advanced, technical person working in this sector. Thematically, these areas are not mutually exclusive, nor should they be treated as such. In addition to the curriculum as a connector of these areas, one thing that the educator must also be mindful of is, regardless of the student level (Associates, Bachelors, or Adult), the student must be employable (Brumm, Hanneman, & Mickelson, 2006). Thus, the path to higher education for the technical student must contain relevant and technically advanced content, yet still prepare a well-rounded professional.

Competency-based education is increasingly being used in diverse learning environments (Boyatzis, 2008). Brumm, Mickelson, Steward, and Kaleita (2006) describe competency-based education as a focus on what students are expected to know or do by the time they complete the program, rather than simply measuring the completion of a specified sequence of learning modules. Competency-based learning requires the definition of learning objectives and then an alignment of the learning outcomes with the skills identified as important for potential employees. One key advantage to competency-based learning is its transparency. This means that all parties understand the learning goals and are given a clear map of how the learning will take place (Brumm et al., 2006). Measureable assessment and the opinion of external stakeholders are the major bases for evaluation of competency-based learning models. The competencies identified by the round table groups are shown in Table 1.

Table 1. Engineering Technology graduate competencies for the food and foodstuff industry

Professional Skills	Technical Skills	Advanced Technical Skills
• Passion for career • Common sense and maturity • Problem solving • Managerial, supervision, leadership, and people skills • Positive attitude and motivation • Business writing and communication (internal and external) • Foreign language skills • Respect for international colleagues • Human resources knowledge (organizational measurement) • Market differentiation • Project management • Business sense • Advancement mentality • Willingness to relocate • Willingness to get dirty, take non-office jobs	• Automation • Fundamental computer skills (Excel, spreadsheet) • Knowledge of industry standards • Knowledge of basic statistics • Ability to handle biologically active products • Workplace safety knowledge • Bulk processing knowledge • Social aspects of food • Food, diet, medical, and health challenges of existing population	• Advanced technology & electronics work skills • Knowledge of Biologics • Lean manufacturing knowledge and skills • Bioprocessing knowledge • Microbiology knowledge • CFR 21 standards knowledge • Process controls • Regulations/operating systems and standards • GFSI • ISO standards • KKnowledge of OSHA, EPA, IDEM • Project analysis skills • Risk mitigation skills • HACCP knowledge • Hygienic design knowledge • Quality management systems knowledge • Quality auditing

Core Competencies for Adult Learners

The preparation of college students normally follows a formal curriculum process, but the preparation of adults for new or changing careers has a slightly different focus. Generally, it is assumed that adult learners have a different approach to learning than secondary and post-secondary students (Cranton, 2006). The typical adult learner tends to be more self-directed than college-aged students and learning may be more voluntary than is the case in other learner groups (Cranton, 2006). Adults commonly enjoy sharing their experiences in a practical discussion format, where useful, applicable and relevant information is presented (Cranton, 2006; Knowles, 1980). Additionally, using the past experiences of adults in the learning has proven to be a very effective way of engaging adult learners in the course content (Dollisso & Martin, 1999). For this reason, many opportunities for discussion, open-ended questions and reflection on past experience and behaviors were integrated into the learning modules designed for adult learners.

Three major components were used in the initial development and modification of adult student core learning competencies. The first means of evaluation were the existing needs of the bulk material supply chain system. Published literature provided the biggest portion of the information used to identify the needs of bulk material supply chain. Based on the literature reviewed, several needs emerged. These include: a systemic approach to identifying risks, an enhanced communication system linking all parts of the supply chain, and a cost effective method to encourage industry adoption (Foster, 2006; Laux & Hurburgh, 2010; Thakur & Hurburgh, 2009; Thakur et al., 2009).

The second component used in the development of core learning competencies for adult students was the review and critique of competencies and course content by a panel of industry experts. Kingman et al. (2005) have found expert panels to be an effective and cost-effective tool for defining curricular content in several work environments. The use of expert groups has been found to promote problem identification, the formulation of ideas, and the development of strategies (Kingman et al., 2005). All are positive actions in the development of a relevant and updated curriculum in bulk material supply chain system, particularly for adult learners.

The final piece of feedback was generated by students who participated in the learning courses and workshops, which have been offered since the spring of 2010. The student feedback was integrated into future course and workshop offerings to better align the course and workshop offerings with the needs of the participants. The effectiveness of the curriculum was

evaluated using Kirkpatrick and Kirkpatrick's 4-Level Evaluation System (Kirkpatrick & Kirkpatrick, 2007). The full evaluation of the curriculum delivered for adult learners in 2010 and modifications made to the 2011 as the result of student evaluations are discussed in greater detail by Mosher, Freeman, & Hurburgh (2011).

Implications for Engineering Technology

The field of engineering technology has the potential to address several long-term needs of the bulk material supply chain. Based on the needs and learning competencies identified by academic and industrial professionals in the field of process-based supply chains and engineering technology, the field is poised to assume a leadership role in preparing professionals to take on the challenges of the 21st century global bulk material, food, and foodstuff system.

With the use of tools such as statistical process control, quality management, and information systems management, engineering technology professionals can begin to address the systemic challenges of the bulk material supply chain, from a global, national, and regional perspective. Although this direction represents a new role for engineering technology graduates, the field is well-positioned to move in this direction.

References

Anderson, N. (2009). Risk-based process development: The food safety objective approach. *Resource: Engineering and Technology for a Sustainable World*, January/February, 12-13.

Association of Technology, Management, and Applied Engineering. (2009). 2009 Accreditation Handbook. Ann Arbor, MI: ATMAE. Accessed July 1, 2012 from: http://atmae.org/accred/2009%20Accreditation%20Handbook%20web%20No%20Sectio ns%201-4.pdf

Bertolini, M., Bevilacqua, M., & Massini, R. (2006). FMECA approach to product traceability in the food industry. *Food Control*, 17(2), 137-145.

Bourne, M.C. (2004). Selection and use of postharvest technologies as a component of the food chain. *Journal of Food Science*, 69(2), CRH 43-CRH46.

Boyatzis, R. E. (2008). Competencies in the 21st century. *Journal of Management Development*, 27(1), 5-12.

Brumm, T.J., Hanneman, L.F. & Mickelson, S.K. (2006). Assessing and developing program outcomes through workplace competencies. *International Journal of Engineering Education*, 22(1), 123-129.

Brumm, T.J., Mickelson, S.K., Steward, B.L., & Kaleita, A.L. (2006). Competency-based outcomes assessment for agricultural engineering programs. *International Journal of Engineering Education*, 22(6), 1163-1172.

Callahan, R.N., Amos, S.J. & Strong, S.D. (2004). Enhancing entry level skills in quality assurance: An industry perspective. *Journal of Industrial Technology*, 20(4), 1-6.

Callahan, R.N. & Strong, S.D.(2004). A comparison of industrial and academic perceptions of quality control education. *Journal of Technology Studies*, 30(4), 45-54.

Cranton, P. (2006). *Understanding and Promoting Transformative Learning*: *A Guide for Educators of Adults. Jossey-Bass:* San Francisco, CA.

Dillisso, A. & Martin, R.A. (1999). Perceptions regarding adult learners' motivation to participate in educational programs. *Journal of Agricultural Education*, 40(4), 36-46.

Foster, S.T., Jr. (2008). Towards an understanding of supply chain quality management. *Journal of Operations Management*, 26(4), 461-467.

Harris, G. (2009, March 26). Investigators find source of many foods untraceable. *New York Times*. Accessed on October 13, 2009 from http://www.nytimes.com/2009/03/26/health/policy/26fda.html

Hurburgh, C.R. & Lawrence, J.D. (2003). The need for QMS. *Resource: Engineering and Technology for a Sustainable World*, 10(9), September 2003, 29.

Kingman, D.M., Yoder, A.M., Hodge, N.S., Ortega, R., & Field, W.E. (2005). Utilizing expert panels in agricultural safety and health research. *Journal of Agricultural Safety and Health*, 11(1), 61-74.

Kirkpatrick, D.L. & Kirkpatrick, J.D. (2007). *Implementing the four levels: A practical guide for effective evaluation of training programs*. Berrett-Koehler Publishers, Inc.: San Francisco, CA

Knowles, M. (1980). *The Modern Practice of Adult Education: From Pedagogy to Andragogy.* New York, NY: Cambridge.

Laux, C.M. (2007). The impacts of a formal quality management system: A case study of implementing ISO 9000 at Farmer's Cooperative Company, Iowa. Unpublished doctoral dissertation, Iowa State University. Dissertation Abstracts International B68/07.

Laux, C.M. & Hurburgh, C.R. (2010). Using quality management systems for food traceability. *Journal of Industrial Technology*, 26(3).

Laux, C., Mosher, G., & Hurburgh, C. (2008). Using quality management systems to meet food traceability requirements of the Bioterrorism Act of 2002. 2008 Conference Proceeding Papers for the National Association of Industrial Technology. 81-87. Accessed July 16, 2012 from: http://atmae.org/conven/NAIT2008ConfPapers.pdf

National Center for Educational Statistics. (2012). Fast Facts. Accessed July 19, 2012 from: http://nces.ed.gov/fastfacts/index.asp?faq=FFOption6#faqFFOption6

Meier, R.L., Williams, M.R., & Singley, R.B. (2004). Supply chain management: Strategic factors from the buyers' perspective. *Journal of Industrial Technology*, 20(2), 1-8.

Mosher, G.A., Freeman, S.A., & Hurburgh, C.R. Jr. (2011). Design of an online course in quality management systems for adult learners. *Journal of Industrial Technology*, 27(4), 1-9.

Patel, L. (2010). 2010 State of the industry: Continued dedication to workplace learning. *T + D*, 64(11), 48-53.

Sperber, W.H. (2005). HACCP does not work from farm to table. *Food Control*, 16(6), 511-514.

Thakur, M. & Hurburgh, C.R. (2009). Framework for implementing traceability system in the bulk grain supply chain. *Journal of Food Engineering*, 95(4), 617-626.

Thakur, M., Mosher, G.A., Brown, B. Bennet, G.S., Shepherd, H.E., & Hurburgh, C.R. (2009). Traceability in the bulk grain supply chain. *Resource: Engineering and Technology for a Sustainable World*, April/May 2009, 20-22.

Wiggins, G. & McTighe, J. (2005). *Understanding by Design (2nd Ed.)*. Association for Supervision and curriculum development, Merrill/Prentice Hall: Alexandria, VA.

Zargari, A. & Hayes, R. (1999). An analysis of industrial technology (IT) programs in meeting students' needs: A survey of IT alumni. *Journal of Industrial Technology*, 15(4), 1-5.

Construction

Construction

Building Information Modeling: Course Offerings and Industry Expectations

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Abstract
The construction industry incurs huge losses that amount to approximately 3-4% of the total industry cost each year due to poor interoperability and data management. Consequently, many construction companies have adopted Building Information Modeling (BIM) to improve information flow and data management. Both practitioners and researchers agree that BIM will bring a revolutionary change in the construction industry by increasing the efficacy of information flow. As the construction programs of the various universities strive to educate their students for professional success, they offer courses on BIM to educate the students with the latest improvement in the construction industry. A survey was conducted among prospective employers, and construction programs offering BIM courses to classify the expectations and the course offerings. Overall, the expectations of the industry and the course offerings showed high agreement. The findings provide important feedback for the construction programs to evaluate and revise their curricula to better prepare the students for professional success in the industry.

Introduction
The construction industry plays a major role in the national economy of the United States, contributing over $570 billion to the national gross domestic product (U. S. Census, 2011). A report published by National Institute of Standards and Technology in 2004 identified losses in excess of $15 billion per year in the construction industry due to poor interoperability and data management, which is approximately 3-4% of the total industry cost (Gallaher, O'Connor, Dettbarn, & Gilday, 2004). As a consequence, many construction firms have adopted Building Information Modeling (BIM) by various means to improve information flow and data management. BIM can be used as a collaborative platform among various stakeholders of the construction industry at different phases of the life cycle of a facility.

Practitioners as well as researchers are of the opinion that BIM has been a revolutionary change in the construction industry that will increase the efficacy of information flow in the industry. While BIM is gaining momentum in the construction industry, there is a growing need for professionals having expertise in BIM. The majority of the university construction programs throughout the United States have underpinned this trend by educating the future professionals with the knowledge of BIM. Johnson and Gunderson (2009) in their survey of the member institutions of Associated Schools of Construction (ASC) indicated a wide range of adoption approaches of the identified trends. However, they did not address the specific instructional methods and the materials covered in the courses. This study examined the course materials used to teach BIM in the various construction programs, and compared the learning outcomes of these courses with the industry's expectations.

Methodology
The goal of the study was to analyze the BIM courses offered by the various construction programs. The course offerings were then compared with the expectations of the construction firms.
Since the authors needed feedback from an appropriately large sample of the construction firms, they decided to conduct

structured surveys rather than oral interviews to save time and obtain more results quicker. The survey questionnaires were restricted in distribution to construction-related firms, which included general contractors, subcontractors, architectural, engineering, consulting, and design build firms. The firms were either members of the industry advisory board of the construction programs of two U.S. universities (one in the Mid-Atlantic region and one in the Midwest region) or regularly visited the universities to recruit students for their internship and full-time positions. It was assumed in the study that the respondents' answers reflected the corporate policy and philosophy of the respective organizations. The authors assumed that the knowledge of the individuals delegating the organizations were representative of the organizations' philosophy and goals, and the delegates' responses to the survey questionnaires accurately represented the organizations by which they were employed.

For the purpose of analyzing the BIM courses offered by the construction programs of the United States, the member institutes of Associated Schools of Construction (ASC) were selected. ASC is a professional association for the development and advancement of construction education. As of 2012, a total of 132 higher educational institutions in the United States are registered with ASC as members. Curricula for the four-year baccalaureate degree in construction were selected for this study, as those are comparatively more structured than curricula for master's degree. Survey questionnaires were sent to faculty members who are responsible to teach the BIM courses in the respective institutions. Copies of the course syllabi were also obtained from individual faculty members.

Distribution of Survey Questionnaires

The survey questionnaires were made into printed copies, and also encoded using a web survey tool to facilitate the distribution electronically. Emails were sent to the Department Chairs of the Construction Programs of each of the member institutes of ASC to gather contact information of the faculty members responsible for teaching BIM courses. Subsequently, invitation emails along with the survey questionnaire were sent to the study population. After two weeks of the first invitation to participate in the survey, an additional email was sent to motivate the study population for participating in the survey. The faculty members were requested to send the course syllabi along with completing the questionnaires. Only the responses that were accompanied by the course syllabi were considered a complete response in the context of this study.

Survey Results

58 construction firms replied to our survey, which resulted in a response rate of 73.4%. Respondents were able to select the types of projects they delivered among four categories: (1) Residential; (2) Commercial; and (3) Civil/infrastructure. Commercial was the most answered project type with majority of the respondents (58.7%) being exclusively involved in commercial projects (see figure 1). The firms were able to select primary contractual role(s) assumed by them among five categories: (1) general contractor/construction manager (GC/CM); (2) subcontractor; (3) consultant; (4) architect; and (5) engineering. GC/CM was the top (72.4%) contractual role the respondents assumed in their projects followed by subcontracting (17.2%) as shown in figure 2. Two of the responding firms indicated they also worked as architect and consultant along with their role as GC/CM, which implies that they were design-build organizations.

Figure 1: Primary types of project delivered by the responding firms

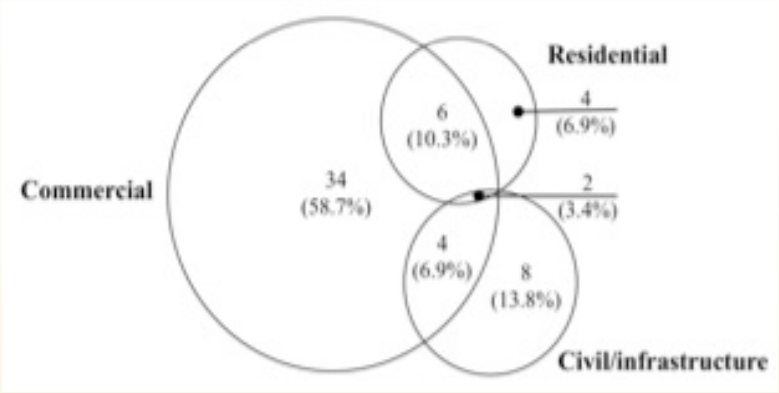
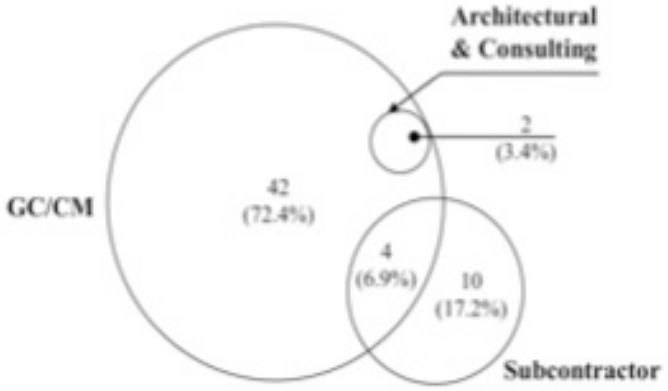


Figure 2: Primary contractual role of the responding firms



To show how representative the sample was across the whole construction industry, the annual revenue and the number of employees of responding firms (see table 1) ranged from various small sized GC/CM and subcontracting firms to large contractors with close to 10,000 employees and annual revenue of $1 billion or more. The major respondent group with respect to the annual revenue was in the range of $100 million - $250 million (24.1%). In regard to the number of employees, there were almost equal number of responding firms that had employees in the range of 101 – 1000 (37.9%) and 1001 – 10,000 (39.7%). In terms of involvement with public funded projects, response indicated that for more than 40% of the firms, the proportion of public funded projects each year was in excess of 60% of their total work volume. Out of which, for 17.2% of the responding firms the proportion of public funded projects was in excess of 80%, as shown in Table 1. The last question related to the profile of the responding firms asked about their area of operation in the United States, and the respondents could select between two categories: (1) in any one state; and (2) in more than one state. Response revealed that 60% of the firms operated in more than one state of the United States as compared to the rest 40% of the firms, whose area of operation was limited to within any one state.

Table 1: Background information of the responding firms

Background Information		Responding Firms N (%)
Annual Revenue	< 50 Million USD	8 (13.8)
	50 – 100 Million USD	5 (8.6)
	100 – 250 Million USD	14 (24.1)
	250 – 500 Million USD	8 (13.8)
	500 – 1000 Million USD	11 (19.0)
	> 1000 Million USD	12 (20.7)
Number of Employees	1 - 10	0 (0.0)
	11 - 100	13 (22.4)
	101 - 1000	22 (37.9)
	1001 - 10000	23 (39.7)
	> 10000	0 (0.0)
Proportion of Public Projects Completed Each Year	None	6 (10.3)
	< 20%	8 (13.8)
	20% - 40%	12(20.7)
	41% - 60%	6 (10.3)
	61% - 80%	16 (27.6)
	> 80%	10 (17.3)
Geographic Location	Any one State of the US	23 (40.0)
	More than one State of the US	35 (60.0)

Out of the total 132 recipients of the surveys, 31% (n=41) institutions responded to the survey. A vast majority (88%) offered degrees in construction management as shown in Table 2. The total number of students in the responding institutions and the degrees offered by them show how representative the sample was across the construction academia. Table 2 shows that the number of students in the individual programs ranged from less than 100 students to more than 500 students.

While 39% of the institutions offered only bachelors degree, another 34% offered both bachelor degree and masters degree, and an additional 17% offered bachelor, masters, and doctoral degrees. The next question asked the respondents about the number of courses on BIM taught in the individual programs. Reponses show that 80% of the institutions offered more than one course on BIM in their curricula. While 25% of the programs offered standalone courses on BIM, 37% programs integrated BIM with other courses, and 38% of the programs adopted both the approaches as shown in Table 2. In response to the question when BIM was first introduced in their programs, 88% institutions responded that they introduced BIM more than one year ago in their curricula. Among the array of available BIM software, majority (78%) of the institutions adopted Autodesk software. For the areas focused in the BIM courses, 54% of the respondents selected pre-construction planning, followed by estimating (51%), scheduling (49%), and mechanical, electrical, and plumbing (MEP) (46%).

Table 2: Background information of the responding institutions

Background Information		Responding Institutions N (%)
Current Academic Program	Architecture	0
	Construction Management	36 (88.0)
	Civil Engineering	1 (2.0)
	Other	4 (10.0)
Total Number of Students	0-100	5 (13.0)
	100-200	15 (38.0)
	200-300	9 (23.0)
	300-400	5 (13.0)
	400-500	3 (7.5)
	> 500	3 (7.5)
Degrees Offered	Only Bachelor	16 (39.0)
	Only Masters	1 (2.5)
	Bachelor, Masters	14 (34.0)
	Masters, Ph.D	1 (2.5)
	Bachelor, Masters, Ph.D	7 (17.0)
	Other associate degree	2 (5.0)
Number of Courses that include BIM	1	8 (20.0)
	2	15 (37.0)
	3	7 (16.5)
	4	4 (10.0)
	> 5	7 (16.5)
How is BIM taught	Standalone course	10 (25.0)
	Integrated with other courses	15 (37.0)
	Both	16 (38.0)
When was BIM first introduced in the curriculum	< 1 year ago	5 (12.0)
	1-2 years ago	6 (15.0)
	2-3 years ago	10 (24.0)
	3-4 years ago	7 (17.0)
	4-5 years ago	10 (24.0)
	> 5 years ago	3 (8.0)
At what level BIM is taught	Freshman	12 (30.0)
	Sophomore	18 (44.0)
	Junior	21 (52.0)
	Senior	20 (49.0)
	Graduate	12 (29.0)
Software taught	Autodesk	32 (78.0)
	Bentley	2 (5.0)
	Vico	7 (17.0)
	ArchiCAD	6 (15.0)
	Other	8 (20.0)
Focus areas of BIM education	Pre-construction planning	22 (54.0)
	Scheduling	20 (49.0)
	Estimating	21 (51.0)
	MEP	19 (46.0)
	Capstone	17 (41.0)
	Other	12 (29.0)

Comparison of Course Offerings and Industry Expectations

In determining whether the courses on BIM offered by the ASC member institutions were aligned with the expectations of the construction firms, the syllabi of the individual courses of the responding institutions were analyzed. Prospective employers were also asked to indicate their expectations from recent graduates about their knowledge through a survey questionnaire.

Content analysis was employed to analyze the courses syllabi based on course description and learning objectives. Content analysis was used to analyze the large amount of data in a systematic manner to identify the fewer selected categories. The expectations of the construction firms were summarized based on the responses of the survey questionnaires.

Results indicated that both the course syllabi and the construction firms agreed that the knowledge about model development was by far the most important knowledge required to work in the industry. The other knowledge areas that emerged from the analysis were model access management, interoperability, model validation, and model specification.

Conclusions

The goal of the study was to compare the BIM courses offered by the construction programs with that of the expectations of the construction firms. The study sought to obtain a better understanding of expectations of the construction firms regarding knowledge of BIM from recent construction graduates who enter their employment. The study tried to tap a representative pool of respondents and reflected the perspectives of a broad diversity of construction firms. The study also analyzed the focus of the BIM courses offered by the construction programs in the United States based on the course descriptions and learning objectives. From the findings presented, it can be concluded that there was a high degree of agreement between the course offerings and the expectations of the industry. It is recommended for the construction programs to check from time to time whether the course offerings are aligned with the expectations of the construction firms. As the construction programs of the various universities strive to educate their students for professional success, the offered curriculum should be always updated and modified according to industry expectations.

References

Census, U. S. (2011). Table 669: Gross domestic product in current and chained (2005) dollars by industry. 2011, from http://www.census.gov/compendia/statab/2011/tables/11s0669.pdf

Gallaher, M., O'Connor, A., Dettbarn, J., & Gilday, L. (2004). Cost analysis of inadequate interoperability in the U.S. capital facilities industry. NIST GCR 04-867, National Institute of Standards and Technology, Gaithersburg, MD.

Johnson, B., & Gunderson, D. (2009). Educating students concerning recent trends in AEC: A survey of ASC member programs. *International Proceedings of the 45th Annual Conference*, Associated Schools of Construction, Gainesville, FL. April 1-4, 2009, page numbers.

Construction

An Argument for a Risk Management Course

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Introduction

Currently, there are existing patterns in the educational system in which the general topic is taught in a specific course, while applications for that topic are also covered in other courses; for instance, mathematics. Topics such as, algebra and trigonometry, are taught in specific mathematics courses, but those applications are also taught in other courses such as surveying, statics, strength of materials, estimating, and quality management, among others. This paper proposes that Risk Management be taught the same way as other general topic courses, with a Risk Management course, with industry specific applications taught in modules throughout the course, while also being supplemented through additional specialty courses.

Construction in the U.S. has had a history of providing education covering two major risk areas since the 1980's: safety and quality. This paper proposes that Construction Management programs need to cover two additional areas of study, due to growing industry trends, have both added more risk to construction companies in recent years: sustainable/green/LEED and Building Information Modeling.

While the construction industry overall has been relatively conservative, and slow to adopt new and unproven technologies over time, sustainable green construction materials and methods have been established throughout the industry, and need to be covered in the classroom (Nobe & Dunbar, 2004). Certifications and "goals" related to green or sustainable construction are now components to many construction contracts, thus making non-compliance, or failure to achieve specific certifications or levels of performance, grounds for making legal claims. Building Information Modeling (BIM) has experienced similar acceptance throughout the construction industry, and is often used on green and sustainable building projects, resulting in additional liability to the parties involved. Additional courses required in a Construction Management program covering emerging trends in the industry may cause scheduling issues such as: What course(s) can be cut?, Can more credit hours be added?, and How will existing faculty members cover additional courses? Arguments for combining risk management topics into one course include: The pressures to keep program credit hours for a degree to a minimum (in some cases 120 credit hours), and allowing existing faculty to include more content in existing course, without adding courses to the required curriculum.

A website study was conducted including 116 Associated Schools of Construction (ASC) member programs' curriculums as of December 2011, to establish a "benchmark" for curricular content in a typical Construction Management Bachelor of Science program. The data collected concerning risk management focused courses will be shared in this paper, along with the average total credit hours in Construction Management programs, and the average number of credit hours covering various risk management topics.

This paper will also propose a general Risk Management course with modules in: Safety, Quality, Sustainable/Green Construction, and Building Information Modeling (BIM). The Risk Management course content will address basic Risk Management processes, and present to students and faculty how this process applies to various areas of Construction.

Limitations

The website study was conducted using the ASCweb.org website to determine current Associated Schools of Construction (ASC) members, as of December 2011, along with the corresponding independent program websites. Curriculum content of ASC member organizations was determined by the individual department, or program websites, and university course catalogs. The authors of this paper do not guarantee the accuracy of the information gathered from these websites, since

many websites were often hard to navigate, making it difficult to find the appropriate data; the websites also may not have been up to date during the time of this study. Since many programs have similar course content, but course titles may vary between programs, the authors attempted to group courses together by content similarities, not just by course titles. Additionally, since this study focused on commonalities among Construction Management courses within programs, not all elective courses were included in construction courses section of this study. Additionally, both ABET and ACCE accreditations require coverage of professional ethics either through a specific course or through a minimum number of content hours spread across many courses. The Ethics courses, were not accounted for in the Construction courses area of this study, but were accounted for in the General Education content data collected. Whether the curricular courses were required or elective is not identified either, but it was noted whether or not the courses were offered by the program during the data collection cycle of this paper.

Study Results

Table 1 below represents data collected for 116 of the 131 Associate Schools of Construction member programs, as of December 2011, and the curricular content in the "risk" areas listed for each ASC region. Used as a comparison to the Table 1 data, a survey was issued to all ASC member programs in 2008, concerning their content regarding Sustainable Construction, and Building Information Modeling courses. The survey received responses from 43 program faculty contacts, and the results were published in the 45th Associated Schools of Construction International Proceedings in 2009 by Johnson and Gunderson (2009). Of the 43 programs who responded to the survey, 17 of those programs offered a specific course in Sustainable Materials and Methods, six of those being required courses, 10 being elective courses, and one program offering both options. The survey results showed that 28 programs offered courses with partial focus on Sustainable Methods and Materials; 25 of those programs listing them as required courses.

Table 1: ASC Members' curricular content as of December 2011, by region.

ASC Risk Management courses By Region as of December 2011	Northeast				Southeast				Great Lakes				North Central				South Central				Rocky Mtn				Far West				TOTAL ASC	
	Number of Programs w/ Content	% Programs in Region w/ Content	Ave Hrs Content	Majority # hrs. in Programs	Number of Programs w/ Content	% Programs in Region w/ Content	Ave Hrs Content	Majority # hrs. in Programs	Number of Programs w/ Content	% Programs in Region w/ Content	Ave Hrs Content	Majority # hrs. in Programs	Number of Programs w/ Content	% Programs in Region w/ Content	Ave Hrs Content	Majority # hrs. in Programs	Number of Programs w/ Content	% Programs in Region w/ Content	Ave Hrs Content	Majority # hrs. in Programs	Number of Programs w/ Content	% Programs in Region w/ Content	Ave Hrs Content	Majority # hrs. in Programs	Number of Programs w/ Content	% Programs in Region w/ Content	Ave Hrs Content	Majority # hrs. in Programs	% Programs in ASC w/ Content	Ave Hrs Content (of programs w/ content)
Number of Programs in Study	19				16				22				14				15				17				13				116	
BIM (Building Information Modeling)	7	37%	3.1	3	4	25%	3.0	3	6	27%	3.0	3	4	29%	3.5	3	6	40%	4.3	3	2	12%	3.0	3	3	23%	7.0	3, 15	28%	3.9
Safety	13	68%	2.8	3	12	75%	3.0	3	19	86%	2.9	3	11	79%	3.1	3	13	87%	2.6	3	12	71%	2.9	2, 3	7	54%	2.9	3	75%	2.9
Quality Control	3	16%	3.7	4	1	6%	3.0		2	9%	3.0	3	1	7%	2.0		2	13%	3.0	3	1	6%	3.0	3	1	8%	3.0		9%	3.0
Risk and Insurance	3	16%	2.7	3	1	6%	3.0		0	0%	0.0		1	7%	3.0		0	0%	0.0		2	12%	3.5	3, 4	0	0%	0.0		6%	3.0
ConstructionLaw and Legal Aspects	8	42%	3.0	3	7	44%	3.0	3	9	41%	3.0	3	6	43%	3.0	3	10	67%	3.3	3	7	41%	3.1	3	10	77%	3.0	3	49%	3.1
Sustainable Construction (LEED)	1	5%	9.0		1	6%	3.0		8	36%	3.0	3	1	7%	3.0		3	20%	3.0	3	4	24%	3.0	3	2	15%	3.5	3, 4	17%	3.9
High Performance Construction	0	0%	0.0		1	6%	3.0		0	0%	0.0		0	0%	0.0		0	0%	0.0		0	0%	0.0		0	0%	0.0		1%	3.0
Average Number Program Credit Hours	129.7				125.4				124.3				127.2				123.8				125.7				128.3 Sm Hrs / 189.2 Qrts				126.3	
	Based on 18 w/ Semesters				Based on 16 w/ Semesters				Based on 19 known w/ Semesters				Based on 14 known w/ Semesters (1 program is 5 yrs)				Based on 15 w/ Semesters				Based on 15 known w/ Semesters				Based on 8 w/ Semesters, 5 w/ Quarters				Based on 7 Regions/ Smstr Hrs	

No assumptions can be made toward the rest of the ASC member programs that failed to respond to the survey, but as seen in Table 1 above, for ASC member programs as of December 2011, 20 of the 116 programs included in the current study offered courses focused solely on Sustainable Construction, either required or elective, and one program even offers a course in High Performance Construction.

In regards to Building Information Modeling (BIM) courses, per Johnson and Gunderson's (2009) survey, only 12 programs of the 43 responders reported specific courses covering BIM concepts; five being required courses, four being elective courses, and three being offered as both elective or core courses. Partial coverage of BIM concepts was reported in 22 of the programs; 16 being required courses, three being elective courses, and two programs offering both elective and core courses. Per the results of the current study, as of December 2011, 32 of the 116 ASC programs in the study offered BIM courses, either as required or elective courses.

Of the 116 ASC programs, 49% of them included a course based on Construction Law that addressed topics such as: contractual, legal, safety, and labor issues, as well as business risk. However, only 9% of the programs in the study included a specific course in Quality Management. Mincks (2008) proposed that Quality Management concepts, if not covered in a single course, could and should be incorporated into a curriculum in various ways including: as part of a core undergraduate course, such as Project Management, as part of a graduate level Construction Management course, combined with other topics, such as Lean Construction, or in Certificate Programs and Education Seminars. This supports the authors' recommendation for a general Risk Management course in which the beginning of the course would address general Risk Management concepts, followed by various learning modules that would address concepts such as: safety, quality, sustainable construction, and BIM components, to name a few. Additional courses could be offered beyond the general Risk Management course to accommodate programs that offer areas of concentration within their curriculum, or would like to offer Certificate Programs, such as the 30-Hour OSHA Training Certificate.

The Risk Management course proposed in this paper complies with the accreditation requirements for the American Council for Construction Education (ACCE), which only requires one semester hour (credit) of coverage for Safety, and has no specific coverage requirement for Quality, or other topics covering risk. The Accreditation Board for Engineering and Technology (ABET), does not have specific coverage requirements in those particular areas of study. Courses in Quality, Safety, and Risk Management, taught by the program faculty, would fall into the ACCE accreditation for Construction Management programs that include a minimum of 20 semester hours of content coverage for that topic category. This study of 116 ASC member programs determined that 69% of the programs were either currently, or will be ACCE accredited in the near future, 70% were ABET accredited, 17% were ATMAE accredited, and 49% of the programs had dual accreditations with a combination of ABET/ACCE, ABET/ATMAE, or ACCE/ATMAE dual-accreditations; only 2% of the programs studied were non-accredited. These results were determined by performing analysis of the program websites, the accrediting group websites, and by sending emails to the program coordinators of the programs that did not have accreditation information displayed on their department website, or in the course catalogs. Programs who failed to respond to the email inquiry were not included in this study.

Risk Management: General Content

Risk is essentially the potential for loss or damages, and is a constant component to the human existence (Rescher, 1983). The components of risk are: magnitude, probability, and exposure to loss, while the determinants of risk are the amount of control, time, and information available (MacCrimmon & Wehrung, 1986). Risk Management is the activity by which risk is recognized, assessed, and managed while developing strategies to eliminate, minimize, or pass the risk to other parties. There are standards that can be used to inform students about appropriate Risk Management procedures including, among others, ISO 3100:2009 (Purdy, 2010).

Due to the number of variables and exposures to danger involved, Construction happens to be a very risky business (Smith, Currie & Hancock, 2009; Panthi & Azhar, 2007). Risk management starts with the identification and assessment of risk, and proceeds to evaluate the possibility for risk avoidance, risk transfer, risk mitigation, or risk acceptance, when risks are low-impact and low-probability (MacCrimmon & Wehrung, 1986; Panthi, Ahmed & Azhar, 2007). These procedures can be generally covered in a Risk Management course, since the source of risk may vary significantly depending on the industry or occupation at hand. There are various methods for evaluating the correct Risk Management procedures to use (avoid, transfer, mitigate, or retain) in certain situations; these methods may include modeling, or the use of matrixes, as proposed by Panthi, Ahmed & Azhar (2007). As seen in Table 1, only seven programs (6%) out of 116 ASC member programs included in the study offered a general course in Risk Management or Insurance. A general Risk Management course could help students understand that many potential hazards can be minimized with the same basic Risk Management approach.

Labor related issues and general business requirements can be covered in a Business, Business Law, or Construction Law course. Of the 116 programs, 49% of them specifically offer a Construction Law course, while others require a Business Law course, or allow it to be taken as a Business Elective. Issues specific to the Construction industry can be covered in the proposed general Risk Management course. These industry-specific risks are typically found within the areas of Construction Safety and Construction Quality, and should also now include Sustainable Construction, Green Building, and Building Information Modeling (BIM) topics. The latter two topics mentioned have recently become common sources of legal claims filed, mainly due to a lack of contractual compliance between parties involved with various types of projects (Holland, 2009; Ke Chiara, Talbot, 2006; Smith, Currie & Hancock, 2009; Vroljijk, 2008; Wojcik, 2011).
Further support for adding these two areas of coverage for Risk Management can be gained by observing current

Construction industry trends as of 2011, which included, but were not limited to, Sustainable/Green Construction, Building Information Modeling, and Risk Management (Lee, Ponton, Cohn & Jeffreys, 2011). The authors state that Risk Management "is relevant in Estimating, Project Management, Equipment, Contracts, and every other facet of the business" and since it is extremely important in industry should be "systematically incorporated" throughout Construction Management programs through existing courses.

While six percent of the 116 ASC member programs included in the study already offer a Risk Management/Insurance course of some type, 94% of the programs do not. In comparison, Safety Management is offered by 75% of the programs included in this study. Many current Safety programs have been adapted from the Total Quality Management model, and Deming's model as suggested by Farooqui, Ahmed and Azhar (2008). The model has three phases: (1) Planning and Preparation, (2) Identification and Assessment, and (3) Execution and Improvement. These are also the steps involved with a Technology Systems approach to Risk Management, and should, therefore, be applicable to any risk category beyond Quality and Safety to include Sustainable/Green Construction or BIM technologies.

The goal of a Technology System is that the objectives be met effectively, or in other words, the objectives of the organization should be achieved at lower costs with fewer resources, making the system as a whole more efficient (Daellenbach, 1994). Safety and quality are generally closed loop systems, in that they require continual improvements and corrections from a feedback control mechanism. The feedback control mechanism sends corrective signals to steer the system in the desired direction (i.e. reduced number of accidents, or low quality production). Self-regulation through feedback loops allows for learning from past events to revise or adapt new procedures in the system. Feed-forward control mechanisms can predict how changes in uncontrollable inputs are likely to affect the overall system process, or individual outputs, and adjust the process as necessary (Daellenbach, 1994).

For any technology system, or in this case, Risk Management, the system inputs can be the desired goals for the project, in addition to the aspects of the project that will affect the system. The System Transformation process is essentially the Construction process, meaning the outputs could be an individual construction component, or the project itself. The new state of the system would be the project status as any one point in the construction process. Control inputs, or decisions, would be the modifications to the construction project based upon accident reviews, failed inspections, etc. The control mechanism may be inspections, checklists, interviews, etc., that will be used to revise the construction process, and be the cause of the control inputs so as to avoid future incidents of the same nature. Thus, this technological system can be used to explain generic Risk Management procedures for any Risk Management program, regardless of the industry.

Proposed Risk Management Course

The proposed outline for a Risk Management course (16 weeks, one semester) would use the first three weeks to cover Risk Management in general, covering common strategies for risk identification, probability, and response, while utilizing the basic Technology Systems approach of: plan, do, check and act/react. The next four weeks would be used to cover Safety, followed by three weeks for Quality, three weeks for Sustainable/Green Construction, or LEED project risks, and finishing with two weeks of coverage for BIM technologies, leaving the last week for the final exam. The specific content areas covered would identify risks unique to that category, and how to identify, evaluate, and take action to minimize potential project specific risks.

For example, taking BIM concepts into consideration, Szhar, Hein and Sketo (2008) have identified several risks that would become important to parties involved in projects utilizing these technologies. They proposed that the first risk would be legal issues surrounding ownership of the BIM data, and copyright laws. Additionally, control of data entry, levels of responsibility, accountability for the data, and perceived liability for design errors are all potential sources of risk when dealing with BIM technologies. Since cost and schedule can be layered into a 3D model, responsibility for technology interfaces amongst the various programs can also be considered potential issues (Szhar, Hein & Sketo, 2008). These areas of risk, among others, and methods to deal with them, could be covered in the two weeks set aside within the curriculum for BIM technologies.

Sustainable/Green Construction content coverage could address topics such as: contractual issues, employee exposure issues on sites with possible contamination such as brown field redevelopment, other environmental issues, along with roles and responsibility/liability issues dealing with newly integrated project delivery systems, and the possible use of BIM technologies on projects throughout the course.

Safety would include: Occupational Safety and Health Act (OSHA) requirements, Total Safety Management plan development, and Risk Management identification strategies (Farooqui, Ahmed & Azhar, 2008). Quality Management could address Total Quality Management Plan development, typical quality issues in construction based upon the type of construction being dealt with, mitigation and management techniques, and other related policies such as, ISO 9000.

Summary

Risk is always going to be a component of construction. The process through which students learn about Risk Management is a choice that each individual program must make regarding its curriculum. The commonalities of methods by which Risk is identified, managed, and dealt with, can be covered in a Risk Management course with specific content within that course being geared toward current trends in the Construction industry. Results of the November through December 2011 review of 116 ASC member websites showed that there were slightly more ASC member programs in 2011 as compared to 2008/2009 that reported including courses in BIM and Sustainable/Green Construction. The increasing trend of these topics being covered in Construction Management programs directly correlates to the reported industry growth trends in those same areas of focus. This industry trend also suggests that various Risk Management topics such as, Safety, Quality, Sustainable/Green Construction, LEED Construction, and BIM technologies, should be covered in Construction Management programs around the country. The proposed composite Risk Management course was designed by the authors to ensure that students receive a general education in Risk Management, while learning methods and procedures to help minimize the potential risks faced every day while working in the Construction industry.

References

Azhar, S., Hein, M., & Sketo, B. (2008). Building Information Modeling (BIM): Benefits, risks, and challenges. *44th ASC Annual International Conference Proceedings*, April 2-5, 2008.

Daellenbach, H. (1994). *Systems and decision making: A management science approach*. West Sussex, England: John Wiley & Sons, LTD.

Farooqui, R., Ahmed, S., & Azhar, S. (2008). Suggestions for a Total Quality Management based safety program for construction industry. *44th ASC Annual International Conference Proceedings*, April 2-5, 2008.

Griffiths, R., Ed. (1981). *Dealing with risk: the planning, management and acceptability of technological risk*. John Wiley & Sons: New York.

Holland, J. K. (2011). How Building Information Modeling (BIM) impacts insurance availability by changing the roles, responsibilities, and risks of project participants. *ConstructionRisk.com.* Available at: http://www.constructionrisk.com/2011/01/how-building-information-modeling-bim-impacts-insurance-availability-by-changing-the-roles-responsibilities-and-risks-of-project-participants/

Johnson, B., & Gunderson, D. (2009). Educating students concerning recent trends in AEC: A survey of ASC member programs. *45th ASC Annual International Conference Proceedings*, April 1-4, 2009.

Ke Chieara, M. & Talbot, M. (2006). BIM: The professional and legal ramifications- a voyage into the unknown. *ConstructionRisk.com* July 2011. Accessed at http://www.constructionrisk.com/2011/07/bim-the-professional-and-legal-ramifications-%E2%80%93-a-voyage-into-the-unknown/

Lee, N., Ponton, R., Cohn, R., & Jeffreys, A. (2011). Analysis of industry trends for improving undergraduate curriculum in Construction Management education. *47th ASC Annual International Conference Proceedings*, April 6-9, 2011, pp. 9-14

Mincks, W. (2008). Emphasizing quality management in a construction curriculum. *44th ASC Annual International Conference Proceedings*, April 2-5, 2008.

Nobe, M., & Dunbar, B. (2004). Sustainable development trends in construction. *ASC Proceedings 40th Annual Conference, Brigham Young University - Provo, Utah,* April 8 - 10, 2004

Panthi, K., Ahmed, S., & Azhar, S. (2007). Risk matrix as a guide to develop risk response. *43rd ASC Annual International Conference Proceedings,* April 12-14, 2007.

Purdy, G. (2010). ISO 3100:2009 Setting a new standard for risk management. *Risk Analysis, 30*, pp. 881-886.

Vrolijk, J. (2008, July). Green and growing: Sustainable building insurance methods are still under construction. *American Agent & Broker, 80*, 7, pp. 34-37.

Wojcik, J. (2011, June). Green building design teams face increased exposures: Contract guarantees on LEED designation create liabilities. *Business Insurance*, June 19, 2011. Accessed at: http://www.businessinsurance.com/article/20110619/ISSUE01/30619994

Construction

Participation on Competitive Teams in Construction: Students' Perspectives

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Abstract
Teamwork is critically important in the construction industry. University construction programs prepare students for working on teams by using a variety of classroom and extracurricular methods. One approach gaining popularity is student competitions, where teams of construction and related majors compete against other schools in a variety of simulated challenges. Faculty mentors coach these student teams, yet little research is available to them on the students' motivations, opinions, and advice for these competitions. This paper provides faculty, administrators, and organizations with the participants' perspectives on student teams. Drawing from interviews with students who have competed in regional, national, and international events, this paper helps construction educators understand the student viewpoint of competing on teams, from recruitment through victory or defeat.

Introduction
Construction projects are built by teams. From the design to the ribbon-cutting ceremony, the process is organized not around individuals, but teams who specialize in the various aspects of a modern construction project. These teams are part of larger project organizations that come together to build everything from houses to skyscrapers and dams to strip malls. If it is larger than a doghouse, it was most likely built by a team.

Construction-related curricula at universities seek to prepare students for successful careers in this team-based industry. As part of this professional preparation, teamwork elements are often incorporated into class assignments and projects. Many students are also afforded the opportunity to test their skills and abilities against those from other institutions in a variety of team-based, inter-university competitions in construction-related areas. As Ryan (1993) stated, "Student team competitions are intended to be an event where students currently enrolled in four-year construction education programs have the opportunity to match skills with students of other schools" (p. 15).

These competitive events in construction are increasing in availability in response to their growing popularity. For example, the Associated Schools of Construction (ASC) Northeast Region had 18 teams compete in three categories in 2004, and had 29 teams compete in the same categories in 2010, representing a greater than 61% increase in student competition (Manion, 2011). ASC has also introduced a wide variety of categories recently, such as Building Information Modeling, Concrete Solutions, Determining Project Risk, LEED (Leadership in Energy and Environmental Design), Preconstruction Services, and Virtual Design and Construction (Brown, n.d.; Schmidt, 2011). While these competitions are hosted regionally, three regions are now also hosting "open" categories and allowing teams from member schools across the nation, and theoretically across the world (ASC has five international school members), to compete (Associated, n.d.; Brown, n.d.; Schmidt, 2011). Other competitions in construction or with significant construction components include the National Electrical Contractors Association (NECA) Student Chapters' Green Energy Challenge, the National Association of Home Builders Student Chapters' Residential Construction Management Competition, and the United States Department of Energy's Solar Decathlon.

This paper provides the students' perspectives of participating on competitive teams in construction. Through the use of interviews, students' views on motivation, experience, and process were obtained from their competitions in regional, national, and international events. Faculty, administrators, and organizations that are coaching, sponsoring, hosting, or considering any of the above will benefit from considering the student participants' views on competing in these events.

Review of Literature

Teams have become widespread in many organizations. As Bolton described, "Public and private organizations are increasingly relying on teams as a new management 'technology' to support institutional missions and improve organizational performance" (1999, p. 233). Recognizing the use of teams in many professions, educators in many disciplines have incorporated team projects into their curricula. As Attle and Baker (2007) stated, "it is critical that professional studies students develop the requisite skills to succeed in a team-oriented environment within the competitive environment of commercial industry. Professional studies classroom provide exceptional opportunities to facilitate team-like cooperation in a competitive business-like environment" (p. 77).

Besides business and management, student teams are also common in other allied fields to construction, particularly design. Markov (2000) used teams of architecture students to design and construct a bridge, while Higuchi and Howell (2000) proposed using student teams in mechanical engineering labs. Labossière and Bisby (2010) were able to integrate a design competition for a pedestrian bridge in Sherbrooke, Canada into a structural engineering design class where student teams competed for the opportunity to have their design finalized and actually constructed.

Interdisciplinary teams are also found in the classroom. Boni, Weingart, and Evenson (2009) described best practices from a graduate capstone course that integrated students from business and design. Other faculty have promoted the use of industry-sponsored projects for student teams to solve in mechanical engineering (Keefe, 2007). Others have championed courses that incorporate student teams and simultaneously emulate the team process by being team-taught by faculty (Jones, 2009; Jones, Mezo, & Warner, 2007).

Student team performance in the classroom has also been examined. For example, Scott (2007) found that "teams whose members had similar problem-solving approaches performed better in the team environment" on a puzzle-solving exercise at a Midwestern university (p. 5). Kapp (2009) found that a team-building intervention helped team performance in a capstone safety course. Baldwin, Bedell, and Johnson (1997) found that "centrality in friendship, communication, and adversarial networks affected both student attitudes and grades" and that "relationships within and between teams also had significant effects on student perceptions of team effectiveness and objective team performance" (p. 1369). Incidences of "social loafing," where students contribute less than others ("slacking") and "diligent isolates," where individual students do disproportionally more than the rest of the team, have also been studied (Pieterse & Thompson, 2010).

However, no literature could be found examining the perceptions of university students participating on competitive teams, despite their popularity in construction fields.

Methodology

As there was little existing research focused on student perspectives of participating on competitive teams in construction, a qualitative research methodology was selected. As Merriam and Simpson (2000) stated, "qualitative research is a particularly appropriate strategy to use when there is little knowledge about the problem" (p. 99). While it is clear that more students are participating in these competitions, their motivations and experiences have not been investigated. The researchers agreed with Seidman's (2006) perspective that "At the heart of interviewing is an interest in other individuals' stories because they are of worth" (p. 9).

Subjects were voluntarily recruited from students and alumni who have participated on student competitive teams in construction while attending the researchers' institution. Potential subjects were identified through records of participation on previous and current student teams. Initial contact was made through an e-mail message, and interviews were scheduled with those subjects who volunteered to participate. One of the researchers was a faculty member in the construction management program that coached, and was coaching, student teams at the time of the study. In order to promote students' open communication, all contact with the participants was therefore made by the co-investigator, a graduate student who had participated on student competitive teams.

After providing their informed consent to participate, subjects were interviewed on the campus of the university at their convenience. Interviews were recorded electronically and field notes were taken by the interviewer for later analysis. A total of 17 subjects who had participated in a total 31 competitive events were interviewed, with a total of nearly 400 minutes of interviews conducted. Each competitive event was described separately during the interviews. All participants were current students with the exception of a single alumnus. There were 15 construction management majors, one construction

management minor, and one participant who had participated in one competition while enrolled as a construction management minor and later as a major when enrolled in a second baccalaureate program.

Interviews were analyzed separately by each investigator. Each interview was coded and categories emerged from the process of analyzing the data as described initially by Glaser and Strauss (1967) and later expounded by Glaser (1978, 1992, 1998, 2001) although results were not developed into theory. Each researcher's results were then integrated into common categories and findings.

Findings

Emergent categories included recruitment, motivation to participate, positive and negative experiences, and industry. Repeat participation was also common and found to be beneficial. The experience was "more educational than a semester's worth of school" according to one participant.

Recruitment

While students were aware of various competitions through posters and banners, particularly those congratulating a winning team, and mass electronic mailings sent to all students, they were recruited through direct, personal contact. This contact was primarily through faculty members, usually the team coaches but also including other construction management faculty, who made a direct connection with the student and encouraged them to participate.

Faculty announcements in class were noted and often the initial way students became aware of a particular event, but the personal interaction actually recruited the student. As one student commented, "I had received e-mails previously but didn't really know what they [competitions] were and was not interested. It was an easy sell once explained [by the faculty member]." Another commented that he was approached by a particular faculty member based on the student's interest in the electrical market segment. "I said, 'Yeah, I'd definitely be down for that.'"

Students were also recruited by other students. Team captains sought out fellow classmates and friends recruited friends: "Knowing people on the team was a big help." Students who had previously participated often wanted to participate again, in essence recruiting themselves for another event. Students that had lost in their category were spurred to try harder in another event and tried to recruit the students that would best enable success. Conversely, students that had won their competitions also wanted to repeat that success. One student stated, "It gets addictive – you want to go and win."

Motivation to Participate

The primary motivation to participate on a competitive team was its function as a "resume builder." Students were looking for a way to distinguish themselves for future employers, and were well aware that certain employers (particularly those that sponsored events and categories) looked at competitors favorably. Several reported receiving interviews and even job offers through contacts made at the competitions, and other students were well aware of this potential. They believed that employers used competitions as a "weeding out" mechanism, and that only the "best of the best" from a school participated, making the likelihood of securing an interview with certain companies more likely.

Similarly, students were motivated by this "best of the best" image. Students were very desirous of placing in a competition, regardless of type. This desire to be in an elite category spurred more effort, commitment, and preparation in future competitions. One student commented about how the team he had competed with finished fourth in a regional competition, narrowly missing placing in the top three. The disappointment of this slim losing margin inspired them to build upon their strengths and correct their weaknesses, resulting in their winning in a national competition category shortly afterwards, providing both a vindication and a certain amount of "bragging rights."

Students also were motivated by the type of competition. For competitions that had both construction and design elements, students were eager to work with their counterparts in the other discipline. Construction majors were interested to "learn how to deal with architects," and designers were interested in "seeing the other side." Besides interdisciplinary aspects, categories mattered: students interested in electrical contracting were interested in competitions focused on electrical challenges, and students interested in heavy/civil work were interested in events in that category.

Positive Experiences

Students enjoyed the competitive and realistic aspects of these events. One student, now employed full-time in the construction industry, stated how it was "real world, especially looking back now that I am in the real world." It was viewed as "experience" in the field, much the same way that internships and other industry involvement were. The industry involvement, as sponsors and more particularly judges, gave it a different component than presenting to faculty members. Presenting in front of industry members was thought to engender more "professionalism" and place more weight on doing one's best. The time constraints and "crunch time" were also believed to be realistic and exciting components.

Communication skills were important to team participants, and were often an area that students believed they learned a lot from having competed. One student, a construction management major that was in an interdisciplinary competition, stated, "It was interesting working with the architects. . . I learned how to phrase things so they would understand it, and to ask questions. . . The architect students were real reserved. Not sure if they should share their ideas. [They] eventually understood I was there to help."

The self-guided aspect was a positive element for those who did it well. Those who prepared "rigorously" on their own were proud of their dedication and commitment while executing their own plan. Being able to plan and prepare at their discretion, with assistance from faculty coaches, was viewed as a positive part of the experience. The preparation phase was considered as the key to proper functioning as a team, including getting to know the other members, identifying each person's strengths and weaknesses, and assigning roles and responsibilities. Leadership by and within the team was differentiated from faculty requirements for a class assignment.

Negative Experiences

While most students had overall positive experiences, some negative aspects were also encountered. Most of these were related to team dynamics: communication, roles, responsibilities, and leadership. A student on an interdisciplinary team said, "It was challenging at times working with the architects. . . There was a difference in the way we thought. We looked at how things work; they look at how they look." Knowing what one's roles and responsibilities were was also considered to be important; otherwise there was a general lack of organization and things were missed. Some students did not even know what others had done on the team and had only focused on their small piece of the competition. Leadership issues developed within teams as well. One competitor related, "We didn't have a taskmaster. No one was responsive or producing quality." Another stated: "It was hard because we did not have one set leader. It was like, 'who wants to do this?' instead of 'you will do this.'"

Relatedly, students who had members who did not contribute equally (social loafing) were viewed negatively. One participant recommended, "Don't allow other to skate by without pulling their weight." "We were all dedicated – but not equally. Some more than others" said another. One team captain advised future participants to avoid "teams that are not fully committed. Pick your team carefully; otherwise your workload will be uneven."
Preparation, or lack thereof, was also found to be a negative aspect. Time management issues overwhelmed some teams, both during the preparation phase or the final compilation of submission materials. During the preparation phase before the actual competition, scheduling around others' classes, work schedules, and other time demands was a source of frustration. Technical preparation, in the form of having taken appropriate classes beforehand, was also a drawback for teams. For example, one team assigned the estimating role to a member who had not taken the estimating class yet in the program, with negative consequences.

Industry

Industry involvement was an important facet of the competitions. Besides the "real world" and job/interview components previously discussed, the simple fact that industry was involved indicated that it was important, and if it was important to industry, it should be important to students. Additionally, students appreciated industry involvement during the preparation phase, including visiting job sites, looking at bid materials, and discussing technical analyses.

Discussion

Faculty, administrators, and others involved or considering becoming involved in competitive events in construction should be mindful of the student perspective. While this qualitative study cannot be generalized to every program, consideration can be given in several areas. For example, personal contact during recruiting was meaningful and more productive for students than mass electronic mail notifications/solicitations.

Competitive team events for students in construction curricula can be positive, productive, and beneficial experiences that prepare the next generation of constructors for industry. Students learn the importance of planning, teamwork, communication, and other "soft" skills while concurrently applying the technical skills learned in the classroom to overcome realistic, challenging construction problems.

References

Associated Schools of Construction. (n.d.). International Region. Retrieved from http://www.ascweb.org/directory/membership.php?regionID=8

Attle, S., & Baker, D. P. (2007). Cooperative learning in a competitive environment. *International Journal of Teaching and Learning in Higher Education*, 19(1), 77-83.

Baldwin, T. T., Bedell, M. D., & Johnson, J. L. (1997). The social fabric of a team-based M.B.A. program: Network effects on student satisfaction and performance. *The Academy of Management Journal*, 40, 1369-1397.

Bolton, M. K. (1999). The role of coaching in student teams: A "just in time" approach to learning. *Journal of Management Education*, 23, 233-250.

Boni, A. A., Weingart, L. R., & Evenson, S. (2009). Innovation in an academic setting: Designing and leading a business through market-focused, interdisciplinary teams. *Academy of Management Learning & Education*, 8, 407-417.

Brown, L. (n.d). Associated Schools of Construction Rocky Mountain Region - Far West Region. Retrieved from http://www.asc67.org/index.html

Glaser, B. G. (1978). *Theoretical sensitivity: Advances in the methodology of grounded theory*. Mill Valley, CA: Sociology Press.

Glaser, B. G. (1992). *Basics of grounded theory analysis: Emergence vs. forcing.* Mill Valley, CA: Sociology Press.

Glaser, B. G. (1998). *Doing grounded theory: Issues and discussions*. Mill Valley, CA: Sociology Press.

Glaser, B. G. (2001). *The grounded theory perspective: Conceptualization contrasted with description*. Mill Valley, CA: Sociology Press.

Glaser, B. G., & Strauss, A. L. (1967). *The discovery of grounded theory: Strategies for qualitative research*. New Brunswick, NJ: AldineTransaction.

Higuchi, H., & Howell, C. (2000). Engineering: Teamwork in the lab. In R. F. Stein & S. Hurd (Eds.), *Using student teams in the classroom* (105-107). Bolton, MA: Anker.

Jones, J. W. (2009). Team teaching collaboration in higher education. *Academic Exchange Quarterly, 13*(4), 104-109.

Jones, J., Mezo, M., & Warner, J. (2007). Team teaching the capstone construction management course: How and why. *International Proceedings of the 43rd Annual Conference*, Associated Schools of Construction, Flagstaff, AZ. April 12-14, 2007, 153-162.

Kapp, E. (2009). Improving student teamwork in a collaborative project-based course. *College Teaching, 57*(3), 139-143.

Keefe, M. (2007). Assessing student team performance in industry sponsored design projects. *Journal of Mechanical Design*, 129, 692-700.

Labossière, P., & Bisby, L. A. (2010). Lessons learned from a design competition for structural engineering students: The case of a pedestrian walkway at the Université de Sherbrooke. *Journal of Professional Issues in Engineering Education and Practice*, 136, 48-56.

Manion, W. (2011, November 17). ASC Northeast Region. Retrieved from http://region1.ascweb.org/

Markov, I. (2000). Architecture: Team competitions. In R. F. Stein & S. Hurd (Eds.), *Using student teams in the classroom* (83-87). Bolton, MA: Anker.

Merriam, S. B., & Simpson, E. L. (2000). *A guide to research for educators and trainers of adults* (updated 2nd ed.). Malabar, FL: Krieger.

Pieterse, V., & Thompson, L. (2010). Academic alignment to reduce the presence of 'social loafers' and 'diligent isolates' in student teams. *Teaching in Higher Education*, 15, 355-367.

Ryan, R. (1993). Development of the first ASC Region III student team project management competition. ASC *Proceedings of the 29th Annual Conference*, Associated Schools of Construction, Fort Collins, CO, April 15-17, 1993, 15-17.

Schmidt, J. (2011, November 4). Associated Schools of Construction Region III. Retrieved from http://region3.ascweb.org/

Scott, S. (2007). Team performance and the problem-solving approach. *Journal of Industrial Technology, 23*(4), 2-7.

Seidman, I. (2006). *Interviewing as qualitative research: A guide for researchers in education and the social sciences*. New York: Teachers College.

Distance & Online Learning

Distance & Online Learning

Instructional Design Strategies for Effective Virtual Teamwork

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Abstract
Due to the growth in online education and the availability of a wide selection of online collaborative tools, the utilization of virtual teamwork is rapidly becoming commonplace among postsecondary institutions, government, and other organizations. As a result, instructors must equip students to meet this increasing employment demand by considering how instructional design impacts their students' virtual teamwork learning experiences and subsequent performance. The instructional design strategies presented in this paper are based upon the recommendations from a qualitative, in-depth, multi-case study that explored how the instructional design of two virtual team projects impacted students' performance. This paper provides detailed strategies for designing virtual team projects that foster trust, manage varying levels of technical skills among students, encourage leadership, promote accountability, and value multiculturalism.

Introduction
Along with the increasing globalization of the workforce and growth in online education, the use of virtual teamwork is swiftly becoming integrated within the curriculum of higher education and the operating practices of government and corporate organizations. According to Mayadas (2010), "Virtual teaming is an important practice, and its importance and usefulness will only increase" (p. xxvii). This opinion is echoed by Chutnik and Grzesik (2009), whose research showed that organizations are employing virtual teams at a growing pace. The use of virtual teams is also increasing in online and blended classes (Karpova, Correia, & Baran, 2009). The Commission on Institutions of Higher Education (CIHE) reported that among employers who participated in their Graduate Employability Survey, 85% of employers rank team working skills as second only to communication as the most important skill sought among new college graduates (Archer & Davison, 2008). In today's world, it is not at all uncommon for employment candidates to be asked if they have virtual team experience (Ubell, 2010).

An increasing number of companies are becoming aware that business is best conducted within virtual associations and are consequently concentrating on rigorous networking with other businesses (Broser et al., 2010). Therefore, it is vital that students gain exposure to virtual teamwork in postsecondary education so that upon entering the workforce they have the experience that is sought by an ever-increasing number of employers. The growth in the utilization of virtual teams raises questions and issues about employing the best instructional design strategies that will result in highest performance and learning outcomes. It is the responsibility of the instructor to consider how their instructional design will impact students.

The instructional design strategies presented in this paper are based upon the findings and recommendations from a qualitative, in-depth multi-case study intended to answer the following research question: How does online instructional design impact students' virtual teamwork performance? Data was collected through document analyses, observations, and student interviews from two virtual teams, one in each of two online Organizational Leadership courses. The two online courses were taught by two different instructors at a regional, Midwestern university. In order to create an online environment for virtual team success, instructors should consider available collaborative technologies for communication and interaction, instructional design, and the value of multiculturalism.

Collaborative Technologies
The rapid and continual growth of technology has expanded the possibilities for interaction among individuals around the globe. Advancements in communication technology provide opportunities for students to collaborate and interact with others in ways that were before limited by time and space (Bergiel, Bergiel, & Balsmeier, 2008). As a result, there are areas within the design of virtual team projects that must be addressed, including availability and choice of communication technologies and levels of students' technical skills.

When designing virtual teams in education, instructors and team leaders must consider the communication technologies available to them through their educational institution. Blackboard, Web-CT, and Sakai are currently the most frequently utilized online course management systems in postsecondary education (Soon & Sarrafzadeh, 2010). These systems include both synchronous and asynchronous collaborative capabilities such as discussion boards, wikis, blogs, email, and virtual chat. Sivunen and Valo (2010) suggested that teams select communication tools based on their team's online community. While the instructor should make several communication options available to teams, the team members should decide how best to communicate based on members' schedules, preferences, or other needs.

Instructors should also consider that technical skills among students may differ. Although social media websites are especially popular among young people, it should not be assumed that because students may have experience with social media they will be prepared for collaborative technologies in the online learning environment (Egert, Jacobs, & Barnes, 2009). Without previous online course experience, students are often unprepared for the course management systems utilized in online education (Egert, Jacobs, & Barnes, 2009). Providing practice with the course technology tools at the beginning of the term may help students to feel more comfortable and lead to higher levels of participation (Young & Norgard, 2006). Instructors should provide clear instructions, support, and practice opportunities with course technology before or at the beginning of the term.

Instructional Design

Integrating virtual teamwork into instructional design comes with many challenges, but can also present opportunities if challenges are anticipated and managed during the planning process. While teams should be encouraged to set goals and be empowered the freedom to determine how to accomplish them, there are some areas in which the instructor needs to set clear guidelines. Instructors must not assume that all students have virtual team experience. Clear expectations about the outcome(s) or deliverable(s) of the team project must be communicated to students. This can be accomplished through transactional instructions and procedures (Bass and Riggio, 2006). These should be stated clearly in the course, syllabus and posted in the online course perhaps in a team project folder so that all students can review the requirements.

Accountability

One of the most important components of virtual teamwork is accountability. How will students be evaluated on the team project outcome or deliverable? How will their performance as a team member be assessed? In addition to instructor evaluation, a common practice in higher education is the use of peer and self-assessments. Resta and Lee (2010) stated, "Peer assessment offers a means of providing individual accountability. Self-assessment also helps learners reflect on their own performance and enhances their accomplishments" (p. 45). Students should have access to the peer and self-assessments early on in the team project so they have an opportunity to review and ask questions about what is expected of them in regard to their team behavior and performance. Knowing expectations up front also helps students to keep the areas of assessment in mind throughout the project and appraise other team members as they near completion.

The amount of points assigned to peer assessments affects its impact on students' performance and level of activity. Peer assessments, worth sufficient points to impact students' overall grade, may motivate students to be more engaged (Rawlings, 2012). However, instructors should be aware that peer assessments could also carry negative consequences if one student harbors antipathy toward another member and takes it out on the peer assessment. When reviewing students' peer assessments for their team members, consistency should be expected. If an assessment seems significantly lower or higher than others, the instructor may wish to investigate or speak with the student(s).

When designing peer assessments, the instructor should ask specific questions that foster reflection. They also may wish to consider requiring students to justify their ratings of peers. Justification of ratings fosters reflection on performance and improvement of assessment skills (Rawlings, 2012). Also, students receiving the justification of points may realize a deeper more meaningful understanding in regard to the quality of their teamwork which may help students to improve their teamwork skills in future academic and work related assignments.

The self-appraisal is equally important as students reflect upon their own performance at the end of the project. The self-assessment can help students indentify areas of strength as well as challenges, thus improving their performance as future team members. Peer evaluations may also reduce the "slacker" issue, one of the most common complaints among students about teamwork. A slacker is a team member who does not contribute their share of the work (Pfaff & Huddleston, 2003). There are also other ways to promote accountability and reduce or eliminate slacker problems while encouraging students to take an active role on their team.

Team Leadership

Team leadership is important in promoting both team and individual accountability, but also for helping the team stay focused and to cultivate community. Often, team leaders naturally emerge. However, when team leadership is absent or ineffective, teams may fail to successfully communicate, resolve conflicts, form community, and thereby lose direction. Instructors should look for ways to encourage, or even require, students to take a leadership role on their team.

Team contracts are a way to promote individual accountability, inclusion, and ownership of team goals, while giving each member an opportunity to take a leadership role. Instructors should consider requiring or encouraging teams to identify leadership roles and responsibilities for each member at the beginning of the project (Rawlings, 2012). It may help be helpful for students if instructors provide a contract template with examples of various leadership roles team members may wish to consider.

As part of the contract, students should also be encouraged or required to identify team norms. For example, teams may wish to select a primary means of communication the instructor has made available. Teams may also wish to set an agreed upon timeframe during which members must respond to emails or other forms of communication within the team community. When team members work together to identify leadership roles and responsibilities as well as team norms, they may be more committed to team goals, leading to higher levels of satisfaction and learning outcomes (Rawlings, 2012).

Empowering Teams

Empowering teams with the ability to take action against slackers, should it become necessary, may also foster accountability by compelling students to actively participate and contribute their share of the work. Instructors can empower teams to "vote off," or fire, members who are not actively participating; however, clear requirements or guidelines for voting off a team member must be established at the beginning of the project (Rawlings, 2012). For example, the instructor may require a unanimous vote by all active team members to remove a non-active member. Also, the instructor may wish to require the active team members to document a reasonable number of attempts to contact the member in question through email or other communication (Rawlings, 2012). An empowerment policy may reduce or eliminate a slacker problem while encouraging students who seek optimum learning experiences and high level grades that their own grade does not rest on those who do not contribute equally (Rawlings, 2012).

Conflict Resolution

Online instructors should always be prepared for team conflict. While it may not be possible to anticipate every potential conflict, proactive preparation should be addressed during the design phase. Bass and Riggio (2006) pointed out, "An important leadership function is managing the conflict and accompanying stress that occurs within the work group. The transformational leader envisions superordinate goals for the conflicting parties – ways in which they both can gain from agreement and cooperation" (p. 69). In some cases, it may be best to allow teams to resolve their own conflict, but the instructor should be ready to step in if necessary. Dool (2010) explained that, "Reducing conflict may encourage positive reactions that will serve as a basis for future growth in teaming skills" (p. 66). One way to help teams reduce conflict is to require them to define team norms and develop a conflict resolution procedure at the beginning of the team project (Rawlings, 2012). When team members have helped to construct the procedure, it my better enable them to avoid conflict.

Building Trust

It is difficult enough to build trust in face-to-face teamwork, but it can be more challenging to build trust in virtual teamwork since team members usually do not meet in person. "As more organizations make use of virtual work teams where members are connected electronically rather than face to face, the issue of leader trust becomes even more important" (Bass & Riggio, 2006, P. 44). There are ways an instructor can promote trust among team members, such as having students introduce themselves and become acquainted by discussing insights from past experiences, culture, and perspectives at the beginning of the term (Dool, 2010). This helps the students feel comfortable with one another. Team contracts and the establishment of team norms at the beginning of the project may also help to build trust among members.

Value of Multiculturalism

Those in both postsecondary institutions and the business sector agree that cultural and global diversity must be a part of the virtual team experience. With technology rapidly expanding, the global connections made possible by virtual teams are creating collaborative opportunities that were not possible a relatively short time ago. Dool (2010) reported that "More than 2.7 million students are pursuing education transnationally, with the United States leading the way, with more than 570,000

foreign students" (p. 161). Cross-cultural virtual teamwork provides an opportunity for individuals to connect and form relationships with those from other cultures and countries, opening their eyes to other points of view. However, along with these opportunities come possible challenges such as perceptions, beliefs and values that can undermine team trust.

At the beginning of the course, instructors should consider welcoming students with a message that affirms multiculturalism as beneficial and advantageous in building professional experience toward one's career (Dool, 2010). Trust can be built through open communication and by encouraging students to focus on the positive aspects associated with a diverse team. Although multicultural virtual teams (MVTs) face challenges, members tend to be motivated by differing viewpoints and are less prone to groupthink (Dool, 2010). Instructors and team leaders should value the diverse perspectives of team members and encourage students to identify and appreciate the benefits that multiculturalism can bring to teamwork. Diversity among team members can provide valuable learning opportunities for teams in any setting.

Conclusion

The increase in the utilization of virtual teams raises questions and issues about the best instructional design strategies that will result in highest performance and learning outcomes. As instructors plan, design, and integrate a virtual team project into their curriculum, there are strategies that should be considered in the areas of collaborative technologies for communication and interaction, instructional design, and the value of multiculturalism. The instructor should make several communication options available to teams and allow the team members to decide how best to communicate. Expectations and outcomes must be clearly communicated to students at the beginning of the project. Students have varying levels of technical skills and those with little or no previous online educational are often unprepared for the course technology. Practice opportunities with course technology before or at the beginning of the term may help students feel more comfortable and prepared for a virtual team project. In order to promote individual and team accountability, instructors should consider using peer and self-assessments that ask in-depth, reflective questions and require students to justify their ratings of peers. Team leadership should be encouraged and one way to promote team leadership is through the use of team contracts that require students to identify leadership roles and responsibilities, team norms, and a conflict resolution process. Empowering teams to remove "slackers" members may also lead to higher levels of accountability and motivate students to be active team members. Building trust in virtual teams is always challenging, but having students become acquainted by sharing experiences, culture, and perspectives may help students feel more comfortable with one another. Thoughtful integration of these strategies within the framework of virtual teamwork may lead to higher levels of team performance and learning outcomes.

References

Archer, W., & Davison J. (2008, February). Graduate employability: What do employers think and want? *The Council for Industry and Higher Education*. Retrieved from Leadership for Business and Higher Education website: http://www.cihe.co.uk/category/knowledge/publications/

Bass, B. M., & Riggio, R. E. (2006). *Transformational leadership* (2nd ed.). Mahwah, NJ: Lawerence Erlbaum Associates.

Bergiel, B.J., Bergiel, E.B., & Balsmeier, E.W. (2008). Natural of virtual teams: A summary of their advantages and disadvantages. *Management Research News*, 31(2), 99-110.

Broser, C., Fritsch, C. Gmelch, O., Pernul, G., Schillinger, R., & Wiesbeck, S. (2010). Analysing requirements for virtual business alliances: The case of SPIKE, *Social Informatics and Telecommunications Engineering, 21*, 35-44. doi: 10.1007/978-3-642-11532-5_5

Chutnik, M., & Grzesik, K. (2009, April). Leading a virtual intercultural team: Implications for virtual team leaders, *Journal of Intercultural Management, 1*(1), 82–90.

Dool, R. (2010). Teaming across borders. In R. Ubell (Ed.), *Virtual teamwork: Mastering the art and practice of online learning and corporate collaboration* (pp. 161-191). New Jersey: Wiley & Sons, Inc.

Egert, C.A., Jacobs, S., & Barnes, S.B. (2009). When social worlds collide: Charting the intersection of social media and courseware/course management systems. In A.A. Ozok, & P. Zaphiris (Eds.), *Online Communities*, LNCS 5621, (452-461). Berlin Heidelberg: Springer-Verlag.

Karpova, E., Correia, A., & Baran, E. (2009). Learn to use and use to learn: Technology in virtual collaboration experience, *Internet and Higher Education, 12*, 45-52.

Mayadas, A., Bourne, J., & Bacsich, P. (2009). Online education today, *Science, 323*(5910), 85-89. doi: 10.1126/science.1168874

Pfaff, E., & Huddleston, P. (2003). Does it matter if I hate teamwork? What impacts student attitudes toward teamwork. *Journal of Marketing Education*, *35*(37), 145-151. Retrieved from http://jmd.sagepub.com/cgi/content/abstract/25/1/37

Piezon, S.L., & Donaldson, R.L. (2005, Winter). Online groups and social loafing: Understanding student-group interactions. *Online Journal of Distance Learning Administration*, *8*(4), Retrieved from http://www.westga.edu/~distance/ojdla/winter84/piezon84.htm

Rawlings, M. (2012). *Impact of instructional design on virtual teamwork* (Doctoral dissertation). Available from ProQuest Dissertations and Theses database. (Order No. 3504062)

Resta, P., & Lee, H. (2010). Peer and self-assessment. In R. Ubell (Ed.), *Virtual teamwork: Mastering the art and practice of online learning and corporate collaboration* (pp. 45-64). New Jersey: Wiley & Sons, Inc.

Roberts, T. S., & McInnerney, J. M. (2007). Seven problems of online group learning (and their solutions). *Educational Technology & Society*, *10*(4), 257-268.

Sivunen, A., & Valo, M. (2010). Communication technologies. In R. Ubell (Ed.), *Virtual teamwork: Mastering the art and practice of online learning and corporate collaboration* (pp. 137-157). New Jersey: Wiley & Sons, Inc.

Soon, L., & Sarrafzadeh, M. (2010). *Preparing students for online group work in distance education*. Paper presented at the Second International Conference on E-Learning and E-Teaching (ICELET 2010), Iran, 11834513, 40 – 48, doi:10.1109/ICELET.2010.5708378

Ubell, R. (2010). *Virtual teamwork: Mastering the art and practice of online learning and corporate collaboration*. New Jersey: Wiley & Sons, Inc.

Young, A., & Norgard, C. 2006. Assessing the quality of online courses from the students' perspective. *Internet and Higher Education 9*(2), 107–115.

Electrical, Electronics & Computer Technology

Electricity, Electronics, & Computer Technology (Automation & Control Systems)

The Effect of Fieldbus Network Induced Delays on the Performance of Closed-Loop Control Systems

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Abstract
Fieldbus networks such as Profibus and Foundation Fieldbus are extensively used in industrial control system implementations because of several benefits they provide. However, as the complexity of modern fieldbus-based control systems increases, the concern on performance of these systems also increases. One of the concerns is the induced delays in the fieldbus network systems due to bus arbitration schemes they use. The impact of these delays on closed-loop control system performance measures such as stability, peak overshoot and settling time are investigated in this paper. It demonstrates the effect of fieldbus network induced delays on the performance of a control system with Proportional, Integral, and Derivative (PID) controller through MATLAB/Simulink simulation of a Direct Current (DC) motor speed control.

Introduction
Industrial control networks such as Foundation Fieldbus, Profibus, and Controller Area Network (CAN), called fieldbuses are commonly utilized in control system implementations (Mahalik, 2003). They interconnect control system equipment such as sensors, actuators and controllers, and function as a local area network for instruments used in both process and manufacturing automation. These systems are also called Networked Control Systems (NCS) (Zhang et al., 2001). The integration of fieldbus into control loop provides several advantages such as reduced system wiring, easier diagnostics, increased interoperability, among others (Berge, 2002). However, the network interconnection also has some fundamental concerns. One of the concerns is the issue of network-induced delay such as sensor-to-controller delay, and controller-to-actuator delay, and its impact on the control system performance.

Gupta and Chow (2010) surveyed recent articles in the NCS area. A special issue on NCS was edited by Antsaklis and Baillieul (2007). Several theoretical results have been reported in the literature that address these time delays (Zhang et al., 2001). For instance, Abdel-Ghaffar et al. (2008) utilized a pole-placement based control algorithm to analyze network delay issues in ISA Fieldbus. The delays associated with the use of Foundation Fieldbus (FF) H1 networks within control loops were investigated by Rankin et al. (2009). Lee et al. (2002) presented the structure of a networked control system by using a Profibus-DP network and investigates the cause of network induced delay. Li Q. et al. (2011) also investigated the delays associated with the use of Profibus-PA networks within control loops. Some researchers analyzed the effect of the time delays on traditional controllers such as Proportional and Integral (PI) controller (Tipsuwan et al., 2003), while others gave new control designs that take the delays into account (Gupta and Chow, 2010). Some of the analysis results give bounds on the allowable delays to preserve stability of the networked control systems (Zhang et al., 2001). Sun and Hou (2007) designed a networked control system for double inverted pendulum using fuzzy logic control. Azimi-Sadjadi (2003) studied the stability of networked control systems in the presence of packet losses. Li H. et al. (2011) developed a control methodology to handle the effects of network induced delays using a gain scheduling controller.

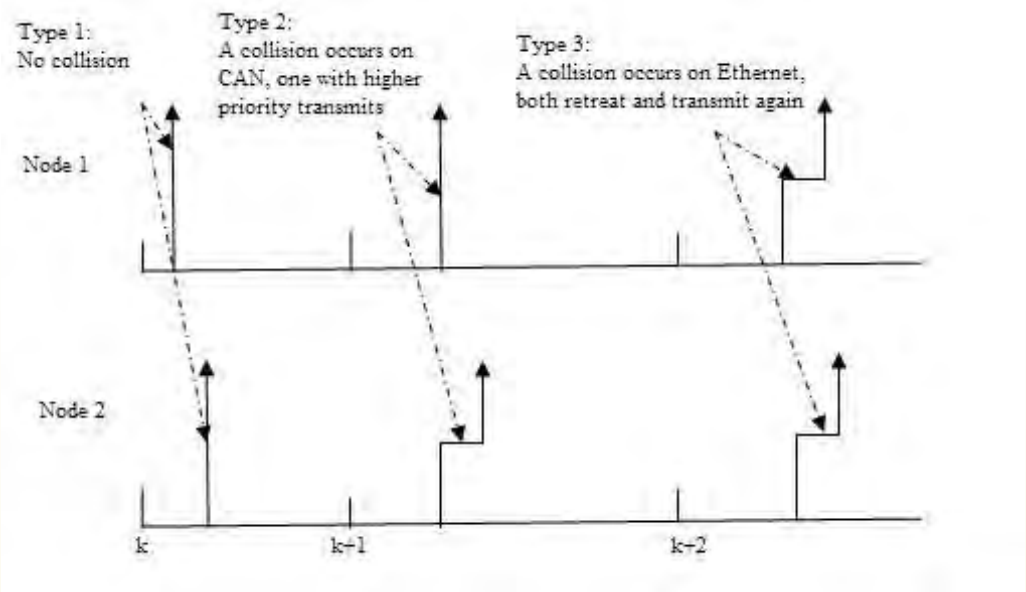
In this paper, the effect of fieldbus network induced delays on control system performance such as stability and step-response for different PID controller gains are demonstrated using a DC motor model. The delays considered are sensor-to-controller delay and controller-to-actuator delay. MATLAB/Simulink software tools are used to analyze the effects of these delays. Section II provides an overview of the causes of fieldbus network induced delays. The effect of network delays on closed-loop control system performance with PID controller is described in Section III. Section IV demonstrates the effect of network delays on a DC motor control system using simulations. Section V offers concluding remarks.

An Overview of the Causes of Fieldbus Network Induced Delays

The introduction of fieldbus networks induces different time delays among devices such as sensors, actuators, and controllers. According to Zhang et al. (2001), the existence of time delays may degrades the system performance in NCS. The network delays can be constant, time varying, or random depending on the Medium Access Control (MAC) protocol of the control network. MAC protocols commonly fall into either random access or scheduling (Zhang et al., 2001). Carrier sense multiple access (CSMA) is used in random access networks. Control networks such as DeviceNet and Ethernet use CSMA protocols. Scheduling networks use Token Passing (TP) and Time Division Multiple Access (TDMA).

Figure 1 shows two nodes that are transmitting messages with respect to a fixed time line for random access networks during different types of conditions (Zhang et al., 2001). A node on a CSMA network monitors the network before each transmission. As shown in Type 1 of Figure 1, a node begins transmission immediately when the network is idle; otherwise it waits until the network is unused (Zhang et al., 2001). A collision occurs when two or more nodes try to transmit at the same time. The approach to resolve the collision depends on the protocol used. For instance, CAN utilizes CSMA with a bitwise arbitration (CSMA/BA) protocol. Since CAN messages are prioritized, the message with the highest priority is transmitted without interruption when a collision occurs, and transmission of the lower priority message is terminated and it is retried when the network is idle as shown in Type 2 of Figure 1. Ethernet also utilizes a CSMA with collision detection (CSMA/CD) protocol. All the affected nodes retreat when collision occurs, wait a random time and retransmit as shown in Type 3 of Figure 1. CSMA networks are considered nondeterministic; but higher priority messages have a better chance of timely transmission when messages are prioritized as in CAN (Zhang et al., 2001). For a CAN based automobile network system, Mainoo and Kolla (2011) showed that the amount of delay time depends on CAN parameters such as baud rate, message length and bus load using statistical analysis of data generated from simulation. It was observed that the mean value of the delay decreases with the increase in baud rate, increases with the increase in message length of the transmitted signal, and increases with an increase in busload.

Figure 1. Timing Diagram for Two Nodes on a Network.

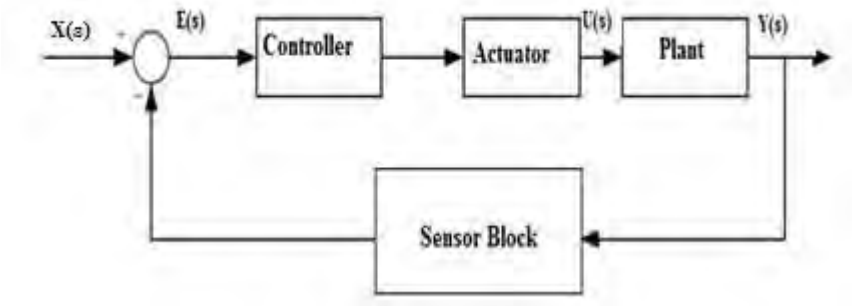


The unreliable transmission, as a result of limited bandwidth and large amount of data packet transmitted over the single channel, is another concern raised in NCS. The failure of a node to either send or receive data as well as the collision of messages may results in packet dropout (Zhang et al., 2001). This can also degrade the performance of the system. Some network protocols may be designed with retry mechanisms for transmission, however, they can only retransmit for a limited amount of time. The packets may be dropped after the time expires. The messages that were not transmitted may be abandoned and new packets may be transmitted when they become available. Regardless of the type of network used, the performance of NCS can be affected by packet dropout as well as network delays.

Effects of Network Delays on the Performance of Closed-Loop Control Systems

The closed-loop control system is shown in Figure 2 (Dorf, 2010). The plant block represents the process such as a DC motor to be controlled. The plant input is represented by the signal *U* and plant output is represented by the signal *Y*. The sensor block measures the plant output such as speed. The actuator block changes the plant input such as DC motor voltage based on the control signal sent by the controller block. The objective of the controller is to make the output such as speed follow the desired set-point value of *X*.

Figure 2. Closed-loop Control System.



There are different types of controllers available such as PID. A typical structure of a PID control system is mathematically represented by

$$u(t) = K_P e(t) + K_I \int e(t)dt + K_D \frac{de(t)}{dt} \qquad (1)$$

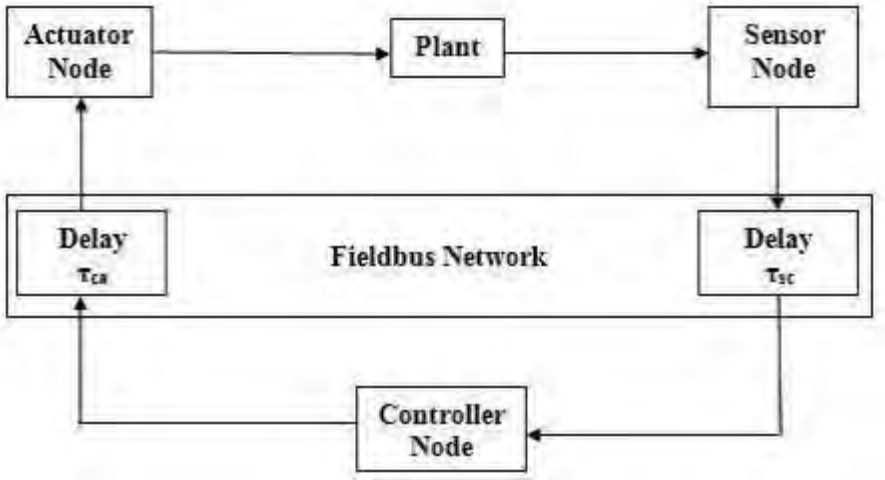
where K_P is proportional gain, K_I is integral gain, and K_D is derivative gain, e is the error which is the difference between output (y) and set-point (x). The controller (1) can be expressed as transfer function by (2) using Laplace Transformation (Dorf, 2010).

$$G_c(s) = K_P + \frac{K_I}{s} + K_D s \qquad (2)$$

A Proportional and Integral (P_I) controller has the same equations as in (1) and (2) except K_D is zero. The controller gains K_P, K_I, and K_D are adjusted to achieve desired system performance.

In the traditional controller implementation, sensor, actuator, etc. are connected to the controller and plant by point-to-point wiring connections. In the fieldbus based implementation, the control loops are closed through a real-time network as shown in Figure 3 (Nelson et al., 1998). While the NCS provides several advantages as stated before, it also raises some fundamental concerns such as the issue of network-induced delay which include sensor-to-controller delay (τ_{sc}), and controller-to-actuator delay (τ_{ca}) as indicated in Figure 3. Any controller computational delay can be included in either τ_{sc} or τ_{ca} without loss of generality. For fixed control law, the sensor-to-controller delay and controller-to-actuator delay can be put together as $\tau = \tau_{sc} + \tau_{ca}$ for analysis purposes (Zhang et al. 2001). The delays can affect the transient response behaviors.

Figure 3. Networked Control System.



Several performance measures are used to study the effectiveness of the controllers. One of them is the transient response of the system output for a step input. Various performance criteria used from the step-response are peak-time, peak-overshoot, settling-time, and rise-time (Dorf, 2010). The peak time is the time required for the response to reach the first peak and the peak overshoot is the maximum value of the output reached after application of the step input. The rise time is usually viewed as the time required for the response to a step input rising from 10% to 90% of its final value. The settling time is the time required for the system output to settle within a certain percentage, usually 5%, of the input amplitude. In the next sections the effect of network induced delays on the performance of different PID controllers is illustrated.

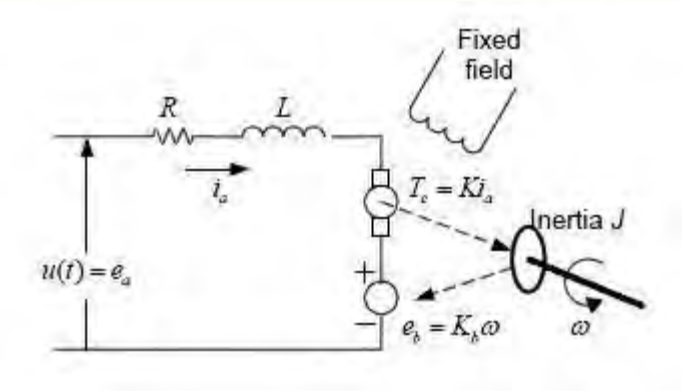
Effect of Network Delays on a DC Motor Control System with PID Controller

The effect of network induced delays is studied using a DC motor model. Two different control schemes were used for this analysis to control the speed of the DC motor. The first one was a PI controller studied by Tipsuwan et al., (2003). In the second controller, the PI concepts were extended to include a derivative mode, resulting in a PID controller.

DC Motor Model

The schematic diagram of the DC motor is shown in Figure 4 (Dorf, 2010). The control input *u(t)* is the armature voltage e_a, and the output is motor angular speed w. The transfer function between w, and e_a is derived by using the loop equation (3) of the armature electric circuit and mechanical torque balance equation (4),

Figure 4. Schematic Diagram of DC Motor.



$$u(t) = e_a = L\frac{di_a}{dt} + R_a + K_b\omega \quad (3)$$

$$J\frac{d\omega}{dt} + B\omega + T_l = T_e = K_a \quad (4)$$

where L is the armature inductance, R is the armature resistance, i_a is the armature current, K_b is the back EMF constant, J is the motor moment of inertia, B is the motor damping coefficient, K is the torque constant and T_l is the load torque. By taking the Laplace Transformation of these equations and substituting the numerical values for different parameters from Tipsuwan et al., (2003) given in Table 1, the transfer function of the motor is given by (5):

$$G_p(s) = \frac{\Omega(s)}{E_a(s)} = \frac{2029.826}{(s^2 + 28.586s + 60.36184)} \quad (5)$$

Table 1. Parameters of DC Motor

J	Inertia	$42.6*10^{-6}$ Kg-m^2
L	Inductance	$170*10^{-3}$ H
R	Resistance	4.67 Ω
B	Damping Coefficient	$47.3*10^{-3}$N-m-sec/rad
K	Torque Constant	$14.7*10^{-3}$ N-m/A
K_b	Back EMF Constant	$14.7*10^{-3}$ V-sec/rad

The plant transfer function between the speed and armature voltage is used in the MATLAB/ Simulink program to evaluate the performance of the networked control system.

When a fieldbus network is used in the network-based closed-loop DC motor speed control, the input voltage command from the controller to the DC motor, and the speed feedback signal from the sensor to the controller may be delayed due to network-induced time delays. If these delays are long enough, the peak time, rise time, settling time and overshoot may affect the overall acceptable control of the DC motor, and it may even make the system unstable. For different PI/PID controller gains given in (2), the effect of these delays are investigated for the DC motor model (5) using MATLAB/Simulink.

Analysis of the Effect of Network Delays in DC Motor with PI/PID Controller

The DC motor transfer function given by equation (5) was used as the plant model, and the PI/PID controller transfer function (2) given before was used with different values for K_P, K_I and K_D in the simulations. The Simulink software determines the closed-loop system transfer function for the entire system based on the motor and controller transfer functions. Network delays between sensor-to-controller and controller-to-actuator were then included in the simulations. These delays were varied to study their effect on system performance.

First, a PI controller with gains K_p = 0.1701 and K_I =0.378 from Tipsuwan et al. (2003) was used in the study. For this controller, the graph of the step input, various outputs when delays (τ_{sc} and τ_{ca}) have equal values of 0, 0.02s, and 0.04s is shown in Figure 5. It was observed that the system performance gradually degraded as the delays increased. The system became unstable at values of delays beyond 0.05s. For instance, the system became unstable at delays of 0.06s, as shown in Figure 6.

Figure 5. PI Controller Performance Measures at Different Network Delays.

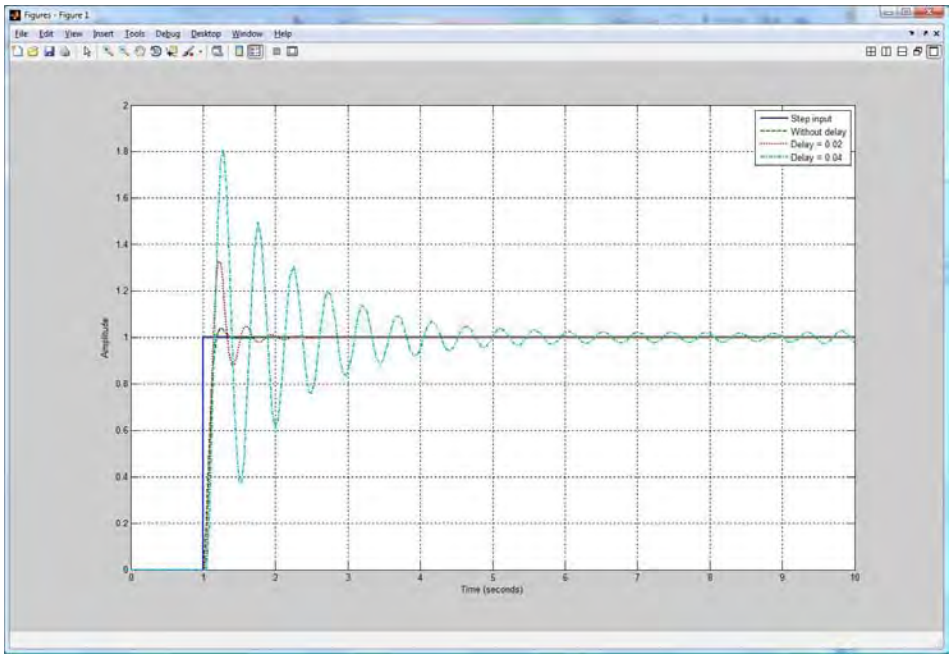


Table 2 presents a summary of the step response information obtained after the simulations of the DC motor with NCS using these PI controller gains. It was observed that, the percentage overshoot as well as settling time increased with an increase in delay. For example, the percentage overshoot and settling time for 0.01s delay were 14.10%, and 0.270s respectively. The percentage overshoot was increased to 81.0% and the settling time also increased to 2.987s when the delays became 0.04s.

Figure 6. PI Controller Performance when Delays (τ_{sc} and τ_{ca}) = 0.06s.

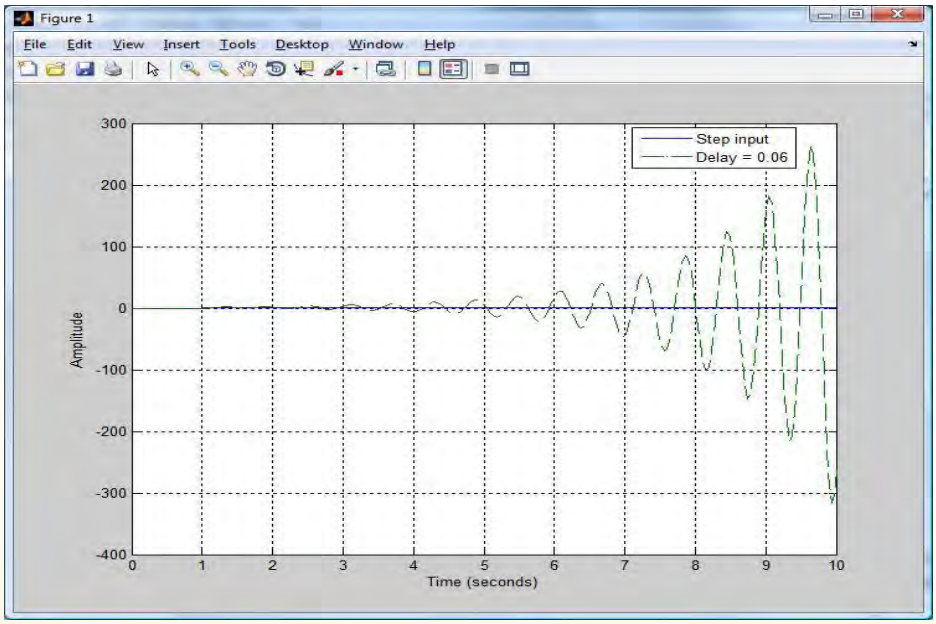


Table 2. PI Controller Parameters and Performance Measures.

	Controller Parameters			Performance Measures			
Delay (s)	K_p	K_I	K_D	% Overshoot	Peak Time (s)	Rise Time (s)	Settling Time (s)
0	0.1701	0.378	0	3.80%	0.239	0.117	0.162
0.01	0.1701	0.378	0	14.10%	0.212	0.0255	0.270
0.02	0.1701	0.378	0	34.20%	0.212	0.083	0.494
0.03	0.1701	0.378	0	55.50%	0.226	0.079	1.154
0.04	0.1701	0.378	0	81.0%	0.267	0.078	2.987
0.05	0.1701	0.378	0	106.10%	0.297	0.078	> 200

A PID controller was designed using the same PI controller gains as discussed above and a derivative gain term was added. The gains used for K_p, K_I and K_D were 0.1701, 0.378 and 0.0075. For this controller, the graph of the step input, various outputs when network delays (τ_{sc} and τ_{ca}) have equal values of 0.00s, 0.03s, and 0.06s are shown in Figure 7. The PID controller response was better than the PI controller without delays with respect to percentage overshoot, though the settling time slightly increased. It can also be observed that the system performance gradually degraded as the network delays increased in values, and especially became unstable at values of delays beyond 0.06s. For instance, the system became unstable at delays of 0.07s, as shown in Figure 8. However, this PID controller improved the performance of the system as it accommodated more network delay values before it became unstable than that of the PI controller.

Figure 7. Performance Measures for PID Controller (1) at Different Delays.

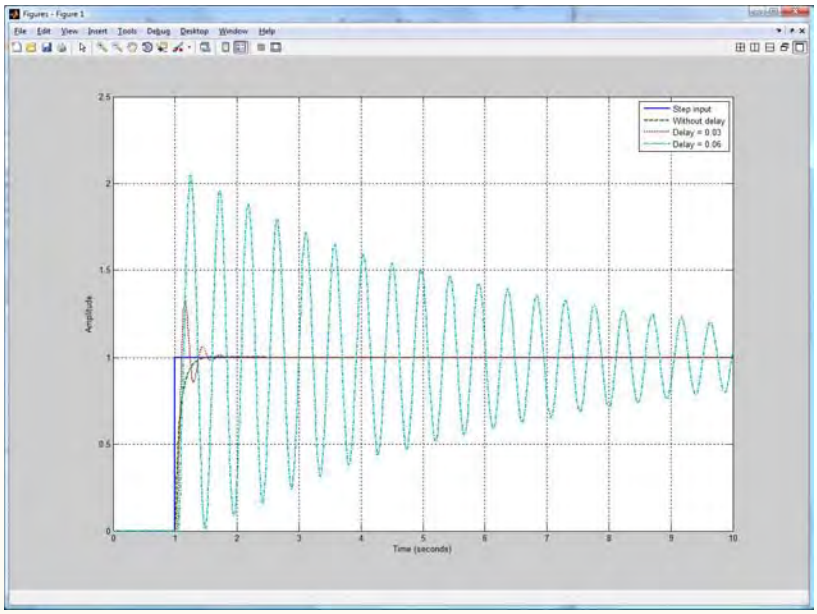


Figure 8. PID Controller (1) Performance when Delays (τ_{sc} and τ_{ca}) = 0.07 s.

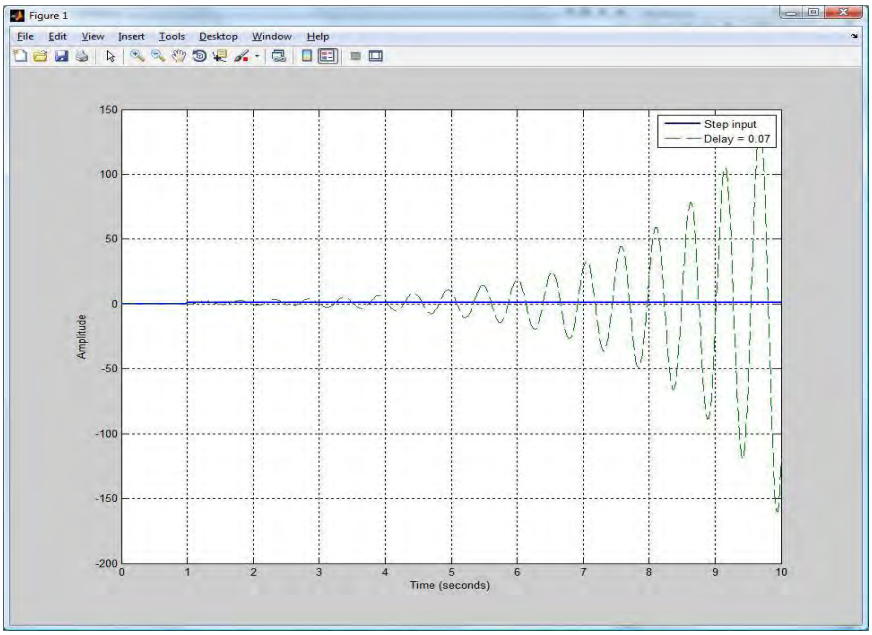


Table 3 presents a summary of the step response information obtained after the simulations of the DC Motor with NCS using these PID controller gains. The PID controller response was better than the PI controller without delays with respect to percentage overshoot though the settling time slightly increased. As with the PI controller the percentage overshoot increased with an increase in delay for PID controller also. The settling time increased with an increase in delays for higher delay values but the change was not significant at lower delay values. For example, the percentage overshoot and settling time for 0.02s delay was 8.0% and 0.247s respectively. The percentage overshoot was increased to 81.2% and the settling time also increased to 2.269s when the delays became 0.05s.

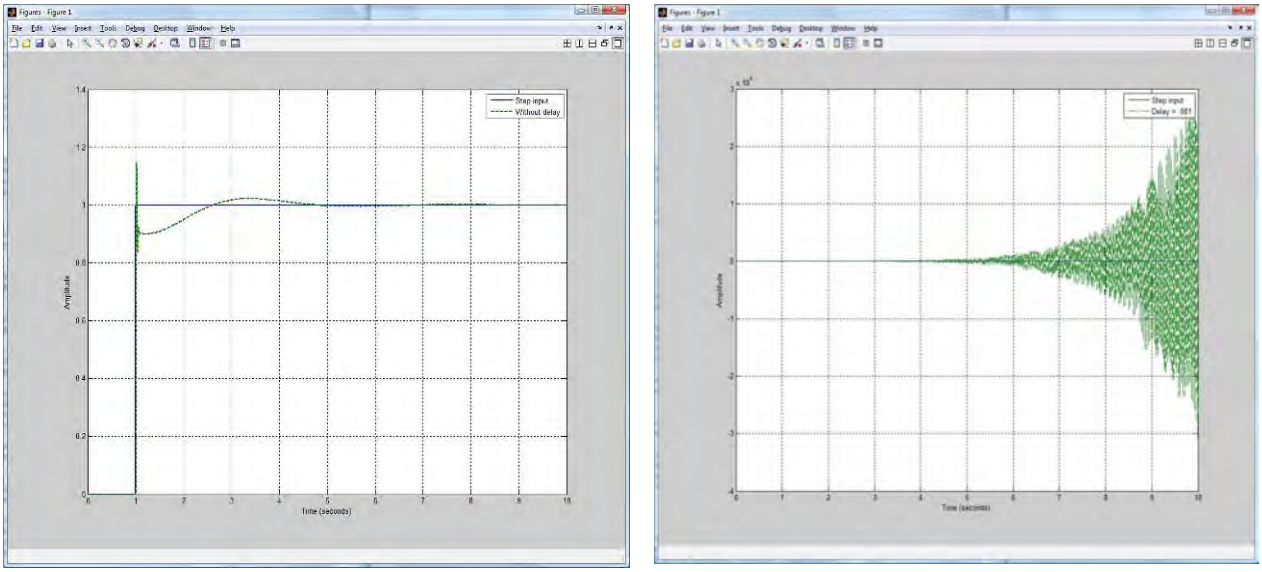
Another PID controller was designed using the same PI controller gains as before but the derivative gain term was further increased from the previous case. The gains used for K_P, K_I and K_D were 0.1701, 0.378 and 0.01. This PID controller response was also better than the PI controller without delays with respect to percentage overshoot though the settling time slightly increased. It was also observed that the system performance gradually degraded as the delays increased in values, and became unstable at values of delays beyond 0.05s. For instance, the system became unstable at delays of 0.06s. However, this PID controller did not improve the performance of the system as it did not accommodate more network delay values than that of the previous PID controller. Therefore, increasing the derivative gain may improve the delay performance only up to a certain derivative gain value after which the performance may degrade.

Table 3. PID Controller (1) Parameters and Performance Measures.

	Controller Parameters			Performance Measures			
Delay (s)	K_p	K_I	K_D	% Overshoot	Peak Time (s)	Rise Time (s)	Settling Time (s)
0	0.1701	0.378	0.0075	0.40%	0.615	0.186	0.267
0.01	0.1701	0.378	0.0075	0.50%	0.605	0.146	0.229
0.02	0.1701	0.378	0.0075	8.00%	0.137	0.060	0.247
0.03	0.1701	0.378	0.0075	32.80%	0.162	0.056	0.470
0.04	0.1701	0.378	0.0075	57.00%	0.192	0.056	0.910
0.05	0.1701	0.378	0.0075	81.20%	0.222	0.055	2.269
0.06	0.1701	0.378	0.0075	105.30%	0.254	0.056	14.92

The simulation results for PID controller (2) having the gains for $K_P = 0.1701$, $K_I = 0.378$ and $K_D = 0.13$ are presented in Figure 9. This controller has the same gains as the PI controller but the derivative gain was further increased. Two graphs are shown: the system performance when the network delays (τ_{sc} and τ_{ca}) were 0.00s, 0.001s. From the figure it can be concluded that the performance of the system degraded when the network delay was increased. The system became unstable when the network delays (τ_{sc} and τ_{ca}) were 0.001s, which were comparable to the delay times obtained in the automobile CAN system simulation (Mainoo and Kolla, 2011).

Figure 10. PID Controller (2) Performance Measures Under Various Network Delays.



a. Network Delays (τ_{sc} and τ_{ca}) = 0s.

b. Network Delays (τ_{sc} and τ_{ca}) = 0.001s.

From these simulations, it was observed that fieldbus network induced delay has an effect on control systems stability and performance as described by the system step responses. Comparing the step response results of the DC motor system without network delays and the step response results of the DC motor system with network delays, the system with the delays had higher overshoot and longer settling time, for network delays with higher delay values. From some of the cases observed, the DC motor system became unstable even with a 1ms delay time, which was comparable to the delay times obtained in the automobile CAN system simulation. The presence of network delays between the sensors, actuators and controllers of the control system degrades the performance and destabilizes the DC motor system. Also, the PID type controller gains have effect on control systems with the presence of fieldbus network induced delays. From the MATLAB/Simulink simulations of the DC motor speed control system, it was observed that, as derivative gain K_D increased, the system performance to accommodate network delays initially improved from the PI controller till certain value of K_D, then it became worse.

Conclusion

The purpose of this paper was to present the effect of fieldbus network induced delays on the performance of closed-loop control systems. An overview of the causes of fieldbus network induced delays was initially discussed. The effect of network delays on closed-loop control system performance with a PID controller was also explained. The impact of delays on PID controller gains on networked control systems were illustrated with simulation of a DC motor model using MATLAB/Simulink software. From these simulations, it was observed that, as the derivative gain K_D increased, the system performance to accommodate network delays initially improved from PI controller till certain value of K_D, then it became worse. The results of this performance evaluation will be useful to design PID controller gains, and to verify how sensitive the control loops are under various time delays.

References

Abdel-Ghaffar, H., Hammad, S. and Zaki, A. (2008). H1 Fieldbus Network Delay: A Digital Pole Placement Control Design. *Proceedings of the 17th World Congress the International Federation of Automatic Control*, 9433-9436, Seoul, Korea.

Antsaklis, P. and Baillieul, J. (eds.). (2007). Special Issue on Technology of Networked Control Systems. *Proceedings of IEEE*, 95, 5-8.

Azimi-Sadjadi, B. (2003). Stability of Networked Control Systems in the Presence of Pocket Losses. *Proceedings of the 2003 IEEE Conference on Decision and Control.*

Berge, J. (2002). *Fieldbuses for Process Control: Engineering, Operation, and Maintenance*. USA: ISA.

Dorf, R. C. and Bishop, R. H. (12th ed.). (2010). *Modern Control Systems*. USA: Prentice Hall.

Gupta, R. A. and Chow, M.-Y. (2010). Networked Control System: Overview and Research Trends. *IEEE Trans. Industrial Electronics*, 57(7), 2527-2535.

Lee, K. C. and Lee, S. (2002). Implementation of Networked Control System Using a Profibus-DP Network. *International Journal of the Korean Society of Precision Engineering (KSPE)*, 3(3), 12-20.

Li, Q., Jiang, J. and Rankin, D. J. (2011). Evaluation of Delays Induced by Profibus PA Networks. *IEEE Transaction on Instrumentation and Measurements*, 60 (8), 2910-2917.

Li, H., Sun, Z., Chow, M.-Y., and Sun, F. (2011). Gain-Scheduling-Based State Feedback Integral Control for Networked Control Systems. *IEEE Transactions on Industrial Electronics*, 58(6), 2465-2472.

Mahalik, N. P. (2003). *Fieldbus Technology: Industrial Network Standards for Real-Time Distributed Control.* Germany: Springer.

Mainoo, J. and Kolla, S. R. (2011).Simulation and Statistical Analysis of Network Delays for Controller Area Network. *Proceedings of International Conference on Information,*

Computing and Telecommunication (ICICT-2011), Bangalore, India, pp.64-70.

Nilsson, J., Bernhardsson, B. and Wittenmark, B. (1998). "Stochastic Analysis and Control of Real-time Systems with Random Time Delays." *Automatica*, 34, pp. 57–64.

Rankin, D. J., Li, Q., and Jiang, J. (2009). Evaluation of Delays Induced by Foundation Fieldbus H1 Networks. *IEEE Transactions on Instrumentation and Measurement*. 58(10), 3684-3692.

Sun, Z.-Y. and Hou, C.-Z. (2007). Fuzzy Control for Networked Control System. *Third International Conference on International Information Hiding and Multimedia Signal Processing (IIH-MSP 2007),* iih-msp, vol. 2, pp.381-384.

Tipsuwan, Y. and Chow, M. Y. (2003). Control Methodologies in Networked Control Systems. *Control Engineering Practice*, 11, 1099-1111.

Zhang, W., Branicky, M. S., and Phillips, S. M. (2001). Stability of Networked Control Systems. *IEEE Control Systems Magazine*, 21 (1), 84-99.

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An Emergency Wireless Communication Framework for Vehicular Networks: Are We There Yet?

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Abstract
In this paper, we investigate the integration of suitable wireless technologies in vehicular networks for forward upcoming traffic information with the least possible delay in order to improve traffic safety. The 2012 National Highway Traffic Safety Administration (NHTSA) report claims that in the US alone one person dies in a vehicle crash every 15 minutes. Additionally, traffic congestion and collisions cause losses totaling billions of dollars in fuel and lost worker productivity. If drivers could get real-time traffic information ahead of time, it could help prevent most of the collisions, helping to save lives, prevent injuries, and reduce the cost incurred due to traffic congestions.

Introduction
Road traffic crashes are one of the largest problems being faced not only in the US but also all over the world. A report published by National Highway Traffic Safety Administration (NHTSA) in 2012 estimates that one person dies in a vehicle crash every 15 minutes in the US. Moreover, the US Department of Transportation (US-DOT) estimates that traffic congestions and crashes cause a waste of billions of dollars in lost worker productivity and fuel costs every year. Studies by Watfa, (2010) and Wang & Thompson (1977) have shown, that "about 60% roadway collisions could be avoided if the operator of the vehicle was provided warning at least one-half second prior to a collision." The number of death, injuries and the excessive cost of traffic collisions can be significantly lowered if the drivers are provided with upcoming traffic information in a timely manner (NHTSA, 2012; Moskvitch, 2011; Hartnstein and Laberteaux, 2010; Watfa, 2010; Festag et al, 2008; Car-2-Car, 2007). Existing information dissemination mechanisms for vehicular network require a driver or a passenger to tune a radio or dial a certain number to get current traffic information. This process is slow and cannot guarantee timely dissemination of information. Devising an automatic wireless based mechanism for communicating traffic information in a timely manner can help drivers make informed travel decisions and avoid hazardous situations. Wireless systems can provide a better alternative for forwarding upcoming traffic information.

A vehicular network is a wireless mobile network where moving vehicles act as nodes in a network, and communicate with each other via Vehicle-to-Vehicle (V2V) communications through Vehicular Ad hoc Networks (VANETs), as well as, with roadside base stations via Vehicle-to-Roadside (V2R), along with possible Roadside-to-Roadside (R2R) communications. Vehicular communications can be used for providing timely information to drivers and to concerned authorities, thereby making the roads safer. For instance, when a road accident occurs, emergency responders could provide information about road closure and the estimated time of re-openings using vehicular communications. In a vehicular network, messages have to be routed from the information source to one or to several destinations as quickly as possible and efficiently (Watfa, 2010; Fuentes, 2011, Rawat, et al., 2011a; Rawat, et al., 2011b).

There are several challenges in realizing the full potential of vehicular communications for intelligent transportation systems. Ongoing research in this area is bridging the gap between theory and practice (Watfa, 2010; Car-2-Car, 2007; US-DOT, 2005). The US-DOT (2005) plans to develop an architecture for vehicle infrastructure integration based largely on roadside

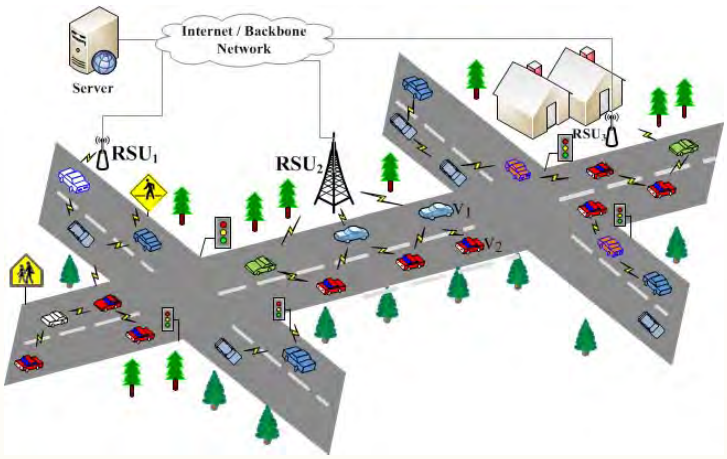
equipment for collecting data from passing vehicles and for disseminating it to other interested vehicles or concerned authorities. Cellular telephone system has been studied at the University of Virginia for vehicular traffic monitoring in limited deployments (Smith, 2003). Santa, et al. (2008) have successfully tested cellular network based on Universal Mobile Telecommunications System (UMTS) for vehicular communications. Since the information exchange between participating vehicles happens through V2R and R2V with possible R2R communications, one can expect higher delay (few milliseconds to a few seconds). Because of the high delay/latency introduced by cellular systems, it is not suitable for forwarding emergency messages in vehicular networks. In addition, cellular networks use licensed bands and users need to pay a usage fee. Unlicensed communication such as Wi-Fi (i.e. WLAN), Bluetooth, etc., would provide a better alternative for communication as users do not have to pay licensing fees. However, because of installation cost and limited availability of Wi-Fi networks, it is not an attractive choice (Trivedi, 2011; Watfa, 2010; Little, 2005). In this context, V2V based communications through VANETs, where devices and associated technologies use unlicensed bands, is a suitable option. It introduces negligible delay for emergency message communication.

In this paper, our contribution is to create a wireless communication framework for vehicular networks to forward upcoming traffic information including time critical emergency messages as quickly as possible so that drivers can take intelligent decision about any accidents, risks or delays. Our idea is to use wireless devices which have least connection setup time to form an ad hoc network of moving vehicles to exchange *emergency messages* among them. It is worth pointing out that non-critical messages such as information about gas station/price, roadside restaurants, etc. could also be forwarded using existing cellular wireless systems. Thus, the framework uses V2V communications for emergencies messages and V2R and R2V communications for other non-emergency or comfort-related messages.

Vehicular Communications Framework and System Description

In the future, vehicular communication is expected to use a variety of wireless technologies such as Wi-Fi, Bluetooth, cellular networks, etc. as shown in Figure 1.

Figure 1: Wireless Communication Framework for Vehicular Networks



The main goal of vehicular communications is to provide safety and comfort for passengers by forwarding upcoming traffic information in a timely manner. A special communication device will be mounted in each vehicle that is capable of receiving (and of processing if needed) along with forwarding to other vehicles through V2V and/or V2R communications. These wireless devices could also facilitate multimedia and Internet connectivity for passengers, provide lane merge assistance, receive information about road side facilities (such as roadside restaurants, gas stations and price, shopping and entertainment centers), and pay automatic parking fees or tolls. In mobile vehicular communications, sending timely traffic updates is important. For instance, vehicles should not forward information about road closures after the road has re-opened. In a broad sense, vehicular communication has two applications: *safety* and *comfort*. *Safety applications* such as accident alert, lane change/merge assistance, collision warning, road condition warning, pedestrian crossing, etc., require messages to be propagated from the point of occurrence to the target vehicles with very low latency (less than a half-second). *Multimedia and comfort applications* aim to improve passenger comfort and traffic efficiency and include

information about road side facilities (such as shopping malls, fast foods, gas stations, hotels, etc.), electronic payments, weather condition, and interactive multimedia communications. These applications may require high speed continuous connectivity and thus are bandwidth-hungry, but they are typically not delay-sensitive like safety-related applications. There are several factors that influence highly mobile vehicular communications. Cellular networks, ad hoc networks, Wireless Local Area Networks (LANs) also known as Wi-Fi and Wireless Personal Area Networks (PANs) (Watfa, 2010; ZigBee Alliance, 2009) are possible candidates for mobile vehicular communications. The selection of wireless technology depends on the application that the vehicular network is envisioned to support. Vehicular networks are challenging because a) vehicles move at high speeds and this results in a changing network topology with frequent network fragmentation (Watfa, 2010; Hartestine and Laberteaux, 2010), b) real time mobile communica-tions is difficult for highly dynamic vehicular networks, c) high mobility results in dynamic vehicle density, and d) drivers may join the highway or take an exit at any time when it is possible for them to do so.

In vehicular communications, when a vehicle, say V_1 has a message for vehicle V_2, it could be forwarded in a number of ways. These include:

i. V_1 could forward the message to Roadside Unit, RSU_2 (or through series of RSUs) and then RSU_2 will relay the received message to V_2. This process introduces latency. Therefore, V2R based communication is not suitable for time-critical emergencies messages. However, V2R based message dissemination model could be used for non-time-critical message dissemination.

ii. Vehicle V_1 could directly forward the message to vehicle V_2 using single hop (or through series of vehicles using multi-hop communications) using V2V communications that results in faster message delivery than using roadside communications.

In this paper, our focus is to develop a vehicular communication model for V2V based message-dissemination where vehicles travel in the same direction as well as in opposite directions. To study this model, individual vehicles are equipped with wireless devices such as ZigBee, Bluetooth, or Wi-Fi. Before actual message transmission, two wireless devices mounted in vehicles should be associated through a connection setup procedure. After setup the two devices would be able to exchange information with each other. Association times along with other specifications for ZigBee, Bluetooth and Wi-Fi technologies are listed in Table 1 (IEEE 802.15.4, 2003; ZigBee Alliance, 2009).

Table 1: Comparison table for different technologies

Features \ Wireless device	ZigBee	Bluetooth	Wi-Fi/WLAN
New association Time	30 milliseconds	~4 seconds	500 milliseconds
Sleeping to active transition time	15 milliseconds	3 seconds	NA
Active slave channel access/ scan time	15 milliseconds	2 milliseconds	100 milliseconds
Distance (meters)	1 – 100+	1-10 (with 0dB power) 100 (with 20dB power)	100+
Data Rate	20-250 Kb/s (Baseband)	720 Kb/s (Baseband) and 1, 2, 3 Mb/s (EDR)	11Mb/s (802.11b) 54 Mb/s (802.11a/g)
Frequency	2.4 GHz (global), 902-928 MHz (Americas), 868 MHz (Europe)	2.4 GHz	2.5 GHz, 5 GHz
Network Size	Unlimited (2^{64})	7	32
IEEE Standard	IEEE 802.15.4/4c	IEEE 802.15.1	802.11
Network Topology	Star/mesh	Star	Mesh/star
Transmission Technology	Direct Sequence Spread Spectrum (DSSS)	Frequency Hopping Spread Spectrum (FHSS)	DSSS/FHSS

Numerical Results and Discussion

In order to study the feasibility of different wireless technologies for real time wireless communications in vehicular networks, individual vehicles are considered to be equipped with communication devices (such as Wi-Fi, ZigBee, Bluetooth, etc.) in our simulation. We consider two different scenarios:

- Scenario 1 (one-way-traffic, i.e., vehicles move in the same direction): In this scenario, vehicles move with almost constant speeds and the relative speed between the vehicles is very small. For instance, the relative speed of two vehicles moving with 70 miles/hour is zero and thus one vehicle could be seen as stationary to a vehicle moving with same speed in the same direction (same velocity). The smaller the relative speed, the longer the time for connection setup and data exchange between the vehicles will be.

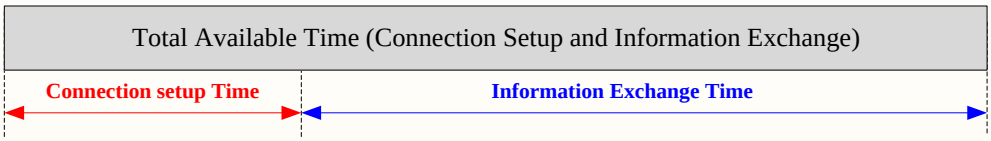
- Scenario 2 (two-way-traffic, i.e., vehicles move in both directions): As noted, the relative speed between vehicles moving in the same direction will be small. However, the relative speed of two vehicles moving in opposite directions will be sum of the speeds of two vehicles. For instance, two vehicles travelling in opposite directions on a highway at speeds of 70 miles/hour will be moving at a relative speed of 140 miles/hour and these vehicles will have a very short time for connection setup and data exchange using wireless devices for a given transmission range.

We conducted simulations using MATLAB (The MathWorks, 2012) to evaluate message delivery capabilities of individual vehicles equipped with ZigBee, WLAN or Bluetooth wireless devices for both scenario 1 and 2. We consider that the communication/transmission range of wireless technologies (WLAN, ZigBee and Bluetooth) is 15 meters to compare them in identical simulation setups. If the transmission range is greater than 15 meters, roadside attackers may be able to insert malicious messages in the vehicular network. Thus, limiting the communication range to 15 meters should help provide increased security in vehicular networks. For a given relative speed (s) and transmission range of a wireless device, i.e., the distance (d), we compute time (t) using:

$$t = \frac{d}{s} \qquad (1)$$

Equation (1) calculates total time available used for connection setup and the subsequent data exchange between vehicles. For instance, two vehicles, with relative speed $s = 70$ miles/hour (i.e. 31.29 meters/second) and wireless device with a transmission range $d = 15$ meter, will remain within a communication range for $t = 479.34$ milliseconds. This time will be used for association and information exchange among vehicles.

Figure 2: Total Available time (connection setup/association along with information exchange time between two devices)

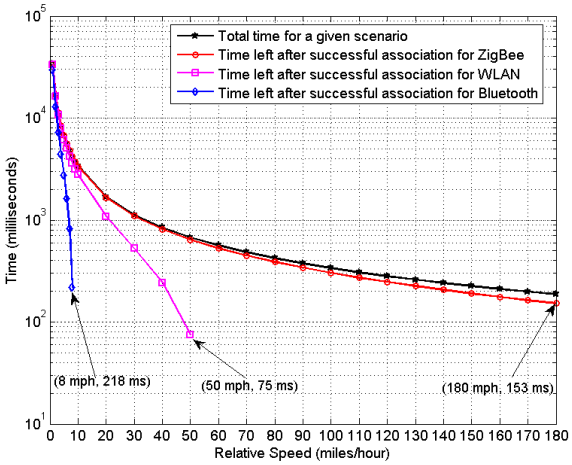


For instance, when vehicles are within a communication range for 479.34 milliseconds, two vehicles with ZigBee devices will take about 30 milliseconds for connection setup leaving 249.34 milliseconds for actual message exchange between them, as shown in Figure 2. However, vehicles with Bluetooth or Wi-Fi devices would not be able to even connect with each other as the total available time (479.34 milliseconds) is less than the association time of Bluetooth (4 seconds) or Wi-Fi (600 milliseconds) and thus would not be able to exchange any information.

In order to compare the suitability of ZigBee, Wi-Fi and Bluetooth technologies for vehicular communications, we consider that all the vehicles are equipped with these devices (one type at a time) and that the *relative* speed of vehicles ranges from 0 miles/hour to 180 miles/hour. Speed limits on typical US interstates are 70 miles/hour. However, we consider speeds of up to 90 miles/hour (180 miles/hour relative speed) for evaluating the performance of different communication technologies. Furthermore, using a range for the relative speeds from 0 to 180 miles/hour represents vehicles that are at a complete stop or moving at the same speed and in the same directions; to vehicles travelling in opposite directions at the

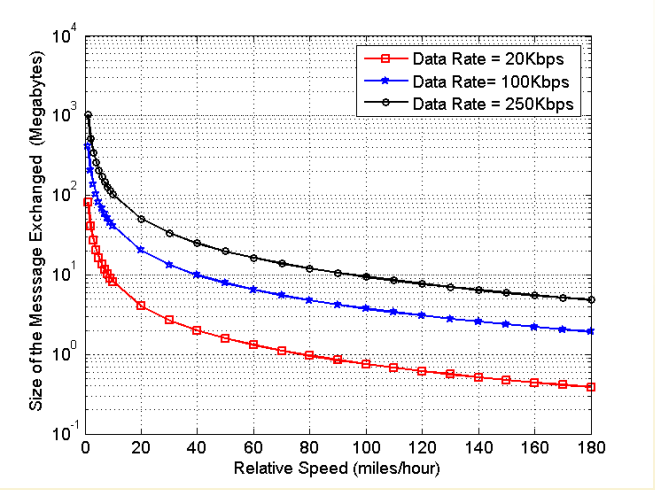
maximum stipulated speed. We computed the *total available time* that would be used for connection setup/association and message exchange between the vehicles. Then, we computed *time left after* successful *association* for ZigBee, WLAN and Bluetooth devices and plotted the results in Figure 3. It is important to note that the available time for vehicles decreases with an increase in relative speed as shown in Figure 3. Vehicles with ZigBee devices have sufficient time (greater than 100 milliseconds) to transmit messages even with relative speed 180 miles/hour as shown in Figure 3. However, the time left after successful association for message exchange is not available for the vehicles with WLAN devices when their *relative speed* is greater than 50 miles/hour because the total available time is less than the connection setup time (600 milliseconds). Similarly, vehicles traveling with a relative speed greater than 8 miles/hour and using Bluetooth devices could not communicate with each other as Bluetooth devices could not establish network connection successfully because of their high connection setup time (~4 seconds) requirement.

Figure 3: Total available time and data exchange time for ZigBee, Wireless LAN and Bluetooth.



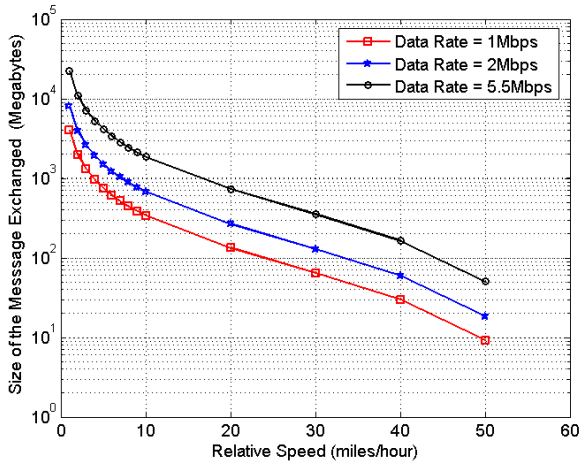
Next, we examine the impact of the relative speed on the size of the data exchanged at different data rates supported by different communication technologies. Vehicular communication using ZigBee devices was simulated for transmission rates of 20 Kbps, 100 Kbps or 250 Kbps and different relative speeds. The simulation result is shown in Figure 4. Transmission rates in wireless communications vary with distance between the communicating devices. For the worst case scenario, which is the slowest transmission rate when vehicles are moving at the highest relative speed, 20 Kbps data rate for relative speed of 180 miles/hour, the size of the message that could be exchanged between vehicles (for 153 milliseconds as shown in Figure 3) is approx. 0.3 Megabytes (307.2 Kilobytes) as shown in Figure 4. It is important to point out that the size of a typical one page message with 568 words is about 5 Kilobytes. Thus, in the worst case scenario, vehicles could exchange 61 pages of messages in 153 milliseconds. In the best case (with high data rate and/or lower relative speed), more number of pages can be exchanged.

Figure 4: Data exchanged using ZigBee networking after successful association.



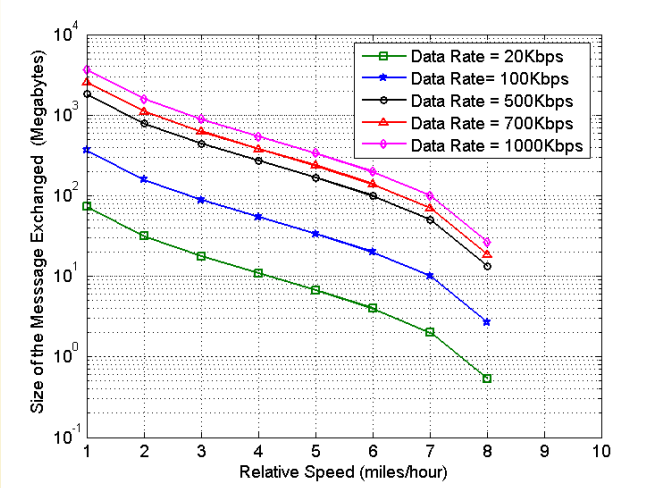
Next, we consider individual vehicles that are equipped with Wi-Fi devices for exchanging messages wirelessly. Figure 5 shows the size of the message exchanged using Wi-Fi devices at different relative speeds for different data transmission rates. Vehicular communications using Wi-Fi devices was simulated at transmission rates of 1 Mbps, 2 Mbps or 5.5 Mbps (data rates for 15 meter in 802.11b/g) considering different distances between communicating vehicles. In the worst case (1 Mbps data rate for 50 miles/hour relative speed), the size of the message that could be transferred between vehicles (for 75 milliseconds as shown in Figure 3) is approximately 9 Megabytes as shown in Figure 5. Vehicles that are travelling with a relative speed 50 miles/hour could even exchange short multimedia content along with upcoming traffic messages. When the relative speed of participating vehicles is less than 20 miles/hour they could exchange about 150 Megabytes in 75 milliseconds. For comparison purposes, a typical 4 minute music video (depending on DVD quality) is about 20 Megabytes to 100 Megabytes. Thus, two vehicles could exchange 2 music videos of 75 Megabytes in 75 milliseconds. Vehicles moving with the relative speed greater than 50 miles/hour could not exchange any message using Wi-Fi devices as shown in Figure 5 because there would be no time left for message to exchange between vehicles after successful association of Wi-Fi devices mounted in the vehicles.

Figure 5: Data exchanged using WLAN ad hoc networking after successful association.



Finally, we consider individual vehicles equipped with Bluetooth devices for exchanging traffic information. Figure 6 shows the size of the message exchanged using ZigBee devices at different relative speeds for different transmission rates. As noted in Table 1, Bluetooth devices take about 4 seconds for connection setup. As a result vehicles moving with relative speed greater than 8 miles/hour could not establish the connection with another vehicle. This results in no message being exchanged between vehicles. Considering the worst case for Bluetooth-based vehicular communications, vehicles moving with a relative speed of 8 miles/hour could exchange 4 Megabytes of message using 20 Kbps data rate. As shown in Figures 3 and 6, vehicles moving in the same direction with relative speed less than 8 miles could easily exchange messages using Bluetooth devices. However, vehicles moving in opposite directions could not use Bluetooth to exchange the message unless they travel with relative speed less than or equal to 8 miles per hour.

Figure 6: Data exchanged using Bluetooth networking after successful association.



Based on the simulation results, we conclude that the ZigBee technology is applicable for inter-vehicular communications for vehicles traveling with high relative speed since ZigBee has short association time (30 milliseconds). Wi-Fi can replace ZigBee only when a relative speed between vehicles is smaller than 50 miles/hour and a high data rate is needed for bandwidth-hungry applications. Bluetooth can only be used if the relative speed is smaller than 8 miles/hour. However, when a message needs to be broadcast to a large geographic area the existing cellular network could be used for vehicular communications.

So Are We There Yet? Challenges in Deployment of the Wireless Communication Framework

With the assumption that there are 346 million vehicles and 16 million built each year, Michael Cops (2006), Program Manager of Vehicle infrastructure integration Consortium, has predicted that by 2020, 50% of vehicles on the road will have computing and communication equipment, and that by 2030 all vehicles will have the equipment and will be able to participate in vehicular communications. There are several challenges that still need to be addressed for fully realizing the capabilities of vehicular communication for intelligent transportation systems. These include:

- User Needs: Vehicular users would need communication with the least latency and reliable connectivity. This is very difficult to achieve because of the high mobility of vehicles and changes in network topology. Users would also expect high bandwidth for interactive multimedia applications which is hard to achieve in VANETs.

- Security and Privacy: Since most of the vehicles are privately owned, maintaining privacy and security using vehicular communications is important. Wireless mobile users of vehicular networks would expect the same level of privacy and security as they have with legacy road driving. To address these issues, vehicles' identities should be made anonymous.

- Authentication: Validation and authenticity of messages is also challenging when vehicle are made anonymous because of privacy and security concerns.

- Data Ownership: Messages containing identity of drivers should not be in the public domain so that no one can trace individual vehicles or drivers.

- Interference from other RF devices: In high density vehicular networks, RF interference would affect the performance of vehicular communications.

- Human Behaviors: Drivers can join the highway or take an exit at any time when it is possible for them to do so. This result in variation of network density and topology according to human behaviors.

It is anticipated that all of these issues will be addressed in near future and we will have true wireless communication over vehicular networks for forwarding emergency and upcoming traffic information. This will make the roads safer to travel.

Conclusion and Future Research

Delivering real-time traffic information to drivers through wireless communication in vehicular network can assist in avoiding traffic accidents and congestions. The selection of wireless technology depends on the application that the vehicular network is envisioned to support. For time-sensitive emergency messages, V2V based communication is suitable whereas other messages could be transmitted using V2R communications. For emergency V2V communication, ZigBee is suitable when the relative speed of vehicles is greater than 50 miles/hour, Wi-Fi could be used when relative speed is less than 50 miles/hour, and Bluetooth could be used when relative speed is less than 8 miles/hour. Furthermore, ZigBee, Wi-Fi and Bluetooth devices operate in unlicensed bands where vehicular users do not have to pay for any licensing fees as in the case in cellular systems.

As part of the ongoing research in vehicular communications, we are prototyping a vehicular communication network using Wi-Fi, Bluetooth and ZigBee wireless devices for comparing their performance results with simulation observations.

Acknowledgements

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References

Bluetooth Technology. (2012). Bluetooth Wireless Technology: Simple, Secure, Everywhere. Retrieved June 14, 2012 from https://www.bluetooth.org/Building/overview.htm

Car-to-Car Communication Consortium. (2007). CAR 2 CAR Communication Consortium Manifesto, Overview of the C2C-CC System. Retrieved June 14, 2012, from http://www.car-to-car.org/index.php?id=11&L=oksjfr http://www.car-to-car.org/

Cops, M. (2006). VII Strategy for Safety and Mobility Program, Retrieved June 14, 2012 from http://www.sigmobile.org/workshops/vanet2006/slides/Cops_VANET06.pdf.

Festag, A. et al. (2008). 'NoW – Network on Wheels': Project Objectives, Technology and Achievements, Proceedings of 5rd International Workshop on Intelligent Transportation (WIT), pp. 211-216, Hamburg, Germany.

Fuentes, J., et al. (Eds.). (2011). Handbook of Research on Mobility and Computing: Evolving Technologies and Ubiquitous Impacts, Handbook of Research on Mobility and Computing, IGI Publications.

Hartenstein, H. and Laberteaux, K. (Eds.). (2010). VANET: Vehicular Applications and Inter-Networking Technologies, John Wiley and Sons.

IEEE 802.15.4. (2003). IEEE 802.15.4 ZigBee Standard. Retrieved June 14, 2012 from http://standards.ieee.org/getieee802/download/802.15.4-2003.pdf

Little, T. D. and Agarwal, A. (2005). An Information Propagation Scheme for VANETs. Proceedings of IEEE Intelligent Transportation Systems, pp. 55 – 160.

Moskvitch, K. (2011, July 12). "'Talking' cars could reduce motorway pile-ups". Retrieved June 14, 2012, from http://www.bbc.com/news/technology-14125245

Rawat, D. B., et al. (2011a). Securing Vehicular Ad-Hoc Networks Against Malicious Drivers: A Probabilistic Approach. Proceedings of the International Conference on Complex, Intelligent, and Software Intensive Systems (CISIS), Seoul, Korea.

Rawat, D. B., et al. (2011b). Enhancing VANET Performance by Joint Adaptation of Transmission Power and Contention Window Size. IEEE Transactions on Parallel and Distributed Systems, 22(9), pp. 1528-1535.

Smith, B. L., et al. (2003). Cell phone probes as an ATMS tool. Center for Transportation Studies at the University of Virginia. Retrieved June 14, 2012 from http://www.cts.virginia.edu/docs/UVACTS-15-5-79.pdf

Santa, J., Moragon, A., & Gomez-Skarmeta, A. F. (2008). Experimental Evaluation of a Novel Vehicular Communication Paradigm Based on Cellular Networks. Proceedings of the IEEE Intelligent Vehicles Symposium.

The MathWorks. (2012). Matrix Laboratory (MATLAB). http://www.mathworks.com/products/matlab/

Trivedi, H., et al. (2011). Routing mechanisms and cross-layer design for Vehicular Ad Hoc Networks: A survey. Proceeding of IEEE Symposium on Computers & Informatics, pp. 243 – 248

U.S. Department of Transportation. (2005). Vehicle infrastructure integration. Retrieved June 14, 2012 from http://www.vehicle-infrastructure.org/documents/VII%20Architecture%20version%201%201%202005_07_20.pdf

U.S. National Highway Traffic Safety Administration. (2012). Budget Overview of FY 2012 Congressional Submission. Retrieved from http://www.nhtsa.gov/staticfiles/administration/pdf/Budgets/FY2012_Budget_Overview-v3.pdf

Wang, C. D. and Thompson, J. P. (1997). "Apparatus and method for motion detection and tracking of objects in a region for collision avoidance utilizing a real-time adaptive probabilistic neural network", US Patent No: 5613039.

Watfa, M. (Ed.). (2010). Advances in Vehicular Ad-Hoc Networks: Developments and Challenges, IGI Global Publishers.

ZigBee Alliance. (2009) ZigBee Overview. Retrieved June 14, 2012 from https://docs.zigbee.org/zigbee-docs/dcn/07-5482.pdf

ZigBee Alliances. (2012). ZigBee Specification: Features At-A-Glance. Retrieved June 14, 2012 from https://docs.zigbee.org/zigbee-docs/dcn/07-5299.pdf

Electricity, Electronics, & Computer Technology (Computer Applications & Networking)

A Wireless System to Detect Crack Propagation in Concrete Structures

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Abstract
Concrete structures have been widely adopted for civil infrastructures. The formation of cracks in concrete is a normal phenomenon. Tracking crack statuses during the operational lifetime of concrete elements provides engineers with information necessary to evaluate a structural element's health, safety margin, and anticipated future performance. Wireless sensor networks are emerging as sensing paradigms that the structural engineering field has begun to consider as substitutes for traditional tethered monitoring systems. In this study, we investigate the ability of wireless system to record quantitatively and accurately existing and propagating cracks in concrete structures. In addition, we investigate the ability of adopting the WAVE system to monitor concrete infrastructures. Tests conducted in a laboratory to monitor the cracks in the structures and explore the validity and reliability of data transmission.

Introduction
Concrete structures have been widely adopted for civil infrastructures. Civil infrastructures are one of the most expensive assets that countries invest (e.g. estimated at $20 trillion in the U.S. (Liu and Tomizuka, 2003). Civil infrastructures often experience deterioration and damage as a direct result of extreme loading, hazardous events, and other environmental effects. In terms of safety, reliability, and sustainability, it is important to inspect and maintenance the structural health of existing concrete infrastructures over its operational life for supporting the economic vitality of our society. In fact, they are costly to replace once they are built (Chong, 1999). The costs associated with the increasing maintenance and surveillance needs due to deterioration are rising.

Cracking is one of the major defects or damages in concrete. It can be the first symptom toward a catastrophic failure of the concrete structures since the stiffness properties will change when crack occurs in a structure. Cracks represent a path of least resistance for moisture and corrosive ionic agents from de-icing salts to reach embedded steel in concrete. Moisture and ionic agents can lead to the corrosion of steel reinforcement and can cause tensile stresses in the concrete in its vicinity. Such tensile stress causes more cracks and can result in spalling of the concrete to cover the reinforcement. Cracks can result from structural overloading, fatigue, and extreme events. Cracks can propagate under the influence of mechanical and environmental factors. Tracking crack states during the operational lifetime of concrete elements provides engineers with information necessary to evaluate a structural element's health, safety margin, and anticipated future performance. Cracks may be either macro-cracks, detectable by visual inspection, or micro-cracks, which can be detected with microscopes or non-destructive testing.

Structure Health Monitoring System (SHM)
The Structure Health Monitoring System (SHM) offers an automated monitoring system for tracking the health of a structure by combining damage detection algorithms with structural monitoring systems (Kolakowski, 2007) to identify and localize the damage area. The application of SHM systems using distributed sensor for collecting the measurement occur locally within a structure of interest and storing the measurement data within a central office (computer) for later analysis. Traditional SHM technology has employed wire-based systems to collect structural data. However, the installation of these wire-based systems can be expensive in labor, time, and price (MacGillivray & Goddard, 1997). To overcome the many disadvantages of wired systems, Straser and Kiremidjian (1998) proposed the design of a low-cost wireless structural health monitoring system (WSHMs) for civil structures. Due to its low cost, researchers in both academia and industry are increasingly focusing on the development of WSHMs applications. . Generally, wireless sensors have their designs broken into four functional subsystems: a sensing interface, computational cores, wireless transceivers, and an actuation interface.

A near real-time WSHM allows for condition-based maintenance practices to be substituted for the current time- or cycle-based maintenance approach thus optimizing maintenance labor and reduce the maintenance cost. In addition, WSHM can significantly reduce the loss of human lives by providing information to emergency response services

Wireless Communication Technology for WSHMS

The major feature of a wireless system node is the fact that data is transmitted wirelessly with the use of radio frequency (RF) communication. The majority of wireless sensor platforms operate on 900 MHz, 2.4 GHz, or 5 GHz frequencies, with the lower frequencies resulting in longer ranges. The Federal Communications Commission (FCC) in the United States has designated these frequencies as unlicensed industrial, scientific, and medical (ISM) frequency bands. Depending on the intended bandwidth and application, some RF of Electrical and Electronics Engineers (IEEE) are available. Wireless personal area network (WPAN) standards include Bluetooth (IEEE 802.15.1), UWB (IEEE 802.15.3), and ZigBee (IEEE 802.15.4). Other wireless technologies, including wireless USB, IR wireless and Radio Frequency Identification (RFID), etc. Each of these standards is accompanied by advantages and limitations for wireless sensor networks.

WAVE System

Wireless access for vehicular environment (WAVE) is important reliable, cost-effective transmission of data to the local transportation office that needs attention. In 2006, the United States FCC allocated 75 MHz of the Dedicated Short Range Communications (DSRC) spectrum at 5.9 GHz to be exclusively used for vehicle-to-vehicle and infrastructure-to-vehicle communications. In the WAVE system, there are two main types of devices: Roadside Units (RSUs) and Onboard Units (OBUs). RSUs are typically considered to be embedded to the infrastructure and service provider, while OBUs operate when in motion and support information exchange with RSUs and other OBUs. Prototype IEEE 802.11p radios have been developed by the Vehicle Infrastructure Integration Consortium both for on-board and road-side units (Jiang and Delgrossi, 2008). The WAVE is a free, licensed spectrum that solves the interference and co-existence problems of WLANs. Comparing to the data service of cellular networks, the advantages of a WAVE system is that the system is dedicated to transportation system. Although a WAVE system is not originally designed to civil structure monitoring, in this study, we investigate the possibility of adopting the WAVE system to monitor concrete infrastructures since it may be used to implement the information dissemination. The roadside units can be utilized to relay data back to a local transportation office where the data may be transmitted via Internet to the engineering office.

Crack Monitoring System

There are several methods for crack monitoring system in concrete structures. Detailed visual inspection of the surface of the structure remains a common method for detecting cracks; systematic crack mapping allows inspectors to monitor the progression of cracks and to hypothesize the nature of their origins (Bungey et al, 2006). Frequency of inspection depends on the design, past performance, and age of the civil structure. Accuracy of visual inspection generally depends upon inspector's experience and skill. This method is time consuming, and expensive.

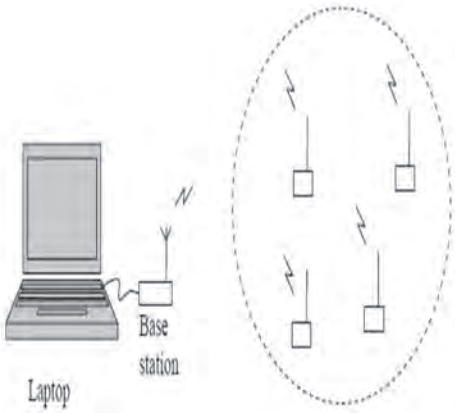
Many well-known non-destructive testing (NDT) methods (such as impact-echo method, ultrasonic pulse-echo method, acoustic impact method (sounding), infrared thermographs, microscopic, X-ray techniques etc.) are currently in use for crack detection in the concrete structures. These techniques require high input power to achieve the required sensitivity and they must performed by NDE specialist. In addition, NDE is generally performed on a routine maintenance schedule when the structure is out of service. The vibration-based technique, crack detection is accomplished by monitoring the changes in the vibration parameters of a structure that are influenced by crack formation and growth. In most cases, only large cracks can be detected. Moreover, the extension of the crack is difficult to monitor based on the vibration parameter changes (Lele and Maiti 2002). In contrast to other researches, this study did not seek to directly correlate the crack formation and propagation to any other physical phenomena; rather it investigate the ability of wireless system to record quantitatively and accurately existing and propagating cracks in concrete structures.

Proposed Methodology

Wireless Sensor Network

The wireless sensor network investigated in this study equipped with crack gauge, wireless node and a base station, which are available commercially for low budget. Instead of a PC-based system, each of the wireless nodes is capable of collecting the data and routing it back to the laptop (roadside unite) via the USB base station (see Figure 1). This network arrangement was a self-healing process where the flow of the data was maintained even if some of nodes were blocked due to a lack of power, physical damage, or interference.

Figure 1. Diagram of the Wireless Network

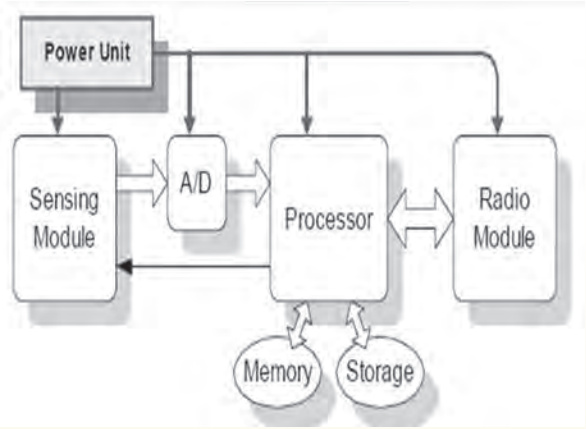


Wireless Sensor Node

The SG-Link module wireless sensor node manufactured and sold by MicroStrain was selected. The SG-Link module has a small size, flexible software, ability to operate without a PC on site, relatively low cost, and a catalogue of add-on sensor boards. In addition, the SG-Link module end-user does not need to program the system manually to function properly, which is attractive to civil engineers. The SG-Link module node used a CC2420 chip for wireless transceivers for low-power consumption.

The sensor node consists of five major components: sensing and signal conditioning, communication, a microprocessor, memory or storage, and a power unit. The sensing units are composed of two subunits: analog-to-digital converters (ADC) and sensors. These units were responsible for pre-processing (encoding, decoding, etc.) the data for transmission. The transceiver unit connected the node to the sensor network via a wireless link such as a radio module. Lastly, the power unit was the source of power for the node, which powered all activities on the sensor node including communication, data processing, and sensing. Figure 2 summarizes the tasks processed by those units on the sensor board.

Figure 2. System Block Diagram for a Wireless Sensor



The Crack Gauge

The TK-09-CPA02- 005/D, a commercial crack gauge manufactures and sold Vishay Intertechnology Inc., was chosen. The crack gauge is made up of a series of metallic traces (twenty grid lines) of known electrical resistance. One or more of the metallic traces will break when the crack occurs which will change the resistance measured across the terminals of the sensor (see Figures 3 & 4). The obvious advantage of such a crack gauge is that it will directly detect the crack or measure the crack propagation. Therefore, the maintenance workers can make their decision instantly whenever they down load the data to their laptop without the need for more data analysis.

Figure 3. Crack Propagation Resistance Versus Rungs Broken (for TK-09-CPA02-005/DP)

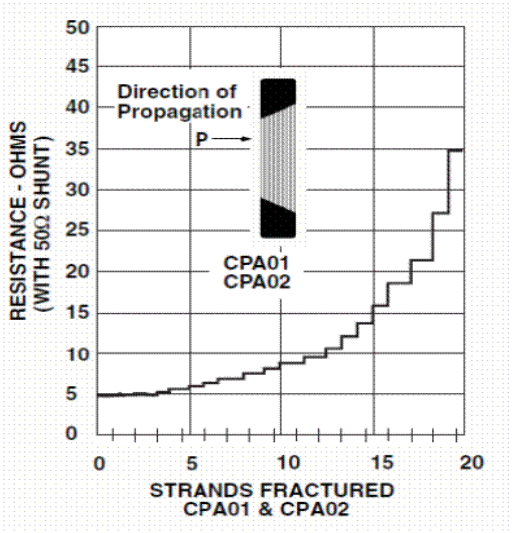
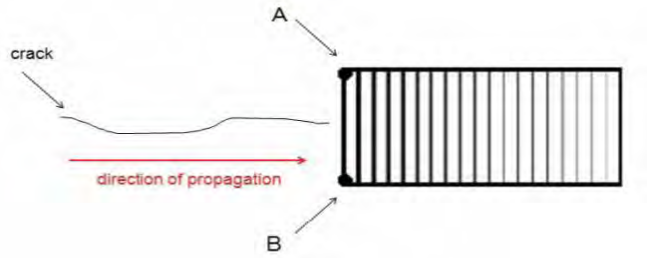


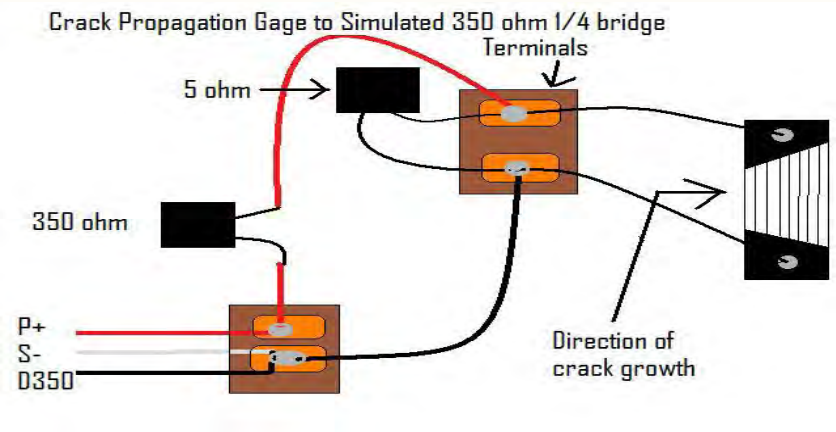
Figure 4. Illustration of a Crack Propagation Pattern between the terminals A and B



Sensor Readout Circuit

The crack propagation gauge is purely resistive sensor and the SG-Link module node is only able to record voltages, two precision resistors were used to create a circuit to convert the resistance output into a voltage. The 5 Ω resistor was placed in parallel with the two terminals of the crack propagation pattern while the 350Ω resistor was placed in a series with the node itself. Figure 5 shows a schematic of this circuit.

Figure 5. Diagram of Sensor Readout Circuit, adapted from Vishay Inter technology, Inc. (2010)



Sample preparation

Eight concrete sample beams 6 x 6 x 21 inch were fabricated. The location of the crack gauge was predetermined at sample mid span of the lower surface of the sample. The surface sanded with fine sand paper, and then it conditioned with acetone. A damp cotton swab was used to remove the resulting concrete dust. After five minutes, it was conditioned with an acidic cleaner followed by a neutralizer. After these solutions had evaporated, thin layer of the adhesive mixture (resin and hardener) was spread on the surface to create a bondable surface. A thin coat of the super glue (SG401) was applied to a sample surface to bond the crack gauge. The crack gauge was attached by clear tape to its back side and then placed on the beam. A firm pressure was applied on top of the gauge for one minute. After about an hour, the tape was removed and the strain gauge was attached to the sample surface.

Experimental Procedure

One crack gauge and one wireless node had been chosen to be used for the experiment. The crack propagation gauge was affixed to the concrete beam sample. The crack gauge was wired to the sensor readout circuit (see Figure 6) and then the sensor readout circuit was connected to the wireless node. The load was increased gradually with a constant minimum rate. The load is applied to the concrete specimen using a small Universal Testing Machine. The wireless node collected the data from crack gauge and relay it back to laptop (roadside) via USP base station, as shown in Figure 7.

Figure 6. Wired the crack gauge to the sensor readout circuit

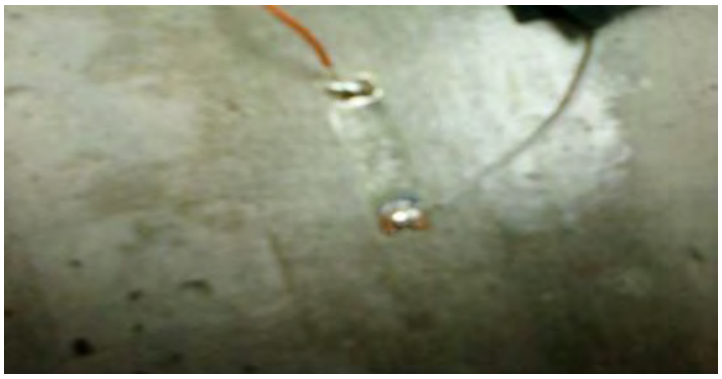
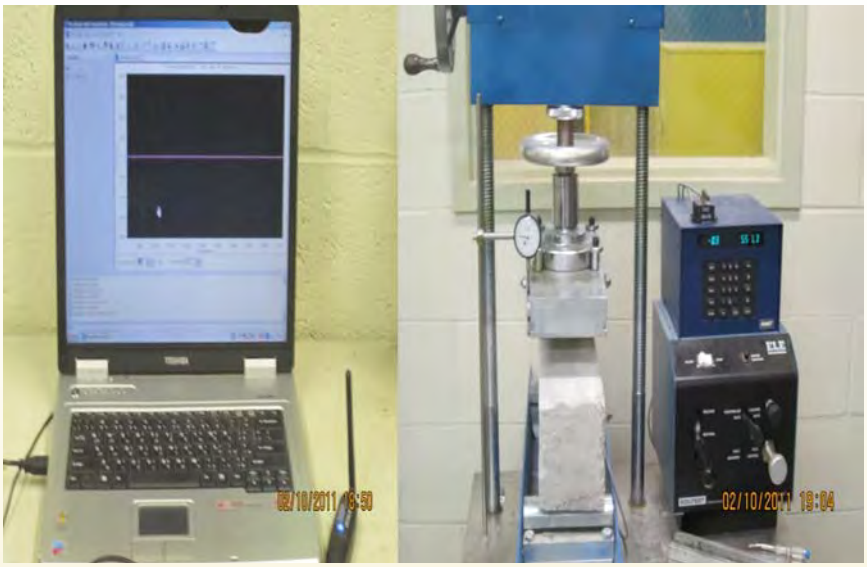


Figure 7. Testing and Collecting Crack Propagation Gauge Data (on Concrete Beam Sample)



Results and Discussion

The result of the experiment is summarized in graph below (see Figure 8). The graph shows the data recorded by the wireless sensor and transmit into laptop during the test. The graph provides clear evidence that the crack propagation under varying load was accompanied by a significant change in the sensor response. The graph indicates that all twenty rungs have been broken due crack propagation (see Figure 9) which could clearly identify from the graph. Each broken rung causes increase in voltage, which represent the crack propagation width. The 12-bit analog-to-digital conversion unit and the sensor readout circuit are combined to increase the minimum-viewable change in voltage output of any sensor to be recorded by the SG-Link module node. Particularly, the crack detected by the first 0-5 rungs, which might be considered a micro-cracks, indicated that the wireless system is highly sensitive to the presence of cracks and it is able to provide a clear indication of crack formation and its propagation.

Figure 8. Data Recorded by SG-Link Module Node Second Series

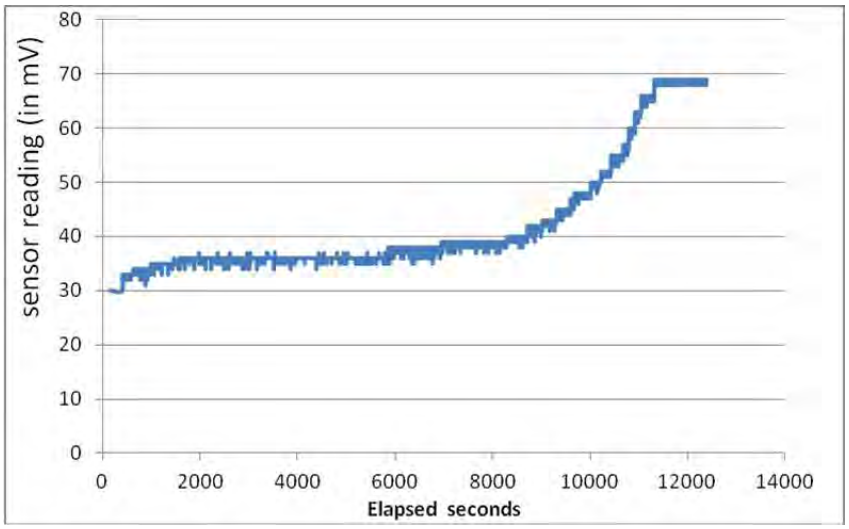


Figure 9. All twenty rungs of the crack gauge have been broken

Conclusions

. Wireless sensor networks are emerging as sensing paradigms that the structural engineering field has begun to consider as substitutes for traditional tethered monitoring systems. The application of wireless sensor networks to detect and quantify the present of cracks in concrete structures was presented and it is promising. It is apparent that the sensor readout circuit of crack sensor for the SG-link module node increases the node sensitivity to detect and measure initial crack formation and propagation under varying loads. Particularly, the crack detected by the first 0-5 rungs, which might be considered a typical hairline crack.

The study shows that a robust communication between the wireless sensors and the data repository ensured 100% success rate in data delivery, which could be considered as a good indicator to utilize WAVE system in monitoring infrastructure. Utilizing WAVE system might be more cost effective and it might provide more reliable service if the collected data can be integrated into the safety part of the WAVE system.

References

Bungey, J. H., Millard, S. G., & Grantham, M. G. (2006). *Testing of concrete in structures*. London, England: Taylor & Francis.

Chong, K. P. (1999). Health monitoring of civil structures. *Journal of Intelligent Material Systems and Structures*, *9*(11), 892–898.

Jiang, D. and Delgrossi, L.(2008) , IEEE 802.11p: Towards an international standard for wireless access in vehicular environments, *Proceedings of IEEE 2008 Vehicular Technology Conference, 11-14*

Kolakowski, P. (2007). Structural health monitoring: A review with the emphasis on low-frequency methods. *Engineering Transactions: IPPT*, *55*(3), 239–275.

Lele, S.P. and Maiti, S.K. (2002)."Modeling of transverse vibration of short beams for crack detection and measurement of crack extension", *Journal of Sound and Vibration*, 3 (257).

Liu, S. C., and Tomizuka, M.,(2003) "Vision and Strategy for Sensors and Smart Structures Technology Research," *Proceedings of the 4th International Workshop on Structural Health Monitoring*, Stanford, CA, 42-52.

M.acGillivray, P. & Goddard, K. (1997). Advanced sensor technology for marine propulsion control systems. *Proceedings of the 11th Ship Control Systems Symposium, Southampton, England, 2*, 245-257.

Straser, E. G. & Kiremidjian, A. S. (1998). *A modular, wireless damage monitoring system for structures* (Report No. 128). Stanford University, Stanford, CA: John A. Blume Earthquake Engineering Center.

Graphics

Graphics

3D Models for Subsurface Volume Computation in the Illinois Basin

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Abstract
This research investigates methods and formulae for integrating reservoir volume computation into a legacy map conversion project. Three oil fields in the Illinois Basin for which legacy mapping was available were used as study areas in this project. The research showed that rule-based volume computation following data gridding provided smoother work flow than use of the traditional contour area method. Volumes computed using different rules were found to converge as grid size decreased. The outcome of this work identified workflows that caused minimal disruption to map conversion procedures and demonstrated that volume computation during map conversion provides information not available initially from the hard copy legacy maps.

Introduction
Exploration for petroleum and natural gas requires mapping and modeling of subsurface structures to determine reservoir shape and extent. In addition, it is necessary to determine reservoir volume. Volume determination is challenging because reservoirs don't have regular geometric shape; volume determination is critical because reservoir volume can determine whether or not to invest in further exploration.

The Illinois Basin covers some 60,000 square miles in Illinois, Kentucky, and Indiana. Exploration in the basin has resulted in a great deal of legacy mapping. Converting this legacy mapping to 3D graphic models enhances viewing and interpretation and also may require determination of reservoir volume.

This research investigates the accuracy and precision of different methods of subsurface volume computation done as part of a legacy map conversion project. Specifically, the following questions are addressed:

(a) What volume computation techniques can be integrated into legacy map conversion?

(b) What governs the accuracy and precision of subsurface volume computation?

(c) How can subsurface volume estimates be improved?

Previous work
Previous work on legacy map conversion has stressed map georeferencing, project organization, and quality control (Demers, M.N. (2005); Kellie, A.C. (2011); Lo, C.P. & Yeung, A.K.W. (2007); Longley, P.A., Goodchild, M.F., Maguire, D.J., & Rhind, D.W. eds. (1999)). Digitizing expresses legacy mapping as a set of points that provides the basis for 3D subsurface modeling. Following digitizing, various computer algorithms generate the grid needed for mapping. Each gridding algorithm employs a specific interpolation method and generates slightly different 3D surfaces. Recognizing this, Kellie (2011) stresses the need for quality control to ensure that the 3D mathematical model developed during gridding match contours or isopachs shown on the legacy mapping.

Gridded data can be used for volume computation, so it follows that both gridding method and grid size might influence volume computation. This could be true even if model and legacy map contours were congruent because inter-contour areas contribute to computed volume. This research investigated use of two gridding algorithms (Kriging and minimum curvature) for map conversion and volume computation. These algorithms are well known and are discussed at length by Journel and Huijbregts (1978) and Briggs (1974). The influence of grid size on volume computation is less well understood, but Busch and Link (1985), in the only reference located, suggest that grid size equal the contour interval.
Volume computation routines have been discussed extensively, perhaps because of their use in earthwork volume

computation (Schofield, W., (2001); Ghilani, C.D. & Wolf, P.R., (2012); Golden Software, (2001, 2011); and Anderson, C.D. and Mikhail, E.M., (1998)). Perhaps the best known technique is the contour area method. With this method, the area enclosing each contour is measured; successive contour areas then are averaged and multiplied by the contour interval. This yields the inter-contour volume. Summing inter-contour volumes provides total reservoir volume. Despite its popularity, Ghilani and Wolf (2012), note that volumes computed using the contour area method are "slightly larger" than the "true" volume.

Cross sectioning provides a second technique for volume computation. With this technique, a grid is placed over each bounding surface. The vertical cross sectional area along each grid row is computed. Volume is determined from successive cross sectional areas and the grid spacing. Various rules (formulae) can be used for area and volume computation. The trapezoidal rule, Simpson's 1/3 rule, and Simpson's 3/8 rule are commonly included in 3D modeling software (Golden Software, 2011). Appendix I shows the rules just listed, and Chapra (2008), Allen and Isaacson (1998), and Weisstein (2012) provide derivations.

Procedure

Based on the above work, research was undertaken to address the questions posed at the beginning of this paper. Three oil fields, currently included in a legacy map conversion project, were selected as study areas. These fields were Handyville Field, Daviess County, Kentucky (Walker, 1988); Sailor Springs Field, Clay County, Illinois (Drexler, 1988); and Stringtown Field, Richland County, Illinois (Cluff, 1988). There is one reservoir at Handyville, three at Sailor Springs, and four at Stringtown.

Legacy isopach (thickness) maps for all of these fields were in line format and included plots of both oil wells and dry holes. Legacy map scales were 1:24,000 at Handyville, 1:31,680 at Sailor Springs, and 1:35,200 at Stringtown. Georeferencing used the state plane coordinate system (Illinois or Kentucky). Digitizing employed Didger software (Golden Software, 2001). Data output was to Surfer contouring and 3D modeling software (Golden Software, 2011).

Surfer gridded and contoured the input data. Two different gridding algorithms (Kriging and minimum curvature) tested the effect of gridding method on resulting volumes. Because grid size also was considered as a variable, each algorithm was used to compute grids of 50x50, 20x20, 10x10, and 5x5 feet. Volumes were computed using the contour area method, and by using the three rule-based formulae (trapezoidal rule, 1/3 rule, and 3/8 rule) shown in appendix 1. Overlaying a contour map made from digitized and gridded data on the legacy map tested congruence of the contours. If congruent, the conversion was considered to be accurate; digital data then could be used for either mapping or volume computation.

Map conversion prepared a standard set of map products for each field. These included a standard base map, a 3D surface model, and a 3D wireframe for technical presentation. (These are shown below in figures 1, 2, and 4.) Initially, contour areas measured during digitizing provided reservoir volume using the contour area method. Surfer software provided rule-based volumes.

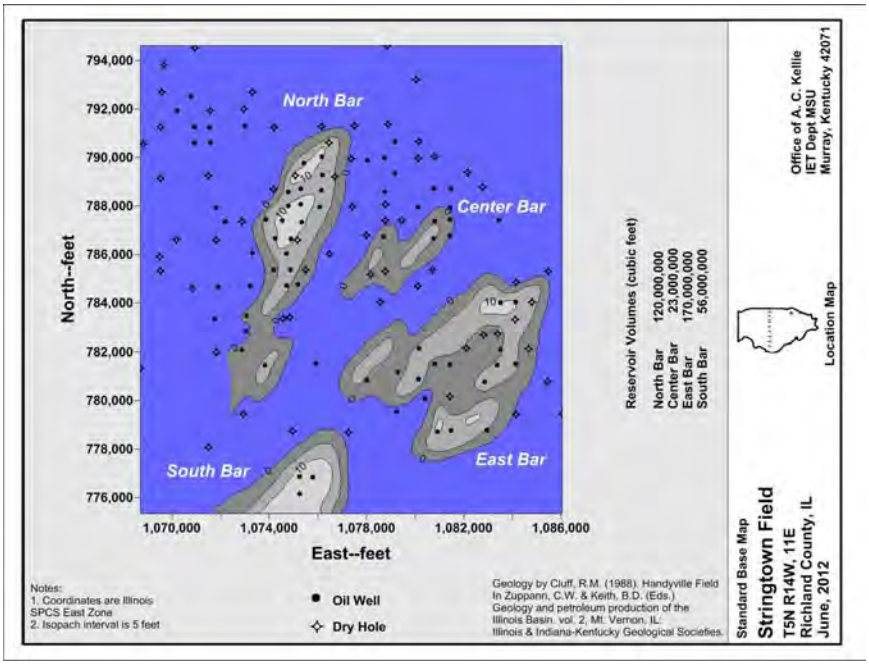
Results and Discussion

The first question posed in this research was, "What volume computation techniques can be integrated into legacy map conversion?" Based on the discussion above, work began by integrating volume computation using contour areas into digitizing. Rule-based volume computation followed gridding.

Early project work suggested that more efficient integration was needed because the contour area method was found to be very time consuming. Normally, the technician digitizes isopachs as polylines. Coordinates are exported to develop the 3D model; polylines are exported as a line graphics file for congruence testing. To obtain contour area, the technician had to digitize isopachs as polygons. This required additional work, because while all isopachs eventually close, not all isopachs close on the map. The technician entered isopach area from digitizing into a computational spreadsheet and then converted polygons to polylines for export and use in congruence testing. The impact on conversion work flows quickly became apparent.

A single oil field may contain multiple reservoirs. For example, figure 1 shows the Stringtown field. There are four bars (reservoirs) in the field, and each bar was digitized separately. Models of each of the bars were combined (mosaiced) following gridding to develop the model for the entire field.

Figure 1. Standard isopach base map for Stringtown field.



Using the rule-based volume program in Surfer caused little disruption to project work flow. There was no need to determine contour areas and no cross-platform data transfer. The technician specified the height (0 feet) of the base isopach and program output showed reservoir volume by all three rules. In addition, the program returned the plane area of the base isopach, so running the Surfer volume computation program for the volume above each isopach (5, 10, 15 feet, etc.) provided isopach areas for contour area volume calculation.

The second question posed by this research was, "What governs the accuracy and precision of subsurface volume computation?" Volume computations shown in tables 1 and 2 address this question.

Precision (repeatability) is addressed first. Table 1 compares field volumes computed using the minimum curvature and Kriged grids and shows average volume, difference from average and percent difference from average for each rule. Separate volumes are shown for grids of 50x50, 20x20, 10x10, and 5x5 feet square. Three things are apparent from these data. First, as grid size decreases, volumes converge. In the absence of other controls, setting the grid size equal to the isopach interval yields the most precise volume while honoring data constraints.

Second, volumes computed from Kriged grids are more precise than volumes computed using minimum curvature. Apparently, with the minimum curvature routine, the 3D surface shape modeled is more dependent on grid size, and this is reflected in volume computation Using Kriging for gridding increases volume precision.

Third, any technical computation must honor the number of significant figures. The most probable value for the volume of the field is the average of the three volumes computed from a grid 5x5 feet square based on a Kriged grid. For the mapping shown in this work, use of 2 significant figures would seem appropriate.

Table 2 compares volumes from the contour area method with volumes from rule-based techniques. This table shows that in general the contour area method returns larger total field volumes. This may not be true, however, for individual bars as shown by volumes computed for the north and south bars at Sailor Springs.

The reason for the differences at Sailor Springs is indicated by figure 2 which shows the modeled surface of the north bar. Legacy mapping showed only the 0 and 5 feet isopachs. In figure 2, the modeled surface extends above 5 feet. Volume in the cross-hatched area was omitted when the contour area method was used but is included in rule-based volumes.

Table 1. Volume computation for Handyville, Sailor Springs, and Stringtown fields.

Grid	Average	δ_{trap}	δ_{trap}%	$\delta_{1/3}$	$\delta_{1/3}$%	$\delta_{3/8}$	$\delta_{3/8}$%
Handyville			Minimum	Curvature			
50x50	200,057,123	8,529	0.0043	-30,223	-0.0151	21,693	0.108
20x20	200,261,774	-1853	-0.0009	672	0.0003	1,182	0.0006
10x10	199,509,034	-501	-0.0003	-399	-0.0002	900	0.0005
5x5	199,728,752	267	0.0001	-789	-0.0004	522	0.0003
Handyville			Kriging				
50x50	199,510,722	1,727	0.0009	-5,377	-0.0027	3,650	0.0018
20x20	199,514,601	-2,316	-0.0012	2,583	0.0013	-267	-0.0001
10x10	199,509,034	-501	-0.0003	-398	-0.0002	900	0.0005
5x5	199,507,809	-16	0.0000	-413	-0.0002	429	0.0002
Sailor Springs			Minimum	Curvature			
50x50	311,749,245	-41,943	-0.0135	9,596	0.031	32,348	0.0104
20x20	318,370,334	16,946	0.0053	-27,634	-0.0087	10,689	0.0034
10x10	317,802,644	-9,622	-0.0030	-13,047	0.0041	22,669	0.0071
5x5	317,202,504	-4,640	-0.0015	-798	-0.0003	5,437	0.0017
Sailor Springs			Kriging				
50x50	316,528,970	-36,621	-0.0116	8,820	0.0028	27,802	0.0088
20x20	313,718,670	-1,109	-0.0004	-11,650	-0.0037	12,760	0.0041
10x10	313,726,392	-9,625	-0.0031	-12,812	-0.0041	22,436	0.0072
5x5	316,653,087	-4,891	-0.0015	-1,156	-0.0004	6,046	0.0019
Stringtown			Minimum	Curvature			
50x50	371,630,858	3,063	0.0008	-71,534	-0.0192	68,470	0.0184
20x20	372,297,142	2,949	0.0008	2,016	0.0005	-4,964	-0.0013
10x10	372,822,662	2,548	0.0007	-332	-0.0001	-2,215	-0.0006
5x5	373,722,901	264	0.0001	544	0.0001	-807	-0.0002
Stringtown			Kriging				
50x50	377,076,294	-3,112	-0.0008	13,233	0.0035	-10,121	-0.0027
20x20	377,029,139	3.221	0.0009	-5,261	-0.0014	2,039	0.0005
10x10	377,029,168	2,471	0.0007	1,085	-0.0003	-1,385	-0.0004
5x5	377,029,025	462	0.0001	162	0.0000	625	-0.0002

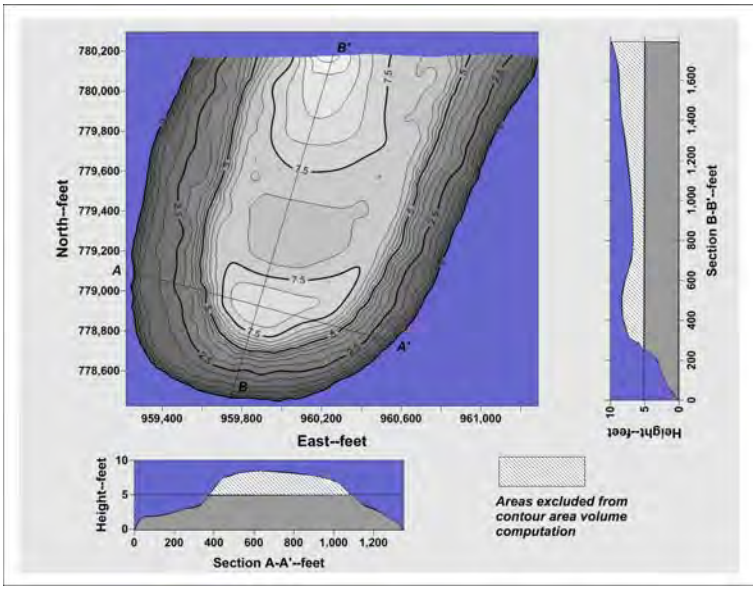
Table 2. Field volume computation by contour area, minimum curvature grid, and Kriged grid. Contour area volumes based on contour interval of 5 feet. Minimum curvature and Kriging based on grid 5 feet x 5 feet.

The reason for the differences at Sailor Springs is indicated by figure 2 which shows the modeled surface of the north bar. Legacy mapping showed only the 0 and 5 feet isopachs. In figure 2, the modeled surface extends above 5 feet. Volume in the cross-hatched area was omitted when the contour area method was used but is included in rule-based volumes.

Table 2. Field volume computation by contour area, minimum curvature grid, and Kriged grid.

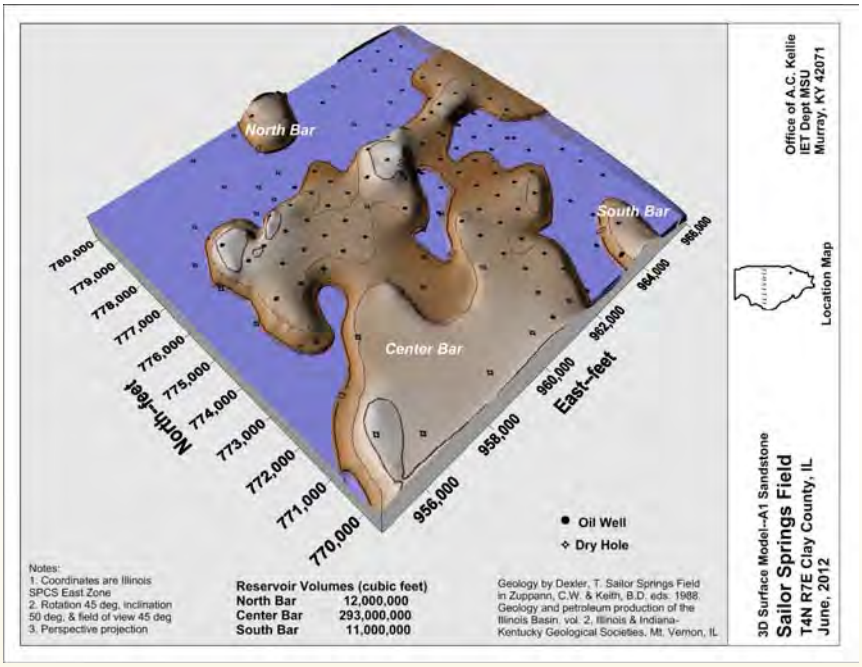
Method	North Bar	Center Bar	East Bar	South Bar	Total
		Handyville			
Contour Area		200,982,523			200,982,523
Minimum Curvature		199,728,752			199,728,752
Kriging		199,507,809			199,507,809
		Sailor Springs			
Contour Area	9,847,555	300,073,965		8,589,045	318,510,565
Minimum Curvature	12,330,721	293,563,863		11,307,920	317,202,504
Kriging	12,410,984	293,373,297		10,868,806	316,653,087
		Stringtown			
Contour Area	127,952,984	23,142,855	175,981,937	58,344,363	385,422,138
Minimum Curvature	126,128,097	23,357,448	168,083,389	56,153,967	373,722,901
Kriging	124,897,365	23,143,468	172,707,588	56,280,604	377,029,025

Figure 2. Modeled surface at North Bar, Sailor Springs field.



Accuracy (nearness to the true volume) is determined outside of the computational routine by the number and distribution of sample points on the original map, and by the scale of the legacy map. Ensuring isopach congruence and use of a grid size equal to the isopach interval simply are attempts to work within the quality of the original data. For example, Figure 3 shows a 3D model of the Sailor Spring field with wells and dry holes plotted on it. The uneven distribution of the wells is apparent, as are areas for which little data was available for plotting isopachs shown on the legacy map. Maps scale influences the work because as map becomes smaller, more generalization in isopach location is required.

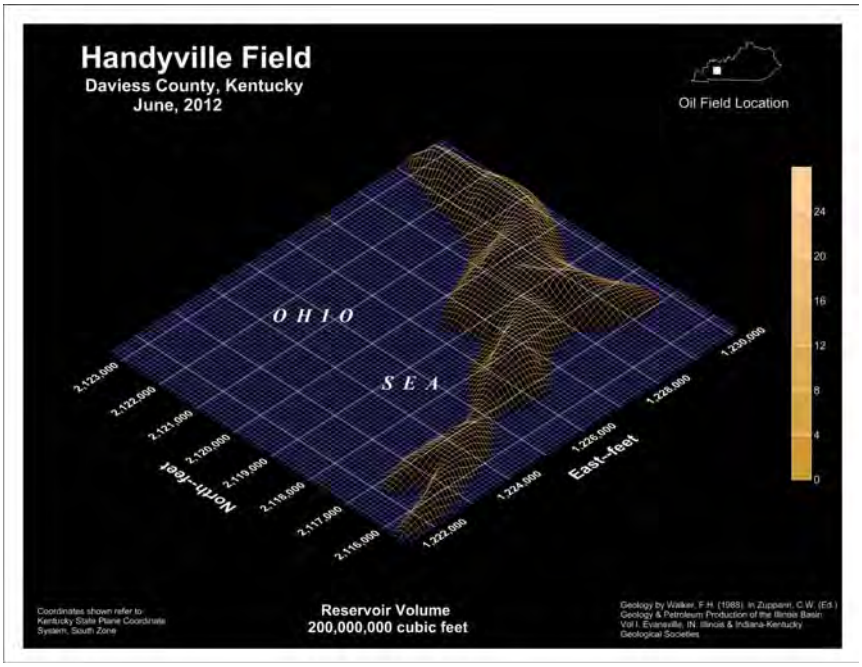
Figure 3. 3D surface model of A1 Sandstone at Sailor Springs field.



The final question posed by this research was, "How can subsurface volume estimates be improved?" First, if volume computation is to be part of a legacy map conversion project, it should be included in the initial project scoping and definition. How volume computation is to be done and how results are to be posted or archived must be addressed as soon as possible in the project.

Second, although fundamental, changes to map design are indicated where volume computation is included as part of legacy map conversion. This makes the results of the work immediately available to management without the need to hunt for an attached or referenced volume report. This can be done by a note on the base map (figure 1), 3D surface model (figure 2), or wireframe (figure 4). In addition, if not already being done, location of wells and dry holes (which helps to inform map users as to data limitations) should be shown on the base map, the 3D model, or both as shown in figures 1 and 2.

Figure 4. 3D wireframe presentation model of Handyville field.



Third, despite learned discussion about rules and algorithms, volume accuracy is set by the legacy mapping used. This research disclosed no reason, beyond personal preference, for using the contour area method for volume computation. Rule-based volume estimates can be more easily integrated into conversion workflows and provide volume estimates that are fully as accurate.

Conclusions

This research showed that reservoir volume computations can be efficiently integrated into legacy map conversion workflow. Using the Kriging algorithm for gridding, and selecting a grid size equal to the isopach interval, yield precise volumes.

Despite the familiarity of the contour area method, the work done herein shows little reason to prefer that technique for subsurface volume computation. Rather, rule-based volume computation routines that can be integrated easily into the conversion process are preferred.

Finally, basic conventions of engineering graphics are essential to presenting the results of volume computation and to conveying an understanding of volume accuracy. Isopachs on maps or models developed from legacy mapping must be of the same interval as on the original; they can be no better. Wells posted on the base map resulting from conversion are needed to convey a sense of data distribution and density. Reservoir volumes posted to the project base map archive the results of volume computation.

References

Allen, M.B. III & Isaacson, E.L. (1998). *Numerical analysis for applied science*. New York: Wiley-Interscience.

Anderson, J.M. & Mikhail, E.M. (1998). *Surveying: Theory and practice*. 7th ed. NY: WCB McGraw Hill.

Briggs, I.C. (1974). Machine contouring using minimum curvature. *Geophysics*, *39*(1), pp. 39-48.

Busch, D.A. and Link, D.A. (1985). *Exploration methods for sandstone reservoirs*. Tulsa: Oil & Gas Consultants International, Inc.

Chapra, S. (2008). *Applied numerical methods with MATLAB for engineers and scientists*. 2nd ed. Boston: McGraw-Hill.

Cluff, R.M. (1988). Stringtown field. In Zuppann, C.W. (Ed.) *Geology and petroleum production of the Illinois Basin*. Vol 2. (pp. 134-137). Mt. Vernon, IL: Illinois & Indiana-Kentucky Geological Societies, Illinois Oil and Gas Association.

Demers, M.N. (2005). *Fundamentals of geographic information systems*. 3rd ed. New York: Wiley.

Drexler, T. (1988). Sailor Springs field. In Zuppann, C.W. (Ed.) *Geology and petroleum production of the Illinois Basin*.Vol 2. (pp. 189-192). Mt. Vernon: Illinois & Indiana-Kentucky Geological Societies, Illinois Oil and Gas Association.

Ghilani, C.D. & Wolf, P.R. (2012). *Elementary surveying: an introduction to geomatics*. 13th ed. Upper Saddle River, NJ: Prentice-Hall.

Golden Software. (2001). *Didger 3*. Golden, CO.

Golden Software. (2011). *Surfer 10*. Golden, CO.

Journel, A.G. & Huijbregts, C. (1978). *Mining geostatistics*. NY: Academic Press.

Kellie, A.C. (2011). Converting Legacy Maps into 3D Models. *Proceedings, Annual Meeting ATMAE, Cleveland, OH.* p. 110-117.

Lo, C.P. & Yeung, A.K.W. (2007). *Concepts and techniques in geographic information systems.* 2nd ed. New Jersey: Pearson.

Longley, P.A., Goodchild, M.F., Maguire, D.J., & Rhind, D.W. (Eds.) (1999). *Geographic information systems*. NY: Wiley.

Schofield, W. (2001). *Engineering surveying*. 5th ed. Oxford: Butterworth-Heinemann.

Walker, F.H. (1988). Handyville field. In Zuppann, C.W. (Ed.). *Geology and petroleum production of the Illinois Basin*.Vol 2. Mt. Vernon: Illinois & Indiana-Kentucky Geological Societies, Illinois Oil and Gas Association.

Weisstein, E.W. (2012). Simpson's rule. From MathWorld—A Wolfram Web Resource. http://mathworld.wolfram.com/SimpsonsRule.html.

Zuppann, C.W. ed. (1988).*Geology and petroleum production of the Illinois Basin:*Vol 2. Mt. Vernon, IL: Illinois & Indiana-Kentucky Geological Societies, Illinois Oil and Gas Association.

Appendix I

The contour area equations can be written as

$$v_n = \left[\frac{(A_{n+1} + A_n)}{2}\right]h \quad \text{.....(1)}$$

and

$$V = \sum_{i=1}^{n}(v_1 + v_2 + v_3 + \ldots + v_n) \quad \text{.....(2)}$$

The trapezoidal rule can be written as

$$A_i = \frac{\Delta x}{2}\left[G_{i,1} + 2G_{i,2} + 2G_{i,3} + \ldots + 2G_{i,nCol-1} + G_{i,nCol}\right] \quad \text{.....(3)}$$

and

$$V \sim \frac{\Delta y}{2}\left[A_1 + 2A_2 + 2A_3 + \ldots + 2A_{nCol-1} + A_{nCol}\right] \quad \text{.....(4)}$$

Simpson's 1/3 rule is

$$A_i = \left[\frac{\Delta x}{3}\right]\left[G_{i,1} + 4G_{i,2} + 2G_{i,3} + 4G_{i,4} + \ldots + 2G_{i,nCol-1} + G_{i,nCol}\right] \quad \text{.....(5)}$$

and

$$V \sim \left[\frac{\Delta y}{3}\right]\left[A_1 + 4A_2 + 2A_3 + 4A_4 + \ldots + 2A_{nCol-1} + A_{nCol}\right] \quad \text{.....(6)}$$

Simpson's 3/8 rule is

$$A_i = \left[\frac{3\Delta x}{8}\right]\left[G_{i,1} + 3G_{i,2} + 3G_{i,3} + 2G_{i,4} + \ldots + 2G_{i,nCol-1} + G_{i,nCol}\right] \quad \text{.....(7)}$$

and

$$V \sim \left[\frac{3\Delta y}{8}\right]\left[A_1 + 3A_2 + 3A_3 + 2A_4 + \ldots + 2A_{nCol-1} + A_{nCol}\right] \quad \text{.....(8)}$$

where v_n = inter-contour volume; A_{n+1}, A_n = area enclosed by successive contours A_{n+1} and A_n; h = interval between contours; V = total reservoir volume. where Δx = grid columm spacing; Δy = grid row spacing; $G_{i,j}$ = grid node value in row i, column j; and A,V are as defined (Golden Software, 2011).

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Graphics

Integrated CAD/CFD Analysis of HVAC Fresh Air Intake System Design of an On-Highway Crane

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Abstract
There has been a consistent need regarding on-highway cranes for a means to introduce outside fresh air into the HVAC system of driver's cab in order to better de-fog the windshield and side windows when a humid and/or wet outside environment is encountered. Existing design of the fresh air intake system was not functional because of its sub-optimal location, which resulted in the air conditioning system expelling hot air in spite of the temperature controls being set to the coldest position. Through the use of CFD analysis on 3D CAD models and graphics visualization, we were able to identify the problem with the existing design, and ultimately we were able to re-locate the fresh air intake for the system to an optimal location that yielded the best possible airflow. The integrated CAD/CFD analysis approach required minimal field testing and saved countless hours of physical modeling and mock-ups, thus minimizing the overall cost of the redesign.

Introduction
The focus of this paper is on demonstrating the use of integrated CAD (Computer Aided Design) /CFD (Computational Fluid Dynamics) analysis as an aid to mechanical design process. Computational fluid dynamics is basically the process of replacing equations that represent fluid flow with numbers and advancing those numbers in space and time to generate a final numerical description of the fluid flow of interest (Anderson et al., 2009). According to Watson (2012), so far CFD has been used to design high value-added products that depend heavily on fluid flow, such as airplanes and automobiles, but it has the potential to substantially improve performance of every product that relies upon fluid flow and heat transfer phenomena. A lot of research has been done on the development of CAD and CFD fields, but these research efforts have been mostly independent of each other. Very few research efforts can be found that captured the synergy between the two fields or used the CAD models in CFD simulation. The idea of closing the gap between CAD model and downstream applications such as CFD was first explored by Farouki (1999) at the SIAM (Society of Industrial and Applied Mathematics) Workshop on Integration of CAD and CFD, held at UC Davis. In the same year, Kellar et al. (1999) used a CAD/CFD interface to enable CFD numerical flow visualization for a generic racing car geometry as part of a detailed project investigating racing car wheel aerodynamics. More recently, Li et al. (2007) created a new innovative fully integrated CAD/CFD design environment to analyze the leakage in a twin-screw supercharger. Their integrated design environment can address all aspects of fluid and geometry requirements for the future supercharger designs. One of the important benefits of integrating CFD with CAD is that it eliminates the need to build costly physical prototypes thus saving time and resources for companies.

In this paper, we present a real world case study in which the use of integrated CAD/CFD design optimization and related graphical methods resulted in improved design of HVAC (Heating, Ventilation and Cooling) fresh air intake system of an on-highway crane. Over the course of development of an on-highway all-terrain crane, a design problem was identified with its HVAC fresh air intake system. It was noticed that whenever the air conditioning unit of the crane was switched on, the air being expelled from the ductwork was hotter than the ambient air temperature. The initial solution to the perceived problem was that there must have been some components that were assembled incorrectly or that the HVAC system had

not been properly charged with refrigerant. However, upon further investigation, it was surmised that there was an inherent flaw within the design of the HVAC system, as was supported by the condition stated earlier.

It was recognized that there was a need to develop an optimal location for fresh air intake into the crane HVAC system in order to stop superheated air from the inside of the engine compartment being introduced into the system which was rendering the system ineffective. The optimal location sought would have the following characteristics: 1) It would be located out of the superheated airflow, 2) be as hidden from plain sight as practical, 3) be shielded from road spray and debris, 4) be located in an easily accessible area for filter maintenance, and 5) would require the minimal amount of material and labor to relocate the intake.

First, initial testing was performed on the existing design and the critical temperature data was recorded under various operating conditions of the crane to establish a baseline and to better understand the problem with the existing design. Next, the 3D CAD model of the existing design was created for the CFD analysis. Then, the CFD analysis was performed on the CAD model. Finally, the new design was developed based on the results of the CFD analysis and ultimately was implemented into the production system.

Initial Testing and Data Collection

Initial testing was performed to establish a baseline fresh air intake temperature for on-highway travel operation. Background information was gathered about the problem of the airflow from the inside of the engine compartment for the fresh air intake system. It was observed that while the machine was in mobile on-road operation, there would be a significant amount of hot air coming through the HVAC system even though the air conditioner was activated.

Road tests were conducted and the critical temperature was measured using appropriately placed thermocouples. The critical temperature observed was the vent temperature inside the driver's cab which determined whether superheated air was being introduced into the HVAC system under various operating conditions. Figure 1 shows the location for the original fresh air intake. It was discovered during the initial long road run testing that this location was not an appropriate location to be drawing outside air into the HVAC system. This, however, was not obvious when the machine was stationary and the HVAC system appeared to function normally. Furthermore, by preventing air from entering the intake filter and vent, it was observed that the HVAC system functioned as intended.

Figure 1. Original Fresh Air Intake Location

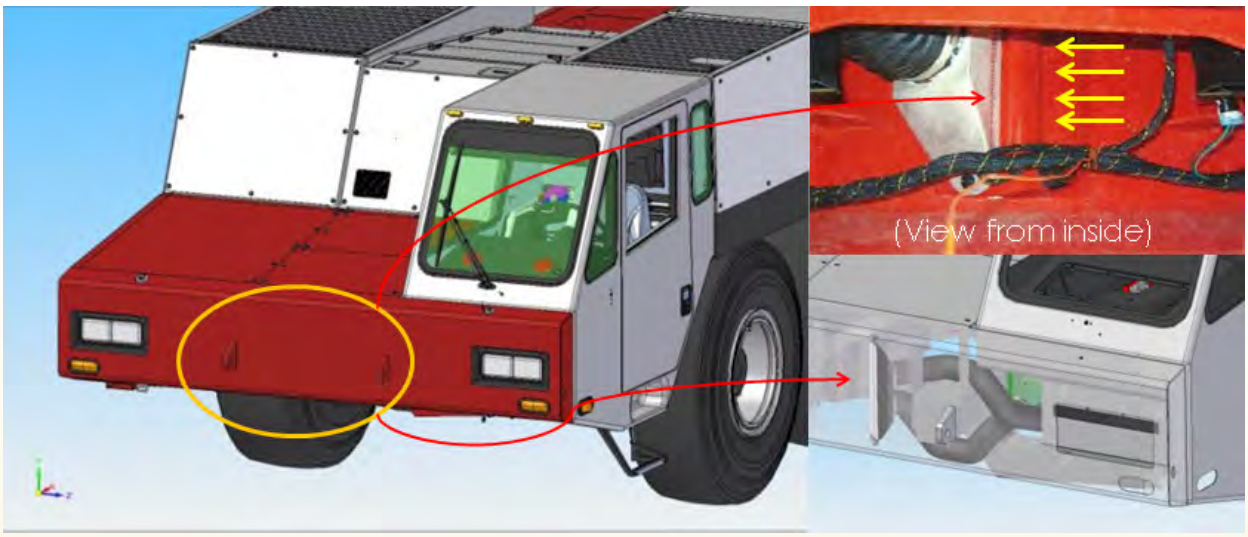


Table 1 summarizes the vent temperature data obtained from the thermocouples under four different operating conditions of the crane: 1) long road run test, 2) stationary test, 3) short road run test, and 4) short road run test (fresh air taped closed and prevented from entering the intake filter and vent). As can be seen from Table 1, the average vent temperature was approximately 135°F during the long road run test. When in stationary mode, the average vent temperature was approximately 47°F which was deemed acceptable. During the short road run test, this temperature rose to nearly 65°F with the air conditioner fully functioning. For the final trial, the intake for outside air was taped closed so that no outside air

entered the system. The road test was then repeated and the vent temperature inside the cab maintained 43°F. This proved: 1) that there is superheated ambient air that is under the hood and behind the front bumper, and 2) that the superheated ambient air was being introduced into the HVAC system causing inadequate cooling on warm/hot days.

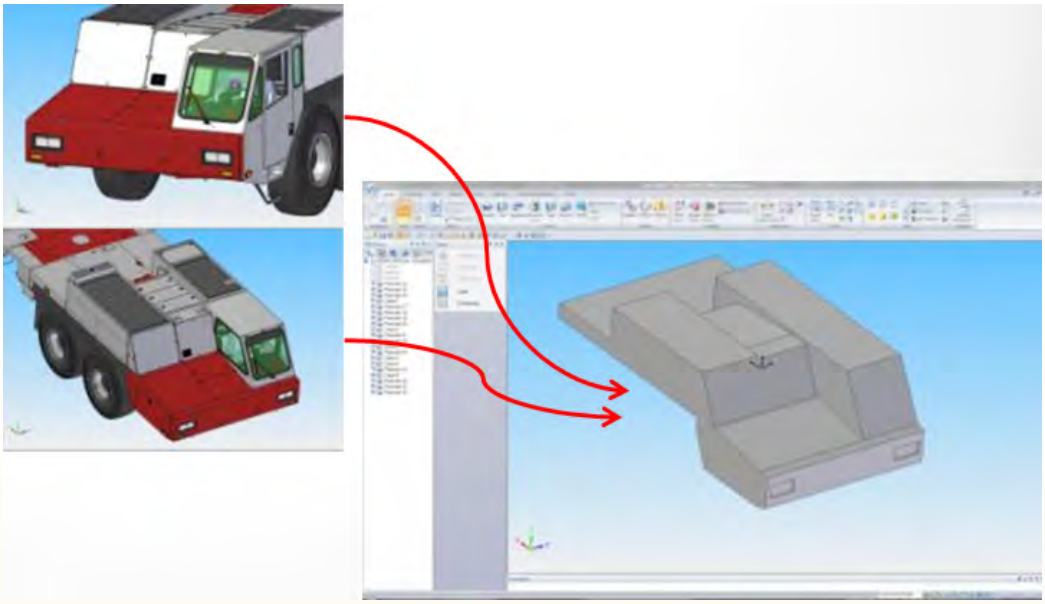
Table 1. Test Data Summary

Crane operating condition	Average Dash Vent Temperature (°F)
Long road run test	135°F
Stationary mode	47°F
Short road run test	65°F
Short road run test (fresh air taped closed and prevented from entering the intake filter and vent)	43°F

3D CAD Modeling

Once the initial testing was completed, a three dimensional (3D) CAD model of the front end of the crane was created in order to perform the CFD analysis. The first and most lengthy part of this task was to assemble a complete 3D model assembly of the complete front end of the carrier portion of the crane. Numerous complex and detailed sub-assemblies were combined to produce this model (See Figure 2).

Figure 2. 3D CAD Model of the Front End of the Crane

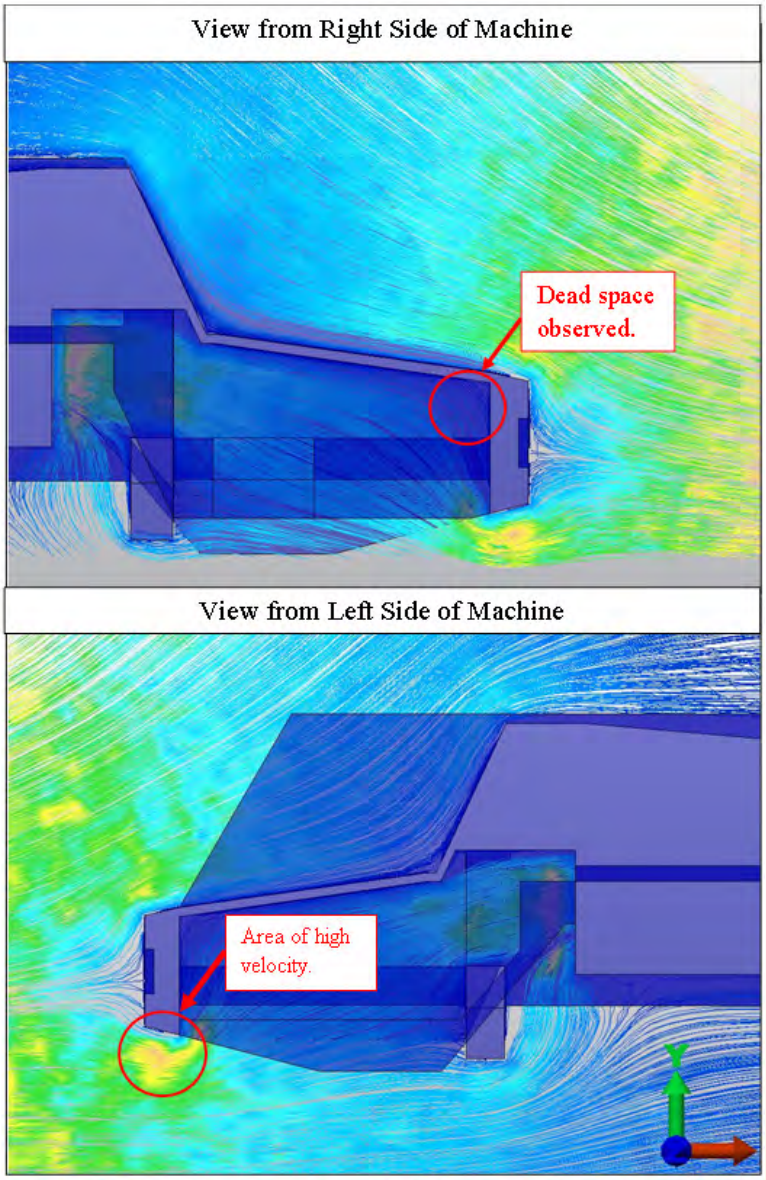


Upon completion of the highly detailed assembly model, a simplified 3D model was required, in order to perform the CFD analysis. Due to the complex geometries of the crane and its sub-assemblies, the full model could not be utilized during the CFD analysis. This would have required intense computational resources and time, which wasn't feasible. Thus, a simplified "box" representation was constructed to represent the complete front end of the crane in the 3D CAD environment. These types of models can often be referred to as Boolean solids or "dumb" solids and are the results of various solid shapes being joined (Madsen et al., 2002). As with any engineering design process, this was an iterative process. The initial Boolean solid was as simple as possible, and during subsequent revisions to the solid, the level of detail was increased to a feasible level, in order to produce more accurate CFD results. During the creation of the 3D model, trial CFD analyses were run to determine if the model was too complex to allow a result to be generated in a feasible amount of time. Thus, there were numerous iterations of this simplified 3D model creation. In the end, a sufficiently complex model was finalized for the final CFD analysis.

CFD Analysis

During the CFD analysis, the simplified 3D model was used to attempt to simulate how the air flows around the front end of the crane while it is travelling on the highway at 55 MPH. Due to extreme complexities in the 3D model creation phase of the project, there were multiple iterations of the CFD analysis. During this process of continually refining the 3D model, each subsequent CFD analysis provided additional insight as to how the air was moving around the front end of the crane. Once the model was deemed sufficient, the final analyses were composed and then studied in order to determine the most suitable placement for the relocated fresh air intake. The CFD analysis was performed using Autodesk Simulation Multiphysics 2012 software, and appropriate renderings were created to display the results of the study (see Figure 3).

Figure 3. Airflow Result Diagrams Showing Existence of Dead Space and Area of High Velocity



After the airflow result diagrams were created, they were analyzed to determine proper design and placement of the new fresh air intake. Design analysis is basically viewed as development and evaluation of a proposed design by utilizing objective thinking (Earle, 2000). While analyzing the results, there were several factors to be kept in mind: serviceability, accessibility, robustness and system simplification. As can be seen in Figure 3 the airflow increases significantly around the periphery of the front bumper. When the air enters under the front hood of the vehicle, it can be seen that there exists a dead space (dark blue area) with little or no airflow. It was this dead space that allowed the stagnant portion of the under-hood air to be superheated and ultimately introduced into the HVAC system of the vehicle. The airspace directly under the

front bumper was observed to have a relatively high airflow (yellow colored area) and would ultimately allow ambient air to be introduced into the system as intended.

Component Relocation and Implementation

Following the CFD analysis, four different alternative locations were explored for the fresh air intake. They are listed below:

Location A – In front of cabin and on left side of the bumper.

Location B – On the top surface of the front sheet metal and hood area, centrally located.

Location C – On the front, center surface of the bumper. This location provides ram-air intake which uses the dynamic air pressure created by the vehicle motion.

Location D – On the bottom, sloped face of the bumper, centered with the HVAC components. This location provides some degree of ram air intake.

Multiple markups of existing CAD assemblies for the HVAC system were created, in addition to hand generated sketches. These markups and sketches attempt to convey the different possibilities that are available for the relocation of the air intake. Sketches are often used in place of complete mechanical drawings, especially when quick changes are desired (Spencer & Dygdon, 1968). In addition to sketches and markups, there were 3D CAD layouts generated showing the possible placements of the air intake. A concept evaluation was performed on each of the four potential locations in order to compare them with each other. Table 2 shows the results of the component relocation concept evaluation. There were 10 criteria used and each criterion was evaluated on a scale from -5 to +5, with -5 being the least desirable, and +5 being the most desirable. A score of zero indicated a neutral score and thus did not have a large impact on the scores. The most feasible and low cost solution (suitable location for the air intake) was chosen to implement. As can be seen from Table 2, *Location D* received the highest total score and thus, it was the logical choice for final implementation.

Table 2. Component Relocation Concept Evaluation

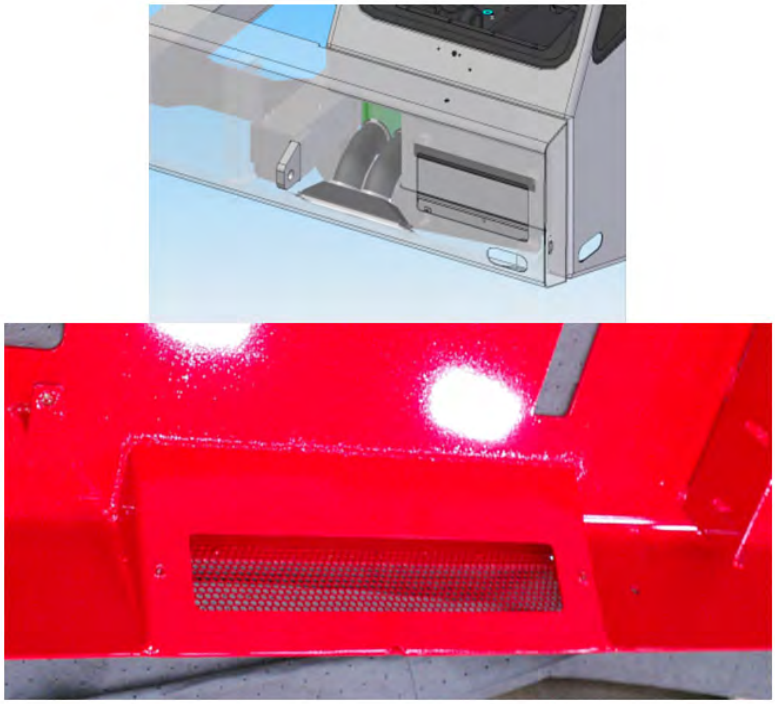
Scoring: -5 - Least Desirable, 0 - Neutral, +5 - Most Desirable

Criteria	Location A	Location B	Location C	Location D
Airflow received	4	3	5	5
Components requiring modification	1	-1	4	4
New components required	0	-1	0	0
Intake filter service access	-3	4	4	4
Component interference	-5	0	0	0
Water accumulation/drainage	5	-5	3	4
Safety issues	0	-5	0	0
Machine logo/signage interference	0	0	-5	0
Cost reduction	0	-5	0	0
Weight reduction	0	-5	-4	0
Total Score	2	-15	7	17

After the new location of the air intake was agreed upon, then the task of redesigning the components of the air intake system began. This phase of the project was one of the more tedious tasks due to the fact that the location chosen will impact multiple assembly groups, sub-assemblies, weldments and sub-weldments. During the creation of the new parts for the air intake, they constantly had to be checked and verified for form, fit and function as well as preventing interference with components that are to be located nearby. The entire process involved the following: 1) the location of the air intake, 2) the re-routing of the air intake lines that lead to the heater/evaporator core for the HVAC system, 3) revision to the sub-weldments affected by the relocation, 4) revisions to the higher level assemblies that call for the sub-weldments and piece parts, 5) proper Engineering Order (EO) documentation was generated to allow the changes to be implemented into the production system.

Figure 4 below shows the new design of the air intake system. The intake mounting and debris screen are located on the bottom sloped surface of the front bumper (*Location D*). As the CFD analysis shows, this was the optimal location to allow semi-ram air to be introduced into the system, without drawing superheated air from the inside of the engine compartment.

Figure 4. New Design of the Air Intake System.



Conclusions & Recommendations

The most important conclusion about the design studies conducted in this paper was simply that the fresh air intake could not remain in place where it originally resided, as it was non-functional. According to Earle (2000), the function is the most important characteristic of a design due to the fact that a product that functions improperly is viewed as a failure regardless of other features. Since the intake had to be moved, the only question was: Where does it go? From the CFD analysis, it was observed that if the intake were to draw its fresh air from anywhere around the periphery of the front bumper, that it would make a major improvement. It was seen that there was a slight dead or low flow area where the existing system was drawing the fresh air. By moving to an area of high flow, there was a significantly lesser chance of introducing superheated air into the HVAC system. It was recommended that the air intake vent be relocated as shown in Figure 4 and the new engineering drawings were produced. This location yields several improvements over the initial design, the greatest of which is the introduction of ambient air, and not superheated air from the inside of the engine compartment into the HVAC system. The new location also maintains easy serviceability and accessibility, while maintaining components that are robust enough to withstand the rigors of day to day operation of a mobile truck crane. Subsequent tests have verified that the new intake location allows the HVAC system to function as intended. During these tests it was noted that the system exceeds expectations (the driver had to adjust the air conditioning temperature control to a warmer temperature to remain comfortable).

References

Anderson, J. J., Degroote, J., Degrez, G., Dick, E., Grundmann, R., and Vierendeels, J. (2009). *Computational Fluid Dynamics: An Introduction* (3rd ed.). (J. F. Wendt, Ed.) Berlin, Germany: Springer-Verlag.

Earle, J. E. (2000). *Graphics for Engineers* (5th ed.). Upper Saddle River, NJ, Unites States: Prentice Hall.

Farouki, R. T. (1999). Closing the gap between CAD model and downstream application (report on the SIAM Workshop on Integration of CAD and CFD, UC Davis, April 12-13, 1999), *SIAM NEWS*, 32 (5), 1-3.

Kellar, W. P., Savill, A.M., and Dawes, W.N. (1999). Integrated CAD/CFD visualisation of a generic formula 1 car front wheel flowfield. *Lecture Notes in Computer Science*, 1593, 90-98.

Li, H. F., Tu, J.Y., Subic, A., and Abu-Hijleh, B. (2007). The leakage analysis in a twin-screw supercharger by using an integrated CAD/CFD three-dimensional model. *Proceedings of International Conference on Computational Methods*, Singapore, 26 May 2007.

Madsen, D. A., Folkestad, J., Schertz, K. A., Shumaker, T. M., Stark, C., and Turpin, J. L. (2002). *Engineering Drawing & Design* (3rd ed.). Albany, NY, United States: Delmar.

Spencer, H. C., and Dygdon, J. T. (1968). *Basic Technical Drawing* (Second Revised ed.). New York, New York: The Macmillan Company.

Watson, C. (2012). Integrating CFD into Mechanical Design. Retrieved July 15, 2012 from the World Wide Web: http://www.ien.com/article/integrating-cfd-into/113847

Management

Management

Perceptions and Rankings of Technology Management Competencies

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Introduction

According to Thamhain (2005) the "Management of technology is the art and science of creating value by using technology together with other resources of an organization" (p. 6). A technology manager should have some minimum level of *technical knowledge*, *applied abilities* in systems design, application, products or processes, and *skills* in one or more contextual areas (ITEA, 2000/2002). Technology managers must have certain competencies that are agreed-upon or measurable, preferably both. At the university level, technology management programs are distinctly different from engineering or engineering technology programs (i.e., mechanical, electrical, civil, etc.). A required management curriculum is what distinguishes ATMAE accredited four-year programs from two-year programs (ATMAE, 2009, para. 6). Minty (2003) asserted that historical comparisons of the technological and managerial perspectives are closely aligned.

In order for technology management programs to succeed, they must produce graduates who possess the requisite knowledge, abilities, and skills. What are the competencies of a technology manager and what does an entry-level technology leader need to know? The *ATMAE Accreditation Handbook* (2009) lists content areas such as quality, finance, accounting, safety, legal, project management, and other courses consistent with the definition of industrial technology. Of these, what are the most important competencies of technology management? Are there others? Without a recognized and accepted body of knowledge for technology management, the discipline of industrial technology, applied technology, and applied engineering will continue to be confused with other technical disciplines. Clarity regarding the required competencies for an entry-level technology manager is imperative. The critical competencies within a body of knowledge should be congruent with ATMAE accreditation standards and the Certified Technology Manager exam. In order for technology management programs to be relevant, their competencies should be recognized and agreed-upon.

In 2010, the ATMAE Management Division set out to define an applicable technology management body of knowledge using a collection of core competencies. The research incorporated existing models, industry opinions, and educator experts. ATMAE members at both the 2010 and 2011 conferences reviewed initial versions of the competency model. In addition, the model was benchmarked against existing literature and research. The researchers found consistency within the initial versions of the competency model. Interested scholars may find the initial model and supporting rationale in the 2011 ATMAE conference proceedings. This paper presents additional supporting data regarding the validity of the ATMAE Technology Management Competency Model and its revisions based on recent ATMAE member feedback.

Research on Technology Management Competencies

The need for a body of knowledge for technical-professional competencies is well documented, particularly with the advent of outcomes-based accreditation and industry's desire for certified employees (SME, ASQ, APICS, PMI, etc.). Teodorescu (2004) defined competencies as successful observable behaviors that enable both positive processes and results. Meier, Williams, and Humphreys (1997) and Meier and Brown (2008) summarized the competencies essential for the success of new employees. Calhoun (2008) created the Health Leadership Competency Model that identified outcomes, appropriate behaviors, and core technical-managerial competencies. Rifkin, Fineman, and Ruhnke (1999) developed a competency model containing a hierarchical framework of the technical manager's role, critical accomplishments, work activities, skills, knowledge and personal attributes. Other published literature regarding management competencies includes

manufacturing and industrial management (Barber, 2000; Earshen, 1995; Ferguson, 1991), general management (Abraham, Karns, Shaw, & Mena, 2001; Ferketich, 1998; Kaufman, 1994; Maes, Weldy, & Icenogle, 1997; Martell, & Carroll, 1994), safety (Blair, 1997), project management (Golob, 2002), retail management (Keech, 1998), and sports administration (Kuo, 1998).

Increasingly, competencies are the basis for determining if programs are offering appropriate content and if students are meeting the competency criteria. ABET accreditation is based on students acquiring specific competencies as measured by student outcomes (ABET.org). Since 2009, ATMAE has encouraged the use of outcomes-based assessment for program accreditation. In 2013, outcomes-based assessment will be required for all programs seeking ATMAE accreditation. The development of a common body of knowledge for technology management competencies provides rationale for a common management core that distinguishes ATMAE accredited four-year programs and gives graduate degrees focus. Thus, a conceptual model is useful when attempting to describe the common elements.

Methodology

The purpose of this research was to validate a core body of knowledge using competencies as the basis for a technology management model. To accomplish the purpose, the following question was of relevance. What are the important core competencies for an entry-level technology manager?

This research sought to validate or refute the previously developed technology management competency model. The survey asked respondents to rank the importance of the competencies in various technology management thematic areas. The survey population was approximately 700 ATMAE members invited to participate using the professional member listserve. The ATMAE listserve consists of all ATMAE members who can send and receive email in order to share and gather information on current developments in the field of technology, technology management, and applied engineering.

In February 2012, the links to the survey were sent and were available for approximately four weeks. After week 1 and week 2, a follow-up email reminder was sent. Qualtrics, a third party survey software provider, automatically collected 93 anonymous responses. At the end of the survey period, 66 surveys were fully completed and validated (9-13% response rate). In April 2012, faculty and industry professionals from engineering, engineering technology, technology, operations management, and advisory boards outside of ATMAE were invited to participate. Additional responses were collected until May 2012 resulting in 124 total responses, of which 75 were fully completed surveys.

Survey participants were first given a glossary of terms relevant to the survey based on the previously developed Technology Management Competency Model and asked a series of questions regarding the applied and managerial contexts of technology management. This was followed by questions that asked participants to check the competencies applicable in each managerial context. The glossary of terms follows:

Technology Management Applied Contexts
Operations-Management of technology within a specific industrial specialty.
Systems-Management of technology across disciplines and companies in an integrated fashion for the purpose of business venture and development.
Project-The one-time application of a process to produce a unique product or service.
Process- The transformation of input elements into output elements with specific properties, within defined parameters or constraints.

Technology Management Managerial Contexts
Quality Management- The use of quality assurance and control of processes and products to achieve consistent and predictable quality.
Risk Management- The identification, assessment, and prioritization of risk followed by coordinated and economical application of resources to minimize, monitor, and control their probability and/or impact.
Self-Management- Methods, skills, and strategies by which individuals can effectively direct their own activities toward the achievement of goals and objectives.
People Management- The deployment and handling of human resources to work together to accomplish desired goals and objectives using available resources efficiently and effectively.

Findings

The survey responses and findings follow. The responses among the participating groups (ATMAE, non-ATMAE, industry advisory groups, etc.) were not significantly different and did not change the results.

Question 1. Participants were asked to select relevant applied contexts of technology management and could check all that applied. The purpose of this question was to validate the top level of the Technology Management Competency Model as shown in Figure 10. A total of 99 individuals responded to the question. See Figure 1. Eighty-four percent of the respondents checked systems and projects while 83% checked processes and operations.

Question 2. Participants were asked to select the relevant management contexts that are applied to processes. Once again, the respondents could check all that applied. The purpose of this question was to determine if technology management in the areas of quality management, risk management, people management, and self-management is applicable to processes. Seventy-seven individuals responded to the question. See Figure 2. Ninety-nine percent of the respondents checked quality management and 81% checked people management. Seventy-three percent checked risk management while 55% checked self-management.

Figure 1. Applied contexts of technology management

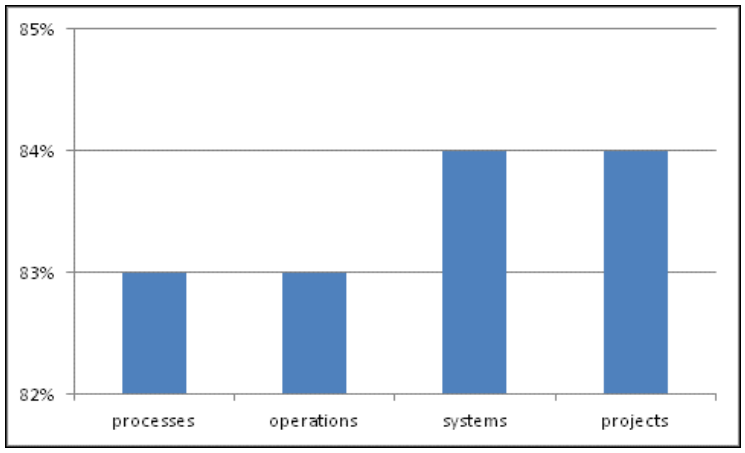
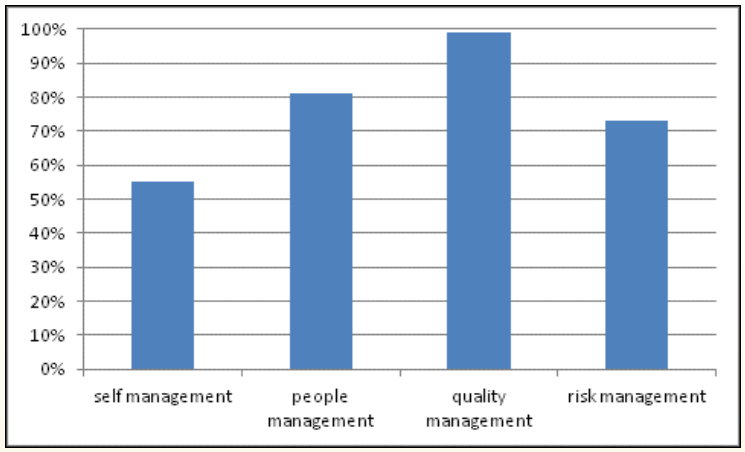
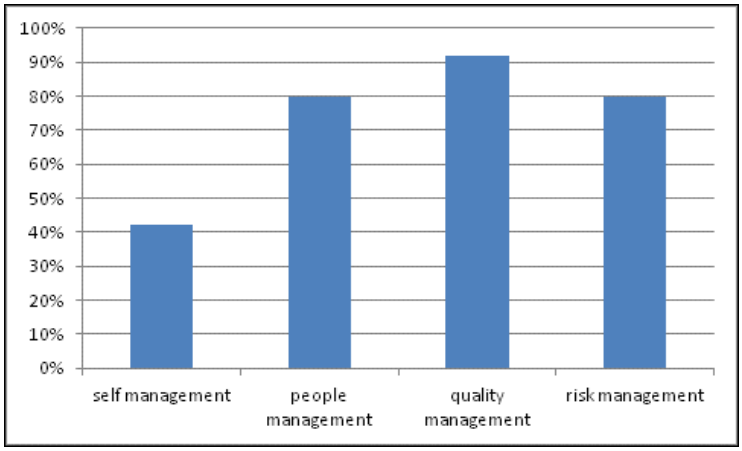


Figure 2. The applicability of specific technology management contexts to processes.



Question 3. Participants were asked to select the relevant management contexts applicable to systems and could check all that applied. The purpose of this question was to determine if technology management in the previously mentioned areas of quality, risk, people, and self is applicable to systems. Seventy-six individuals responded to the question. See Figure 3. Ninety-two percent of the respondents checked quality management and 80% checked people and risk management. Forty-two percent checked self-management.

Figure 3. The applicability of specific technology management contexts to systems.



Question 4. Participants were asked to select the relevant management contexts applied to operations as above. The purpose of this question was to determine if technology management in quality, risk, people, and self is applicable to operations. Seventy-five individuals responded to the question. See Figure 4. Ninety-two percent of the respondents checked people and quality. Seventy-seven percent checked risk management. Fifty-nine percent checked self-management.

Question 5. Participants were asked to select the relevant management contexts applied to projects. The purpose of this question was to determine if technology management is applicable to projects. Seventy-six individuals responded to the question. See Figure 5. Eighty-nine percent checked people and 88% checked quality. Seventy-six percent checked self-management and 71% checked risk management.

Figure 4. The applicability of specific technology management contexts to operations.

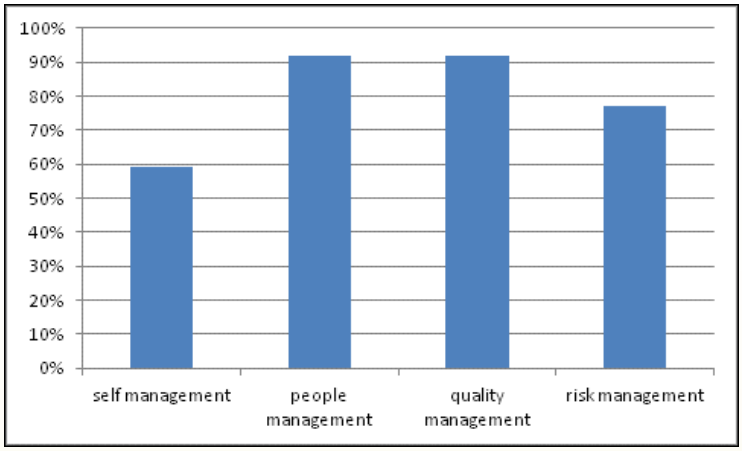
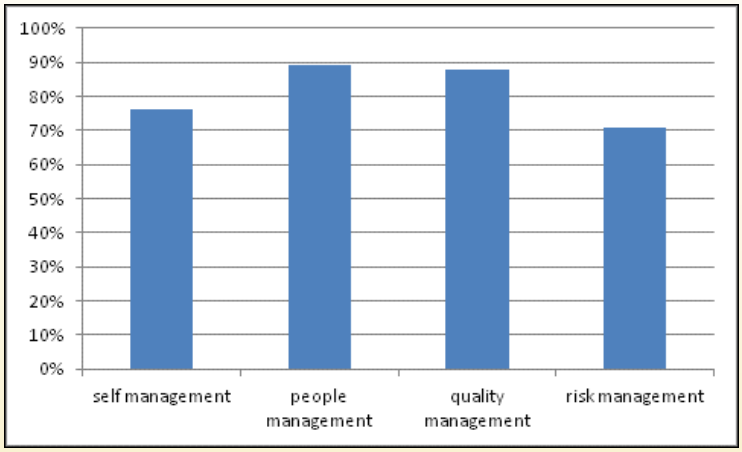


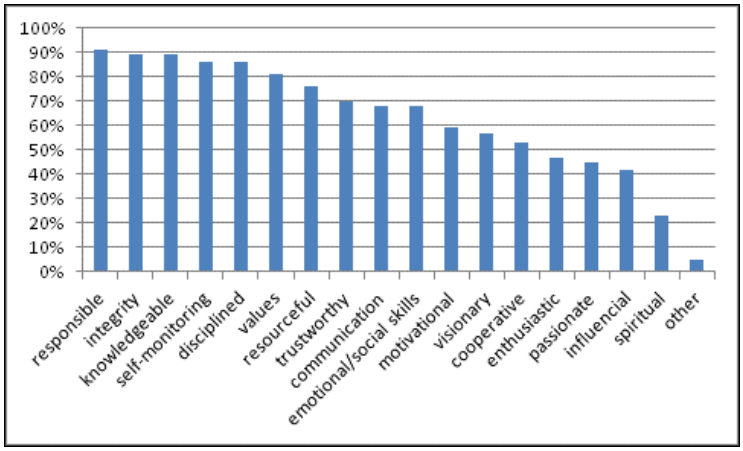
Figure 5. The applicability of specific technology management contexts to projects.



Respondents were given the opportunity to select applicable entry-level technology management competencies in each of the management contextual areas (i.e., quality, risk, people, and self). The competency lists were taken from the previously published literature used to develop the initial Technology Management Competency Model. Each contextual management area listed between 16-19 generic competencies and included a field labeled other, where respondents could add additional competencies. The purpose of these questions was to validate or refute the published competencies and determine which were the most important. In addition, thematic areas could begin to be identified. For self-management, people management, quality management, and risk management, the number of responses was 74, 72, 71, and 71, respectively.

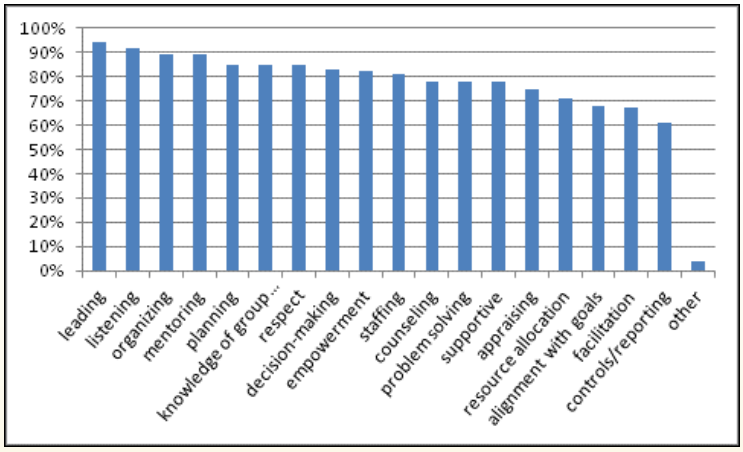
Question 6. Participants were asked to select the competencies applicable to self-management. In Figure 6, the percentage of responses is sorted from highest to lowest. Five percent of respondents added these additional competencies: Innovative, ethical, monitoring quality or the ability to discern quality, family, company, and society.

Figure 6. Applicable self-management competencies sorted by percentage of responses.



Question 7. Participants were asked to select the competencies applicable to people management. The sorted percentage of responses is shown in Figure 7. Four percent of respondents added the following competencies: Open communications, training and development, and their personal needs, company, and society.

Figure 7. Applicable people management competencies sorted by percentage response.



Question 8. Participants were asked to select the competencies applicable to quality management. The sorted percentage of responses is shown in Figure 8. Four percent of respondents added the following competencies: teaming, benchmarking, communication, documentation/ISO 9000, compensation systems, ethics, tools of Ishikawa in addition to SPC, assessment, etc. - TQM is more than control or assurance, innovation, finance, environment, and responsibility.

Question 9. Participants were asked to select the competencies applicable to risk management. The sorted percentage is shown in Figure 9. Three percent of respondents added that all the above apply, but some more important than others, such as people, society, and environment.

Figure 8. Applicable quality management competencies sorted by percentage response.

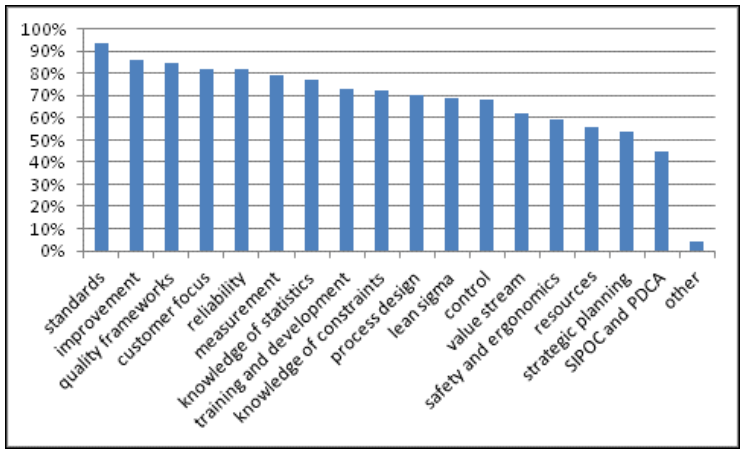
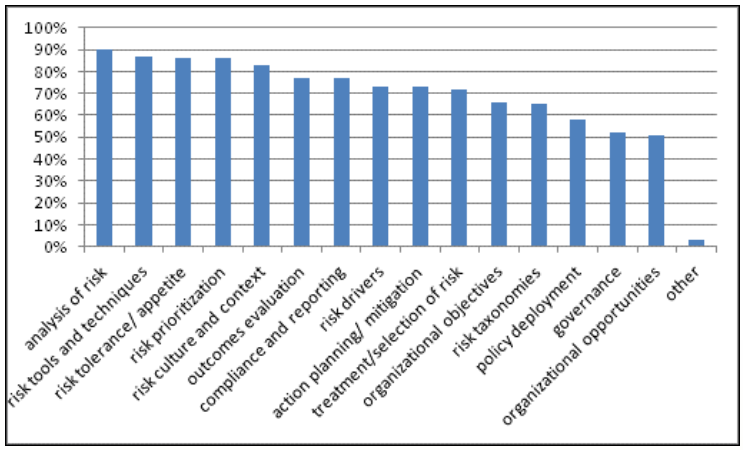


Figure 9. Applicable risk management competencies sorted by percentage response.



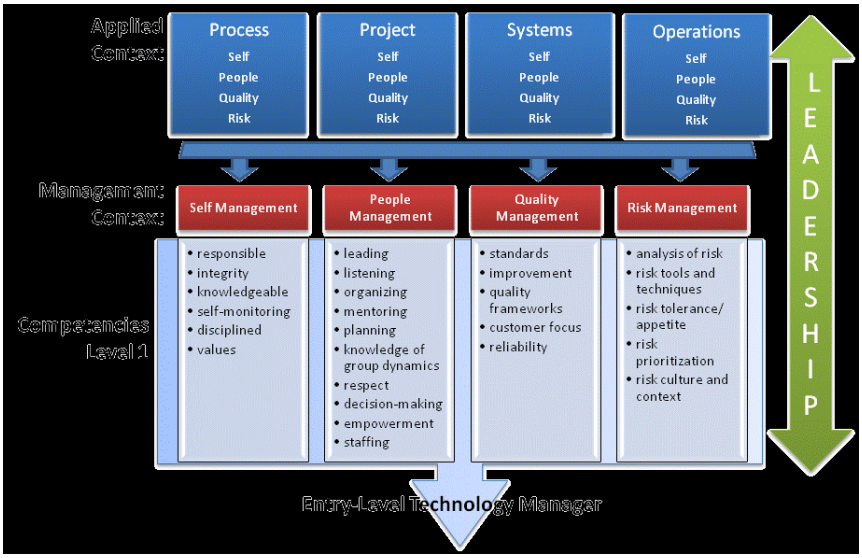
The Technology Management Competency Model

The Technology Management Competency model shown in Figure 10 shows the generic entry-level competencies for a technology manager within a category of knowledge for a specific managerial context. The competencies are applicable to systems, operations, processes, and projects and linked throughout by accepted leadership principles. The operational definitions of these competencies were provided in the Methodology section of the paper. The findings indicate that the Technology Management Competency Model has a degree of validity, particularly with regard to the applied contexts of process, project, systems, and operations. Respondents overwhelmingly agreed on these applied contexts. In terms of the quality, people, risk, and self-management contexts, a majority of the respondents agreed that they apply to process, project, systems, and operations. The only exception was the applicability of self-management to systems (defined as the management of technology across disciplines and companies in an integrated fashion for the purpose of business venture and development). However, over two-fifths of the respondents perceived a degree of applicability. Thus, the applied and management contexts of the model appear to have merit and a degree of support from the academic and industrial communities. The researchers found that the relevance of competencies varied by respondents. Because of the variance of responses to the competencies, they were stratified into three levels.

In terms of the competencies, the greatest response variation (23%-91%) was in regards to the self-management context. The least amount of variation was in response to people management with responses ranging from 61% to 94% on all competencies. All competencies for risk management had greater than 50% response. For quality management, only one

competency received less than 50% response - suppliers, inputs, process, outputs, and customers (SIPOC) and plan, do, check, act (PDCA). Any competency receiving less than 50% response was deleted. The competencies were then stratified by the level of response rather than by the original generic themes. This stacked ranking keeps the important the competencies at the forefront for outcomes assessment and reinforces the critical entry-level knowledge, skills, and abilities of technology managers. The competencies are purposely broad to allow for flexibility, interpretation, and justification for the use of popular synonyms.

Figure 10. Technology Management Competency Model with level 1 competencies shown



To illustrate, the entire competencies for quality management are shown in Table 1. Competencies receiving greater than 80% response were categorized level one (1). Competencies receiving between 60-80% were designated level two (2) and competencies greater than 50%, but less than 70% were labeled level three (3). The stratified tables for risk, people, and self-management are shown in Tables 2, 3, and 4, respectively.

Table 1. Quality Management Competencies

Level	Competency
1	standards improvement quality frameworks customer focus reliability
2	measurement knowledge of statistics training and development knowledge of constraints process design
3	lean sigma control value stream safety and ergonomics resources strategic planning

Table 2. Risk Management Competencies

Level	Competency
1	analysis of risk risk tools and techniques risk tolerance/ appetite risk prioritization risk culture and context
2	outcomes evaluation compliance and reporting risk drivers action planning/ mitigation treatment/selection of risk
3	organizational objectives risk taxonomies policy deployment governance organizational opportunities

Table 3. People Management Competencies

Level	Competency
1	leading listening organizing mentoring planning knowledge of group dynamics respect decision-making empowerment staffing
2	counseling problem solving supportive appraising resource allocation
3	alignment with goals facilitation controls/reporting

Table 4. Self-Management Competencies

Level	Competency
1	responsible integrity knowledgeable self-monitoring disciplined values
2	resourceful trustworthy
3	communication emotional/social skills motivational visionary cooperative

GAPS: Competancies, Outcomes, Assessments, Standards and Certification

ATMAE sets standards for academic program accreditation, professional certification, and development for educators and industry professionals involved in technology, leadership, and systems design (ATMAE, 2011). The development of a common and recognized body of knowledge starts with an understanding of the technology management entry-level competencies. The operational effectiveness of accredited technology programs depends on identifying outcomes,

competencies, and measures. The lack of an agreed-upon technology management competencies results in confusion and a further weakening of the discipline. Without a recognized and accepted body of knowledge for technology management, the discipline of industrial technology, engineering technology, and applied engineering will continue to be confused with other technical disciplines. Clarity regarding the competencies is imperative.

Next Steps

The ATMAE accreditation standards and the Certified Technology Manager (CTM) exam should recognize and incorporate these competencies. ATMAE membership and industry advisory boards should ratify and adopt these technology management competencies. In particular, the Management Division of ATMAE must take a lead role in its adoption. With an agreed upon and certified body of knowledge, educational learning outcomes that are congruent with industry needs and revised accreditation standards for technology management will result. The next steps are to submit the model for a vote of the ATMAE membership and align with certification/ accreditation standards.

References

Abraham, S. E., Karns, L. A., Shaw, K., & Mena, M. A. (2001) Managerial competencies and the managerial performance appraisal process, *Journal of Management Development, 20*(10), 842 - 852

Accreditation Board for Engineering and Technology (ABET). (2011). Accreditation criteria, policies and procedures**.** http://abet.org/accreditation-criteria-policies-documents/

Association of Technology, Management, and Applied Engineering (ATMAE) (2009) by Wright, Jr., J. R. on behalf of the 2008-2009 ATMAE Executive Board. http://atmae.org/Venn/ATMAEVennDefinitions.pdf

Association of Technology, Management, and Applied Engineering (ATMAE) (2009) *Accreditation handbook*. Ann Arbor, MI: ATMAE

Association of Technology, Management, and Applied Engineering (ATMAE) (2011) *Outcomes assessment accreditation handbook*. Ann Arbor, MI: ATMAE

Barber, C. S. (2000). Current and future managerial competency requirements for manufacturing, assembly, and/or material processing functions. (Doctoral dissertation, University of Southern California) Digital Dissertations AT3017986.

Blair, E. H. (1997). Occupational safety management competencies as perceived by certified safety professionals and safety educators. (Doctoral dissertation, University of Kentucky. 1997). Dissertation Abstract International, 58/06, 2092.

Calhoun, J.G. (2008). Development of an interprofessional competency model for healthcare leadership. *Journal of Healthcare Management 53*(6), 375-390.

Earshen, J. J. (1995). Analysis of trends and influences affecting programs preparing industrial managers as offered at US colleges and industries with implications for baccalaureate industrial technology programs. (Doctoral dissertation, State University of New York at Buffalo. 1995). Dissertation Abstract International, 56/04, 1228.

Ferguson, G. (1991). Developing a curriculum for IE graduates of today and tomorrow. *Industrial Engineering, 23*(11) 46-50.

Ferketich, M. L. (1998). Managerial skill preparation in MBA programs for the 21st century: A critical evaluation. (Doctoral dissertation, University of Southern California, 1998) UMI Microform, 9902796.

Golob, M. P. (2002). Implementing project management competencies in the workplace. (Doctoral dissertation, Capella University). Dissertation Abstracts International, 63/02, 661.

International Technology Education Association (ITEA) (2006). *Technological literacy for all: A rational and structure for the study of technology*. Reston, VA: Technology for all Americans project, funded by the National Science Foundation and National Aeronautics and Space Administration.

International Technology Education Association (ITEA) (2000/2002). *Standards for technological literacy. Content for the study of technology*. Reston, VA: Technology for all Americans project, funded by the National Science Foundation and National Aeronautics and Space Administration.

Kaufman, B. E. (1994). What companies want from HR graduates. *HRMagazine, 39*(9) 84-86.

Keech, K. M. (1998). Industry-based competencies for entry-level retail management positions: A national Delphi study. (Doctoral dissertation, Texas Tech University, 1998) UMI Microform, 9841975.

Kuo, S. F. (1998). Perceived necessary leaders' competencies or skills in the fields of sport administration, higher education and business in Taiwan. (Doctoral dissertation, University of New Mexico, 1998) UMI Microform, 9839212.

Maes, J. D., Weldy, T. G., & Icenogle, M. L. (1997). A managerial perspective: Oral communication competency is most important for business students in the workplace. *The Journal of Business Communication. 34*(1) 67-80.

Martell, K. & Carroll, S. (1994), Stress the functional skills when hiring top managers. *HR Magazine, 39*(7), 85-87.

Meier, R. L., Williams, M. R., & Humphreys, M.A. (1997). *Year one report on curriculum, instructional materials, and faculty enhancement for advanced technology education initiatives focusing on competency gaps in engineering and technological education*. Washington DC: National Science Foundation (Grant #9752083), pp. 19-21.

Meier, R. L., & Brown, D. (2008). An exploratory study to identify a common managerial/professional core curriculum for NAIT baccalaureate programs. *Journal of Industrial Technology, 24*(2): http://atmae.org/jit/Articles/meier050908.pdf

Meier, R. L., Williams, M. R., & Humphreys, M.A. (1997). *Year one report on curriculum, instructional materials, and faculty enhancement for advanced technology education initiatives focusing on competency gaps in engineering and technological education*. Washington DC: National Science Foundation (Grant #9752083), 19-21.

Minty, G. (2003). The future history of industrial technology. *Journal of Industrial Technology, 20* (1), http://atmae.org/jit/Articles/minty102903.pdf

Rifkin, K. I., Fineman, M., & Ruhnke, C. H. (1999). Developing technical managers – First you need a competency model. *Research Technology Management, 42*(2), 53-57.

Teodorescu, T. M. (2004). Competence is what matters. *Performance Improvement 43*(8), 8-12.

Thamhain, H. J. (2005). *Management of technology: Managing effectively in technology-intensive organizations*. Hoboken, NJ: John Wiley & Sons.

Management

Using Modularity and Cross-Enterprise Technology in Large Organizations to Achieve Cost Savings and Improved Performance through Innovative System Integration

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Abstract
Through this paper the audience will gain insight into achieving innovation within large organizations. Large organizations are in some respects the most fertile ground for innovation having vast and diverse resources to leverage. In other respects large organizations, especially older ones, have entrenched methods of operation that strongly resist innovation. A case study using open system architectures and existing technologies to demonstrate communication capability on the United States Air Force B-2 Spirit Stealth Bomber is presented. Management principles for achieving innovation within large organizations are explored through context of this case study and technology management theory.

Introduction
A case study exploring technology management principles for implementing innovation within large enterprise was conducted. Modular open systems were used to quickly demonstrate capability for potential interim use, discovery and to energize innovation in large enterprise. Management principles for achieving innovation within large organizations were explored through context of this case study supported by technology management theory.

Modular Communications Case Study
A communications system was demonstrated on the United States Air Force B-2 Spirit Stealth Bomber by applying modular design theory (Baldwin & Clark 2000) using a non-integrated open avionics subsystem concept called the Avionics Plug and Play, or AP2.

Illustration 1: B-2 Spirit Stealth Bomber and Avionics Plug and Play (AP2) Concept Equipment Rack

The AP2 concept uses open system standards and separates mission systems from B-2 flight critical systems to reduce integration time, cost and risk. External organizational partnerships and active senior executive engagement enabled using AP2 for a non-operational one-time demonstration in compliance with all applicable Department of Defense and Air Force regulations and statutes.

Origins – Strengthening Connections

A periodic planning conference identified an airborne communications system able to provide interoperable worldwide communications onboard the B-2. This system had been used in the late 1990's on the B-2 but was discontinued due to lack of antenna availability. Planning conference proceedings identified interoperable communications as a requirement with renewed importance. In response, the communication system manufacturer provided a ground demonstration of the system. The hard problem of integrating an external antenna on the low observable B-2 for flight demonstration remained.

Rapid Integration Technical Constraints

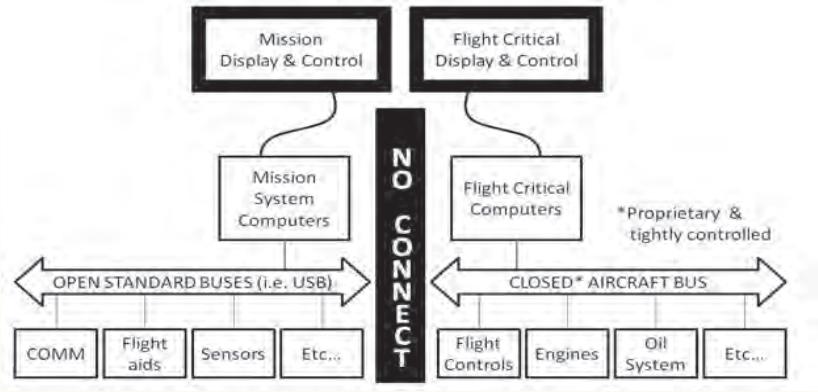
Typical enterprise processes consume a year or more of coordination before engineering development and integration work can even begin on a project. Because of the rapid nature of this integration additional technical constraints applied that favored plug and play modular design:

1. No permanent modification to B-2.
2. No connection with B-2 integrated avionics or the operational flight program (OFP).
3. No sharing or use of existing antennas.
4. No development budget. Limited travel and manning resources only.
5. Temporary B-2 modifications processing and approval in accordance with regulations.

B-2 Avionics Plug and Play

The innovation behind the Avionics Plug and Play, or AP2, concept (Illustration 1) is the open modular design foundation. AP2 consists of Microsoft Windows Blade servers, radios and other equipment that are rack-mounted in the rear of the B-2 cockpit with displays and keyboard controls at each pilot station. AP2 is completely isolated from aircraft avionics systems that are critical for flight and share only circuit breaker protected aircraft power (Figure 1). Separation enables open integration of mission systems by harnessing the power of open systems and modularity without possibility of interference.

Figure 1: AP2 Concept Separating Mission Systems From Flight Critical Systems



Theory

Four major theories are helpful in achieving technical innovation in large enterprise. Design thinking as presented by Martin (2012) supports the primary conference theme of strengthening connections for mutual benefit and innovation. Modular theory of complex adaptive systems by Baldwin and Clark (2000), *Design Rules: the Power of Modularity*, provides a foundation for AP2 non-integrated open systems design. The theory of disruptive innovation as developed by Clayton Christensen (2001) gives context to large organization challenges in overcoming standard process paradigms that require direct CEO-level engagement. Finally, the technology adoption lifecycle (Rogers 2003) and theoretical work on user resistance to new technology adoption (Kim & Kankanhalli 2009) provides insight into large enterprise innovation difficulties.

Design Thinking

Evidence suggests innovation is generated by humans and not processes. Martin (2012) asserts that large enterprise processes tend to be excellent at analytical analysis but that design also requires intuitive thinking where humans have a distinct advantage. Intuitive thinking combines many factors in non-linear and asymmetric ways to achieve more than the sum of the parts and fill in missing pieces of information based on non-definitive accumulations of understanding. These factors form an intellectual capital required to innovate (Amiri, Jandaghi & Ramezan 2011).

Modular Design Theory

Baldwin and Clark's (2000) modular design theory is a complex adaptive system design approach that creates options after initial implementation by defining design rules. As long as the design rules are followed the designers are free to apply modular operators for system adaptation. The six operators of modular design are splitting, substituting, augmenting, excluding, inverting, and porting. By application of these operators designs evolve without requiring involvement or even knowledge of the original system architect. This provides several advantages useful for system owners.

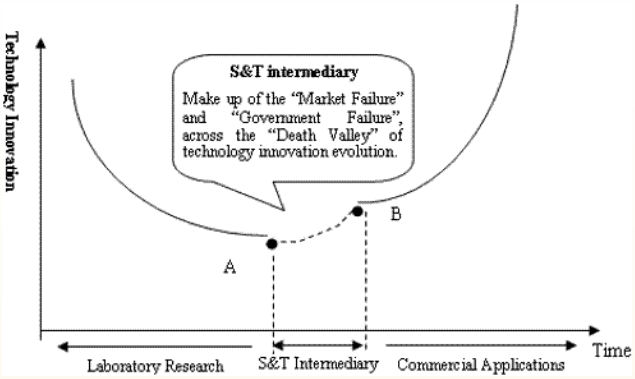
Modularity assists in managing complexity by dividing large complex systems into simpler components. Modular division also permits independent parallel work to reduce dependencies, improve development process reliability (reduce risk) and increase productivity. Possibly the most compelling advantage for technology management application is that modularity is more tolerant of uncertainty. Uncertainty in business sector markets, technology disruption, geopolitical national security needs and others can be hedged with modular system design (Baldwin 2002).

Disruptive Innovation Theory

Early innovation seldom provides revolutionary capability that provides comprehensive solutions all at once. Because of early performance weakness, disruptive innovations usually require support until performance matures and features expand to compete with established technologies. Large enterprise processes are not equipped to handle disruptive (future growth creating) innovation. Enterprise is challenged in that it attempts to innovate at the wrong level of the company. Innovation initiatives that are supported tend to focus on operations efficiency improvements and cost saving measures (Christensen 2009; Christensen 2001; Euchner 2011; Kohlbacher & Hang 2011).

Disruptive technologies have extremely valuable roles in industry despite lower initial performance and difficult transition to application (Figure 2).

Figure 2: Death Valley Of Technology Innovation Evolution (Xiaoyuan &Yanning 2011)



Several advantages encourage efforts to achieve disruptive innovation in large organizations (Christensen 2001).

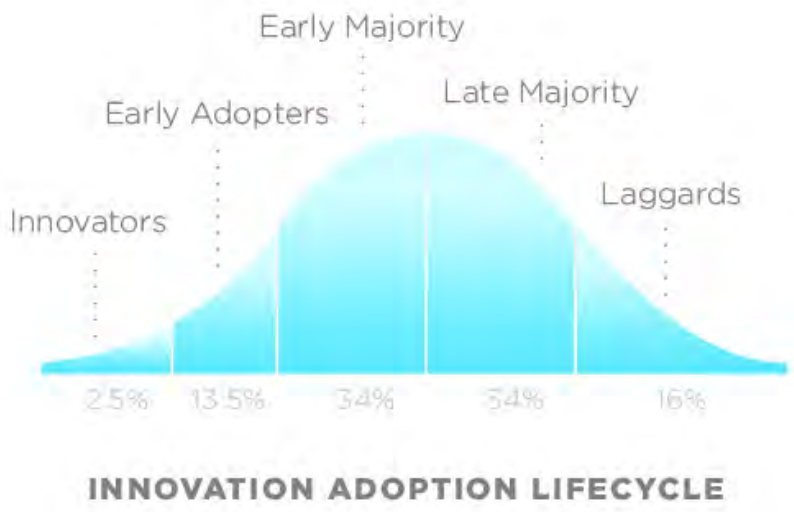
1. Create major new growth in the industries they penetrate
2. Allows less-skilled and less-affluent people to do things
3. Better, cheaper and more convenient products and services

Technology Acceptance and User Resistance

A fundamental challenge for large organization innovation is that broad support is typically required for implementation. Technology adoption theory presented by (Rogers 2003) classifies ideal innovation adopters into five categories: innovators, early adopters, early majority, late majority and laggards. Innovators, the earliest adopters, make up only 2.5% of the whole

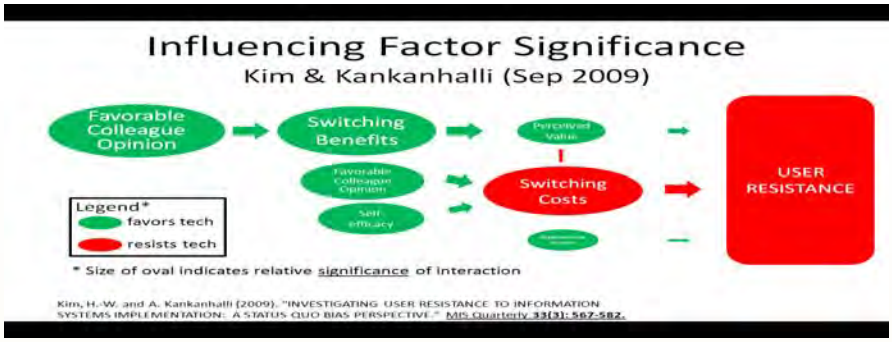
(Figure 3). Out of every 100 decision leaders and workers in a large organization, by the Rogers' model, two to three would be in support during the early 'innovators' stage. This level of support is by standard processes insufficient for adoption.

Figure 3: Innovation Adoption Lifecycle (Rogers 2003)



According to work by Kim & Kankanhalli (2009) the largest direct positive correlation to user resistance is switching costs (Figure 4). Perceived value and organizational support for an innovation cannot overcome switching costs directly. However, colleague opinion tends to reduce perceived switching costs while simultaneously increasing perceived value. In large enterprise colleague opinion strongly influences perceived value and perceived risks in decision-making logic of those with authority to approve, deny or delay innovation (Kim & Kankanhalli 2009).

Figure 4: User resistance influencing factors (Kim & Kankanhalli 2009).



Method

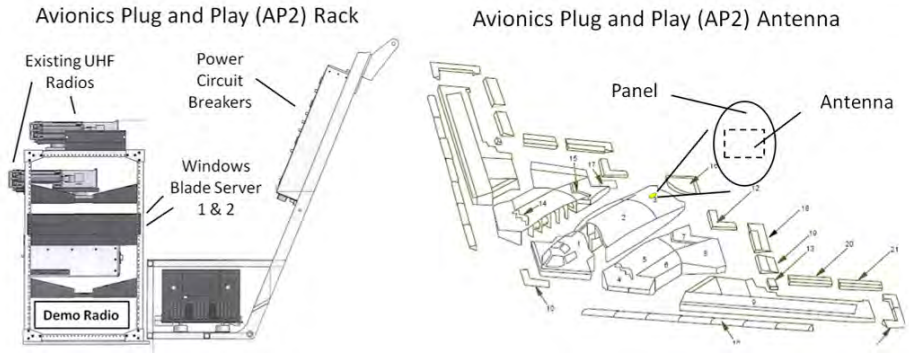
Technology management areas include technical solution, project management and enterprise engagement. Technical solution feasibility and ability for the system design to meet user needs was the first priority for successful rapid integration. Managing available resources to implement the technical solution was the second. And third was engaging the enterprise for authority to demonstrate followed by transition to operational capability for lifecycle sustainment.

Technical Solution

The primary technical challenge was determining a way to add an additional antenna to the B-2 since no existing antenna was available. An existing process for temporary installation of a test instrumentation antenna via a panel on the rear spine of the B-2 was adapted (Figure 5). By producing a compatible form factor panel with the demonstration antenna and replacing the original panel during demonstration no permanent modification to the aircraft was required. This solution was also compatible with the modular design theory (Baldwin & Clark 2000) in establishing the design rules for AP2 panel production and substitution. Installation/removal of the modular demo antenna panel followed the same procedural guidance as the original panel.

The demo radio was mounted to the bottom of the AP2 rack and provided both power and antenna inputs. A temporary wiring harness was installed from the rear cockpit area through the weapon bay and aft equipment bay to the AP2 antenna. Procedure for this installation and removal mirrored the test instrumentation procedures using the same shielded cable bundle and mounting brackets. Pilot interface and control of the demo system was provided by a carry-on stand alone laptop identical to that used in the ground demonstration.

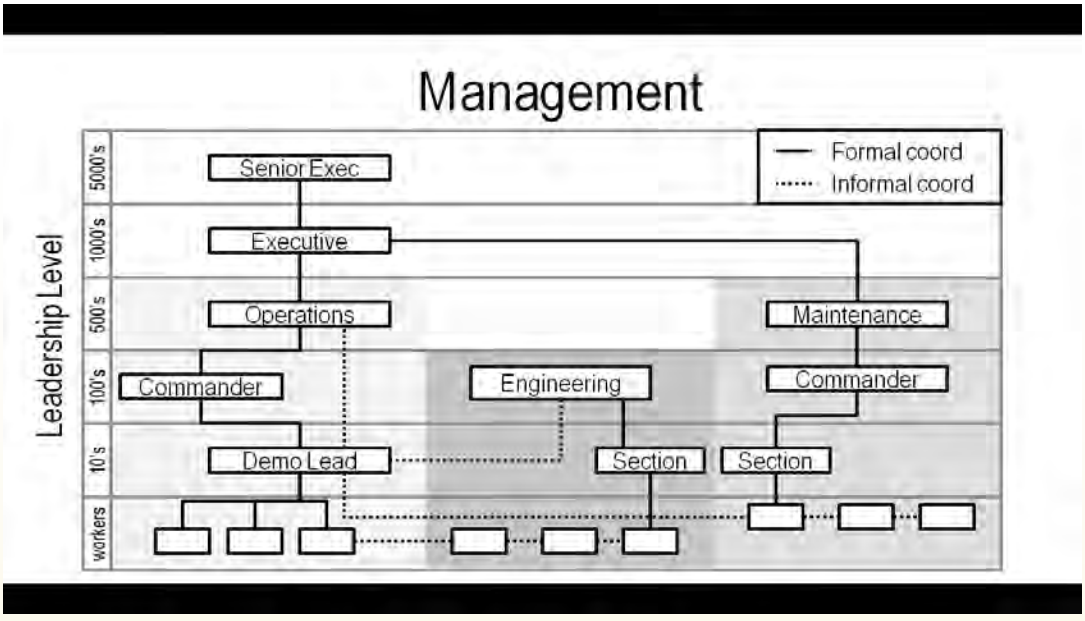
Figure 5: Plug and Play Panel Technical Solution for Demonstration



Project Management

Implementation method was to leverage local expertise and resources on a non-interference basis with regular work schedules. Work was broken down into three primary organizations; operations, engineering and maintenance. Operations handled project coordination, engineering direction and system operation. Engineering handled equipment rack and wiring detailed engineering design, fabrication and installation/removal. Maintenance handled antenna panel detailed engineering design, fabrication and installation/removal. Coordination was also required with flight-line maintenance for positioning and access to aircraft when required during the project. The bulk of this coordination was informal (Figure 6).

Figure 6: Formal and Informal Project Management Organizational Structure

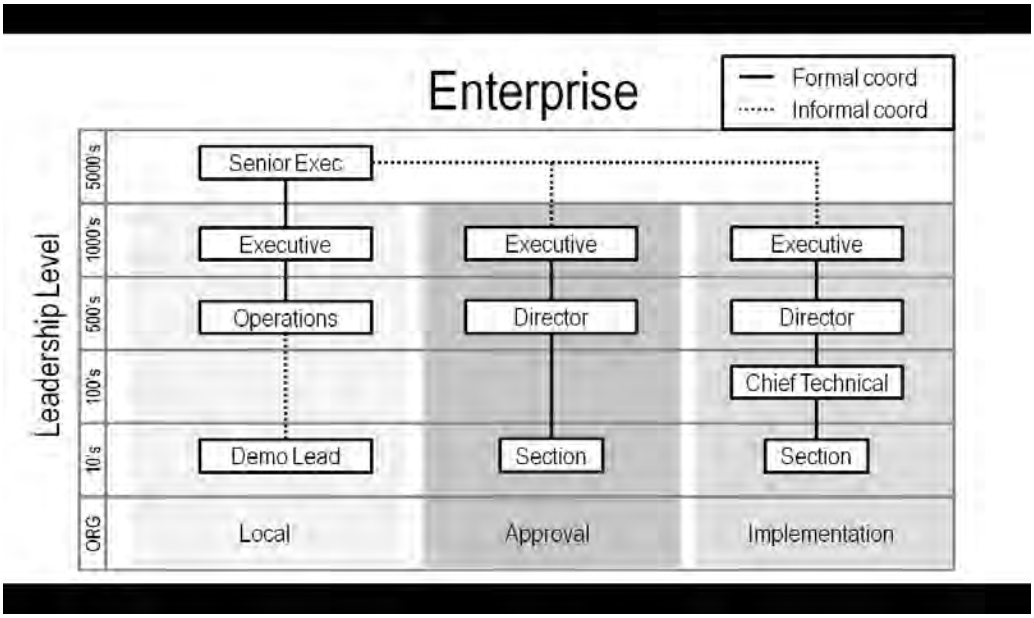


Management flow included solution development, lab demonstration with actual aircraft systems, ground demonstration on aircraft, and finally flight demonstration. The operations project coordinator engaged first through formal peer level leadership for coordination of engineering and maintenance activity. Later informal direct engagement with working level technicians through experienced and well connected individuals within the engineering and maintenance organizations was required (Figure 6).

Enterprise Engagement

Local leadership supported and approved the demonstration shortly after the post lab demonstration of the system based on operational need and feasibility. Approval from two offsite enterprise organizations was needed prior to modification of the aircraft for demonstration. First, an approval organization was needed to establish a requirement which was then passed to the implementation organization for engineering design and assessment of flight demonstration risk. Final approval was required for modification based on cost, available funds and risk assessment.

Figure 7: Project Enterprise Organization and Coordination Structure



The approach to enterprise approval was to initiate the process early by submitting required paperwork with anticipated/ tentative engineering and project information for parallel workflow. As more information was known the paperwork was to be updated to expedite the process. In this manner the engineering review could participate in design detail requirements. The enterprise transition plan provided the demonstration directly to senior executive sponsor (Figure 7) for implementation support. Post demonstration results were also to be provided to all participants. Approval and implementation organization working levels could then evaluate the results and leverage the demonstration for support and engineering knowledge for future development.

Results

A short description of the modular communications case study overall results and management perspectives on the effort are provided. Then management issues for technical solution, project management and enterprise engagement are described.

Modular Communications Case Study

Overall demonstration technical results were excellent with minor lessons learned for follow-on improvements. Senior executive leadership monitored and communicated with airborne B-2's from the control center during a multiple-night large force exercise conducted in airspace outside of Las Vegas, Nevada. This was the first time this control center reliably and consistently monitored B-2 positions during a large force exercise in just under a decade.

Technical Solution

From a technology management perspective this solution benefited from three factors; identifying resources through connections, establishing limited objectives, and leveraging modular plug and play.

R1T: Identifying resources in large organizations – "be interested, get connected"

Informal connections were the singular success factor for this demonstration. First, this capability was identified by enterprise supported connection opportunities. Second, ability to implement this demonstration required informal external partnership. For example, the system manufacturer provided resources, equipment and technical support and Georgia Technical Research Institute in Atlanta, Georgia provided excellent electro-magnetic expertise, development and test facilities. Finally, internal resources such as local metal shop fabrication and engineering capabilities were identified informally.

R2T: Achieving limited objectives using existing systems – "one thing is good enough"

John Wooden, a famous U.S. basketball coach counsels, "don't let what you cannot do interfere with what you can do." When approaching this effort the pertinent question was not "what do we really need?" or "what would solve all our problems?", rather, it was "what can we actually accomplish that has some value in the direction of and with potential for maturing into what we really need?" Amiri et al. (2011) defines innovation as 'bringing into existence' something new that can be sustained and repeated and which has some value or utility. This capability did not provide a full solution communications capability many within the enterprise desired. But it did provide capability in the direction of improved communications; plug and play antennas. And it has generated follow-on effort potential.

R3T: Modularity, standards and interchangeability – "plug and play"

Integration through AP2 provided modular, standard hardware and software interfaces with ability to interchange equipment from one aircraft to another quickly. Use of the panel as a plug and play installation location has opened the realm of possible integration of other capabilities. Plug and play panels can be interchanged between aircraft with different mission dependent functionality. This modular approach potentially opens design of capabilities to small business, non-governmental and commercial providers. Any Microsoft Windows compatible, flight certified system that fits within the approximately 6 inch square panel area is a candidate. This promises to open competition, increase flexibility and provide a streamlined mechanism for improved capability.

Project Management

Management results were effective with no serious issues or problems experienced executing the demonstration. Feedback from operations, engineering and maintenance was that the procedures would be straightforward to implement on a recurring basis. A significant concern stated by maintenance was maintaining, controlling and tracking the plug and play panels accurately.

R4M: Skipping the middle men – "getting to the boss"

Without senior executive support and direction this innovation would not have occurred. Completion of this demonstration occurred only because of senior executive level direction to upper and middle management. While necessary for disruptive innovation (Christensen 2009; Christensen 2001; Euchner 2011; Joseph 2010) this approach was not without cost. This had negative impacts on organizational issues of resistance, fit and support (Ford 2012). Lack of direct maintenance and engineering leadership advocacy and buy-in left the local reaction to demo success muted. Senior executive leadership was very pleased but middle and upper management forced to support the effort maintained resistance. As one engineer stated demo success was "the worst possible outcome" due to leadership then wanting the capability. However, some early adopters receptive to the concept emerged (Rogers 2003).

R5M: Generating excitement through progress - "make them believe"

Senior executives and workers that accomplished the actual work demonstrated less concerned with organizational perceptions and appeared motivated by pure accomplishment. Working level pride, dedication and desire for improvement made this demonstration a success. Simple appreciation and maintaining momentum by communicating successes along the way kept the worker team supportive. A lesson learned was that increased communication to the broader enterprise on project progress, rationale and successes may have decreased resistance. Though, additional project exposure could have had an opposite effect as well based on Rogers (2003) technology adoption lifecycle observations.

Enterprise Engagement

Enterprise management results were a low point for the demonstration. Overcoming enterprise resistance is a slow and uncertain endeavor. However, certain revelations in the demonstration have altered enterprise thinking in positive ways.

R6E: Paradox of innovation – "inefficiency for efficiency's sake"

The enterprise dilemma of resource allocation (Harrell & Sage 2010) was a strong negative pressure resisting this demonstration. Despite low demonstration costs, the implications of success were anticipated to be significant implementation costs. These anticipated costs would upset a much challenged short-term fiscal environment. A decision on how much to invest in innovation is required but decisions on evaluating innovative efforts should be more vision oriented than a judgment on short term results (Christensen 2001).

R7E: Reaping unanticipated benefits – "the epiphanies"

Several unanticipated benefits emerged from this demonstration. First, there was interest and low level support from academia and industry for business development. Georgia Technical Research Institute supported to the project as an example of support to operational activities. Second, combining training and demonstration flights provided a non-interference method to evaluate new capabilities. Standard processes require long instrumented test flights that cost two or more valuable training flights. Third, the modification could provide aircrew with other situation awareness information in addition to the primary command and control requirement.

Conclusion

Innovation in large organizations requires relentless pursuit and perseverance. Each situation will have unique opportunities and barriers to be exploited and avoided. Several key points are presented to assist dedicated innovators. Innovation management principles found in literature support these key points experienced during case study innovation efforts on the B-2 Stealth Bomber. In short they are to identify resources, determine key limited objectives achievable with existing systems, leverage open system standards, convince only those required for the portion they are required, generate excitement by communicating progress, and exploit unanticipated benefits. Finally, executives must understand that innovation is not free. The paradox of innovation is that short term inefficiency (cost) is required to achieve long term efficiency (savings). This case study supports Christensen's conclusion that disruptive innovation in large enterprise requires visionary senior executive engagement from above operational levels.

References

Amiri, A. N., Jandaghi, G. & Ramezan, M. (2011). An investigation to the impact of intellectual capital on organizational innovation. [Article]. European Journal of Scientific Research, 64(3), 472-477.

Christensen, C. (2009). Innovation for executives (Vol. 1, pp. 149-150): Multi-Science Publishing Co Ltd.

Christensen, C. T. (2001). The great disruption. [Article]. Foreign Affairs, 80(2), 80.

Euchner, J. (2011). Managing disruption: an interview with Clayton Christensen. (Vol. 54, pp. 11): Industrial Research Institute, Inc.

Ford, S. J. (2012). Disentangling the complexity of early-stage technology acquisitions. [Article]. Research Technology Management, 55(3), 40.

Harrell, J. M. & Sage, A. P. (2010). An enterprise architecture methodology to address the enterprise dilemma. [Article]. Information Knowledge Systems Management, 9(3/4), 211-237.

Joseph, R. C. (2010). Individual resistance to IT innovations. [Article]. Communications of the ACM, 53(4), 144-146.

Kim, H.W. & Kankanhalli, A. (2009). Investigating user resistance to information systems implementation: a status quo bias perspective. [Article]. MIS Quarterly, 33(3), 567-582.

Kohlbacher, F. & Hang, C. (2011). Applying the disruptive innovation framework to the silver market. [Article]. Ageing International, 36(1), 82-101.

Rogers, E. M. (2003). Diffusion of innovations. New York, NY: Free Press.

Xiaoyuan, Z. & Yanning, Z. (2011). Development of Chinese science and technology intermediaries and their integration into the open innovation paradigm. [Article]. Technology Analysis & Strategic Management, 23(1), 25-48.

Manufacturing

Manufacturing

Being the Next Steve Jobs Without Offshoring – MTEC SmartZone

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Abstract
Managing production across extended supply chains due to costs incurred from supplier reliability and/or transportation has increased interest in reshoring. Also, there is an increased concern to retain intellectual property in certain manufactured products that may be proprietary due to military and/or national security issues or to protect innovations. This paper explains how an engineering and technology focused research university encourages innovation and fosters student engineering talent. Relationships like those fostered by Michigan Tech Enterprise Corporation (MTEC) SmartZone and Michigan Technological University have encouraged cooperation of companies like GE Aviation to leverage university student talent and keep the US manufacturing.

Introduction
Michigan Tech Enterprise Corporation (MTEC) SmartZone is a business incubator funded by Michigan Economic Develop Corporation with a mission to create jobs in the technology sector. As part of the job creation strategy in a rural community, MTEC SmartZone has helped Fortune 500 companies, Ford, GE Aviation and Dematic; to create satellite offices near Michigan Technological University. These companies utilize student talent to provide a low cost alternative to outsourcing engineering.

Why train graduate engineers in other countries when we can train American engineering students and retain that knowledge in the States? This concept has been wildly successful. Ford, GE and Dematic have found a reliable labor force that work in the same time zone and without language barriers. Michigan Tech students earn money and gain real world experience, while attending school in their engineering field. Meanwhile, the community retains student jobs here rather than co-op opportunities found in other towns. Collectively these companies contribute millions in payroll dollars every year. Students are spending their paychecks at local bike shops and restaurants, impacting the local economy.

MTEC SmartZone's efforts are equally focused on economic gardening, supporting local technology entrepreneurs who want to build technology businesses. These local technology companies also utilize Michigan Tech students to help affordably grow their business, offering the same kinds of engineering and manufacturing opportunities as the larger firms in town.

Background
In the January 2012 State of the Union Address, President Obama attacked offshoring, urging businesses to bring jobs back to the US referencing technology, business start-ups and innovation as the key. According to a Computerworld web article, Obama urged Congress to back policies that help "every risk-taker and entrepreneur who aspires to become the next Steve Jobs." (Thibodeau, 2012).

Steve Jobs is an innovator, yes. But Apple's iPad is made in China by Taiwan-based Foxconn Technologies Group, which employs more than 1 million people. According to an AP Business Writer, Brazil's government says Foxconn plans to open factories in Brazil also to produce iPads and other products (McDonald, 2012). From what has been revealed of Obama's 2013 fiscal budget plan, changes to the tax code will discourage these American companies from searching for cheaper costs offshore and encourage reshoring, as well as supporting education and research that fosters the manufacturing sector (Butcher, 2012). These policy reforms all seem to make good sense, but the argument is that it will disallow American companies to be globally competitive and closer to their customers.
At this time it has not been determined where Microsoft will manufacture the Windows Surface Tablet, which was unveiled

in June 2012 as the rival to Apple Computer's iPad. Microsoft, primarily a software company, has had previous tablets made by hardware manufacturers such as Samsung and Hewlett-Packard (HP). If the Windows Surface Tablet is manufactured by US manufacturers it may be a marketing "Made in the USA" advantage, but according to a ZDNet Senior Technology Editor, some market analysts believe that Microsoft will be in direct competition with their long time supporter Original Equipment Manufacturers (OEMs) that will mean the loss of jobs in the manufacturing sector, particularly for OEMs that have a strong base of US operations such as Dell and HP (Perlow, 2012).

Reshoring Manufacturing

Obviously, there are no easy answers to bringing manufacturing jobs back to the US as many analysts struggle to find the right mixture to help the economy in the US, but to still be competitive globally. For example, the internet business Quirky.com producing a milk crate home storage system for Target and Staples, in the US, is one company that has decided to manufacture in the US partly because of a tight shipment schedule not allowing for the months required to ship from China. In addition, the company CEO wants to bring half of Quirky's manufacturing back to America in the next 18 months, because labor and shipping costs are rising in China. When production can be largely automated and better manufacturing techniques are used, as in the case of the milk crates, US products can be made with less overall costs. The Quirky CEO who plans to reshore gradually explains that "the U.S. worker is 3.2 times (more) productive than the average Chinese worker." (Frenkel, 2012). This is just one of many examples of a company that has made the decision to reshore its manufacturing.

MTEC SmartZone is very committed to economic gardening and the development of local technology entrepreneurs who want to build technology businesses. Many times technology jobs lead to companies manufacturing in the US. For example, GS Engineering located in Houghton, Michigan was incorporated in 2001 as the first company to graduate from the MTEC SmartZone program. GS Engineering initially began with 3 employees working from their homes, and in 2008 moved into a newly constructed facility that combines office space with several material testing labs, and a high bay area for vehicle development projects. GS Engineering has grown to nearly 70 full-time employees serving the US market exclusively with customers including the Department of Energy, Department of Defense clients, leading vehicle manufacturers, and material development companies. GS has been recognized many times over for their innovations and accomplishments including the Michigan High-Tech Small Business of the Year by the Michigan Economic Development Corporation in 2003, and most recently Michigan's 2010 Government Contractor of the Year (GS Engineering Incorporated, 2012).

ASME Vision 2030 for Mechanical Engineering Technology

The design and marketing of an engineering education is just as competitive as that of a new product. Marketing a manufacturing related engineering and engineering technology program in the current economy, and then providing a valuable education to students interested in engineering and manufacturing in the US is a challenge. First year retention, diversity of race and gender is also a concern for most US engineering programs.

The vision of the American Society of Mechanical Engineers (ASME) is explained by the authors of the ASEE 2012 Annual Conference proceedings paper, ASME's Vision 2030's Import for Mechanical Engineering Technology in the following:

> "The ASME Vision 2030 Task Force pursued two primary objectives: help define the knowledge and skills that mechanical engineering or mechanical engineering technology graduates should have to be globally competitive, and, to provide, and advocate for their adoption, recommendations for mechanical engineering education curricula, with the goal of providing graduates with improved expertise for successful professional practice." (Perry & Kirkpatrick, 2012)

The author's continue to summarize the strengths of engineering technology (ET) graduates as engineering practitioners and as implementers of technology; job-ready and focused on applied engineering, as compared to results of the survey that the greatest weaknesses noted by employers of current mechanical engineering (ME) graduates were a lack of practical experience in how devices are made or work. This is due the fact that mechanical engineering technology (MET) curriculums in most universities include more labs associated with courses where students experience more hands on activities as part of the curriculum, and MET faculty generally have more industrial experience. One of the recommendations of the report is that Mechanical Engineering Technology programs should strive towards creating curricula that inspire innovation, creativity, and entrepreneurship (Perry & Kirkpatrick, 2012). ME and MET student internship opportunities in MTEC SmartZone businesses give students the opportunity to supplement their engineering education and attain these goals laid out in the ASME Vision 2030.

Four Pillars of Manufacturing

The four pillars of manufacturing are explained in another ASEE 2012 conference presentation by the authors of the paper, The Four Pillars of Manufacturing Engineering: What Engineering and Technology Graduates Should Know about Manufacturing**,** in the following:

> "Developed by the Society of Manufacturing Engineers (SME) through its Center for Education, the four pillars model is derived from the ABET accreditation criteria for manufacturing engineering programs and builds on the topics in the SME body of knowledge for the certification of manufacturing engineers and manufacturing technologists. The concept of the four pillars encompasses: 1) Materials and manufacturing processes; 2) Product, tooling, and assembly engineering; 3) Manufacturing systems and operations; and 4) Manufacturing competitiveness." (Mott, et al., 2012)

Manufacturing competitiveness is defined by the authors as understanding the analysis, synthesis, and control of manufacturing operations using statistical and calculus based methods, simulation and information technology (Mott, et al., 2012). These are the key tools that future engineers will utilize to improve the chances for the US manufacturing to start reshoring. The authors in this report reveal another essential tool related to the idea of reshoring, which is to help develop an understanding of the global manufacturing industry, and to develop a profile of the skills needed in the manufacturing industry, especially for future competitiveness in the global market (Mott, et al., 2012). This goal can be accomplished by combining strenuous engineering courses with practical laboratory activities, and ideally an industry experiences as interns at companies like those at the MTEC SmartZone to experience the global business perspective.

US Government Role in Engineering and Manufacturing Education

At the PLM World: America's User Conference 2012 Assistant Secretary Jane Oates, United States Department of Labor in the Employment & Training Administration presented the keynote address: Closing the Technical Workforce Gap – The Role of Academic, Government, and Business Collaboration in STEM Education summarized in the following abstract.

> "The Department of Labor's Employment and Training Administration (ETA) is the federal agency charged with supporting the efficient functioning of the U.S. labor market by providing job training, employment, labor market information, and income support for workers who have lost their jobs. Millions of employees have been dislocated from their jobs in traditional industries and need new skills to compete for jobs in the labor market. Now more than ever, there is fierce global competition for an educated workforce. To address these economic dynamics, the ETA is strengthening partnerships across federal agencies, developing clear career pathways that lead to attainment of industry-recognized credentials, developing better virtual career tools, and investing in "earn and learn" training strategies." (Oates, 2012)

The result of these efforts that were explained by Secretary Oates in the announcement of the availability of funding for the Advanced Manufacturing Jobs and Innovation Accelerator Challenge (AMJA) where regional partnerships across the nation can compete to access grant funds to support advanced manufacturing activities. The AMJA was designed to foster job creation, increase public and private investments, and enhance economic prosperity by harnessing the economic growth and job creation potential resulting from advanced manufacturing activities within high-growth industry clusters. As outlined in the AMJA executive summary, this initiative leveraged participating funding agencies providing approximately $26 million in Federal support for the AMJA that will be used to fund approximately 12 three year projects (EDA, et al., 2012). An example of this type of partnership is a project where curriculum was developed around the use of the PLM Siemens NX and Teamcenter software to train students in a Design Technology curriculum at Iowa Western Community College to fulfill high tech manufacturing needs in their local area.

MTEC SmartZone Role

MTEC SmartZone offers a solution for Fortune 500 companies outsourcing engineering work and supporting technology start-ups. Several Michigan Tech alumni and students have worked for MTEC SmartZone companies gaining valuable experience. Some students start as interns and then as full time employees after graduation. For example, Michigan Tech students design and detail parts for electronic systems at GE Aviation which are used for testing and simulating the flight systems for aircraft. The knowledge of how parts are manufactured and understanding of quality control techniques are a key role of these engineers. This valuable knowledge is gained through both education and on-the-job experience.

MTEC SmartZone History

Michigan's legislature created the concept of "SmartZone's" in the year 1998. The concept was in response to Michigan's dependence on the automotive industry and the realization that jobs are created by entrepreneurs. All fifteen SmartZone's are associated with Michigan research universities, MTEC SmartZone was the first in the state, which was created through the collaborative effort of Michigan Tech, the cities of Houghton and Hancock, and the local economic development agency. MTEC SmartZone is a business incubator, created to provide technology entrepreneurs business counseling, support, funding and space. The SmartZone provides the basic internet, phone, copying and other services so the entrepreneur can focus on his business. MTEC SmartZone's business coaching is critical to growing companies because most entrepreneurs are technical in nature and need help understanding the financial (including raising funds), marketing and strategic parts of the business.

The National Business Incubator Association indicates that only 44% of start-ups are still in business after 5 years. Start-ups graduating from business incubators improve their success rate to 87%. Clearly, to create a successful economic gardening environment, a business incubator can help create viable companies.

MTEC SmartZone "Made in USA" Success Stories

Michigan Tech offers our start-up firms, which are all technology based, access to creative talent. Endres Machining is a start-up machine tool manufacture created by Michigan Tech professor, Bill Endres. Endres utilizes interns and co-op students to help design, machine, and test their designs. Over the last six years, they have employed close to a dozen interns from the Michigan Tech's Mechanical Engineering Department.

Talon Research is a small engineering firm started by female Michigan Tech alum, Dorothy Rhunonen. Dorothy graduated from the Mechanical Design Engineering Technology AS degree program (the AS degree was transformed in 2005 to the currently offered BS degree in MET) at Michigan Tech. She remains involved in daily operations as the senior mechanical design engineer. Talon does CAD design for many business sectors including medical and military. However, recently developed a technology and service that detects public road defamation more effectively and less costly than current methods. They have also accessed student talent at Michigan Tech to help further develop the product and provide engineering services. These students are learning hands-on design, testing and project management skills. Talon employs interns from Michigan Tech's MET Program to work in the summer and if their schedule permits, throughout the school year.

However, the largest employer of student interns are the Fortune 500 Companies who set up satellite offices in Houghton. GE Aviation employs 35-50 students per semester from various disciplines. The software that the students work with has to collaborate heavily with the hardware and controls in the design and testing of the aircraft's "black box" product improvements. Not only do the students learn their own engineering area more completely, but they learn to collaborate with other disciplines, having to figure out the age old dilemma "It's a software problem --- no it's a hardware problem!"

Dematic, a global $1.2 billion logistics company, that specializes in material handling systems employs Computer Science students, Mechanical Engineering and MET students. They joined MTEC SmartZone "family" in April of 2012. Dematic worked closely with MTEC SmartZone and Michigan Tech to sign the lease, hire 11 students, create work spaces including, computers and within 20 days. The students work for the Engineering Development Department within Dematic, starting with projects that the engineers within the company cannot complete with their limited headcount. The company has been so pleased with the talent that they will be utilizing the students throughout the school year with increasingly challenging projects.

Conclusions and Recommendations

The result of the GE Aviation and Dematic efforts in matching projects to the student's ability and helping them grow by giving them increasingly complex projects has helped to create very desirable engineering graduates. Competitors even come to these companies asking for the names of any internship students that they will not be hiring permanently.

Engineering education can be greatly supplemented with a program that encourages companies to hire students and that provides them with "real-world" experience. The result is a graduating engineer with the skills needed to work within a company, in a collaborative manner, and an engineer whose education has been enhanced through the synergy of classroom and hands-on experience.

Government project grants can be leveraged to support local organizations like MTEC SmartZone in communities around the country. Also, with the help of an organization like the MTEC SmartZone, start-up entrepreneurship companies have the opportunity to bring new innovations into the marketplace without offshoring the engineering and/or manufacturing of their product. Companies like GE Aviation involved in military contracts can keep their engineering and manufacturing in the US without worries of national security issues or protecting their innovations. Moving work back to the United States in this manner helps move our country forward.

References

Butcher, D. R. (2012, January 26). *State of the Union 2012: The Manufacturing Perspective.* Retrieved from ThomasNet News, Industry Market Trends: http://www.news.thomasnet.com

EDA, NIST, DOC, DOE, ETA, DOL, & SBA, &. (2012). *Executive Summary; ANNOUNCEMENT OF FEDERAL FUNDING OPPORTUNITY, ADVANCED MANUFACTURING JOBS AND INNOVATION ACCELERATOR CHALLENGE.* Washington DC: US Government.

Frenkel, K. A. (2012, June 30). *Manufacturer Quirky finds China not always cheapest.* Retrieved from SanFrancisco Chronicle, Technology: http://www.sfgate.com

GS Engineering Incorporated. (2012, July 1). *GS Engineering - About Us*. Retrieved from GS Engineering: htpp://www.gsengineering.com/About_Us/profile.html

McDonald, J. (2012, July 2). *China: Apple Pays $60M To Settle 'iPad' Case* . Retrieved from Manufacturing.net, The Leading Source for Manufacturing News and Insight: http://www.manufacturing.net

Mott, R. L., Bennett, R. J., Jack, H., Wendel, S., Stratton, M. J., Raju, V., . . . Waldrop, P. (2012). AC 2012-4210: THE FOUR PILLARS OF MANUFACTURING ENGINEERING:. *ASEE 2012 Conference Proceedings* (p. 14). San Antonio: ASEE.

Oates, J. (2012). Closing the Technical Workforce GapThe Role of Academic, Government, and Business Collaboration in STEM Education. *PLM World: Siemens PLM Connection 2012* (p. 1). Las Vegas: PLM World.

Perlow, J. (2012, June 28). *Microsoft: The Evil Empire re-Surfaces.* Retrieved from ZDNet, Tech Broiler: http://www.zdnet.com

Perry, T., & Kirkpatrick, A. T. (2012). AC 2012-4832: ASME'S VISION 2030'S IMPORT FOR MECHANICAL. *ASEE 2012 Conference Proceedings* (p. 10). San Antonio: ASEE.

Thibodeau, P. (2012, January 28). *Obama attacks offshoring, seeks visa reform.* Retrieved from Computerworld, The Voice of the ICT Community: http://www.computerworld.co.nz

Manufacturing

Digital Manufacturing and Simulation Curriculum Evolution

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Introduction

Our manufacturing technology program includes curriculum utilizing advance CAD and computer simulation software for the design and analysis of industrial operations. Recent projects included work with a major automotive OEM, and with a major defence-industry company. Our digital manufacturing courses have evolved significantly this past year due to partner company expectations, transition to semesters and new technologies. This paper explains the evolutional revisions in our program to better prepare our graduates to understand and apply these technologies in manufacturing careers.

Historical Curriculum Overview

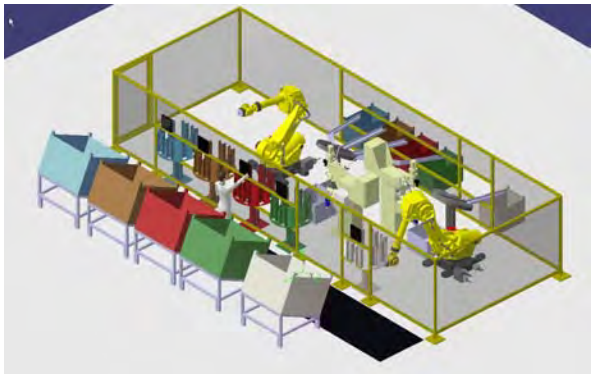
Digital Manufacturing and Manufacturing Simulation are courses taught in our Department of Technological Studies. These two semester-long classes are required of students getting a manufacturing technology major with a manufacturing management option. (In previous years these were taken for three quarters.) These courses are for junior and senior level students, all of whom have had previous CAD coursework. Students learn specific CAD and simulation applications from tutorials and online course materials, and create individual models to develop proficiencies. During the second semester teams of students work with local companies to create simulation models of actual manufacturing operations. Each student team then prepares PowerPoint materials which are presented with recommendations to representatives of the company.

The simulation applications used in these industrial projects have included robotic workcell processing, assembly sequencing, ergonomics analysis, and discrete-event materials/process flow studies. This curriculum has provided an opportunity for integration of several technologies and manufacturing management aspects into application-based environments, including 3-D CAD modelling, ergonomics, robotics, 3D graphics, FEA, production system design, concurrent engineering principles, and product life-cycle management (PLM). Students gain skills and experience in teamwork, project planning, problem solving, and formal multi-media presentations in industrial environments. Benefits include exposure to in-plant manufacturing operations, and the opportunity to personally deal with company professionals. Students have obtained coop/internship positions, and graduates are finding related jobs in the fields of manufacturing and applications engineering.

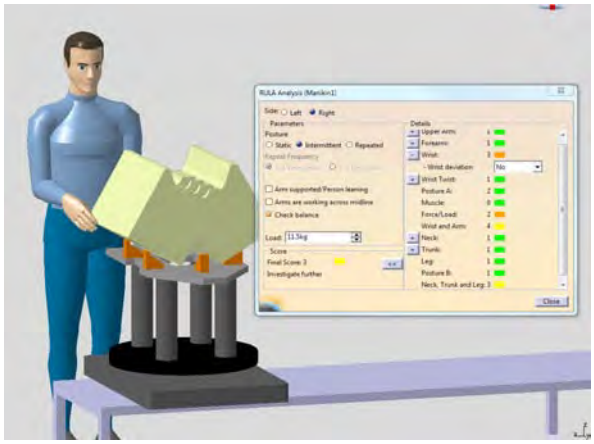
The Technological Studies Department has been utilizing the software offered by Dassault Systèmes, which provides access to a variety of digital manufacturing applications for CAD (CATIA) and manufacturing simulations (DELMIA). An advantage of utilizing this suite of products is the common interfaces between their various applications. Due to this common ownership, the simulation software has been revised and incorporated into the CATIA interface environment. These two applications work together seamlessly, with the ability to switch between various "workbenches" for each application while working on the same model. Students utilizing the Delmia products also gained proficiencies in the use of the CATIA CAD application during their course work. The high visual and graphical nature of the 3D simulations has also proven effective in stimulating student interest in the Technological Studies program, countering some public negativism for industrial/manufacturing occupations.

An additional incentive has been the extensive use of this specific simulation software by major companies in our geographical region (Honda, General Dynamics, Chrysler, and Toyota), providing opportunities for internships, co-ops and jobs using this software at automotive OEMs and major defense industries. Graduates have even found successful placements at Boeing and NASA. Also, the incorporation of such advanced computer applications into an undergraduate industrial technology program has served to differentiate our program from similar ones.

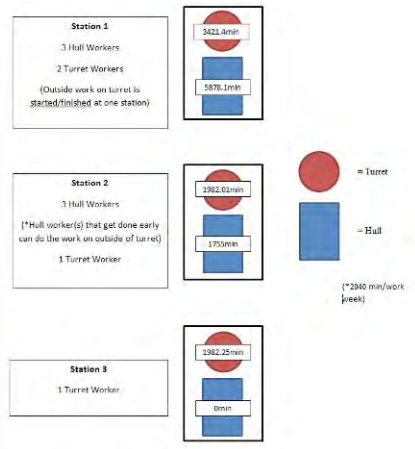
Examples of Student Simulation Projects with Companies



A tier one supplier to Honda was looking for opportunities to consolidate five individual operations into a single workcell. The team of students integrated these operations with two robots. The same team also completed an ergonomic analysis of the worker loading innovative indexing accumulation racks they designed for the operation.



Another team modeled a new engine assembly line for a major OEM. This included an ergonomic analysis of the strains an operator experiences in rotating a fixture on the assembly line, along with cycle time and robotic reachability analysis.



The task for one team was to make recommendations for consolidation and rebalancing an assembly line for a major military vehicle. Objectives were production efficiency while reducing from one unit per day to one per week, 75% floor space reduction, and safety improvements, which were all well received.

Motivation for Changes

In addition to changing from quarters to semesters this past year, revisions in software, company expectations and collaborative product data management systems are driving new strategic objectives and curriculum. The operating environment for the software previously involved installation onto each PC, and licensing set up on a campus server. The result was that powerful computers and sophisticated graphics cards were required, so students were limited to running on these machines. Although we have had good success with students using remote access to the computers (from anywhere on the Internet), there were sometimes restrictions due to network issues or a specific PC being used by someone else when requested.

Another driver for change has been company requests for more sophisticated analysis and recommendations from class project work. Honda in particular was looking for capstone level deliveries. In our previous one-quarter long projects student teams were learning software and then applying it to a company project in a 3-4 week window. After completion of 10 projects with Honda we have stopped requests for work with them, although we are still doing projects with their tier one suppliers.

A third aspect motivating change has been availability of a new integrated platform of digital manufacturing applications

for academic institutions at practical pricing. Dassault Systèmes is providing the following suite of products for use in my classes, with the significant advantage of commonality of interface and exchange of data between the applications.[1]

- CATIA for 3D product design
- DELMIA for manufacturing simulation
- SIMULIA for structural analysis
- ENOVIA for product data management and project collaboration

These are products are transitioning into a new server-based operating platform designated V6. We will be using this platform in 2012-13, as explained later.

New pricing models are permitting transition to an extensive suite of products for less than $10,000 per year for 20 user seats. In past years we paid $15-25,000 for a more limited set of applications. There are similar products available from other companies. Siemens has also developed an extensive suite of similar products, including NX, Tecnomatix, and Teamcenter.[2]

Company Collaborations

The issue of getting company involvement for class projects has required some persistence. The cooperation was gained largely by offering the opportunity for company representatives and management to influence students to pursue manufacturing jobs (appealing to their personal interests, and "parenting" emotions), plus opportunities for employees to demonstrate community service. Now there is very good acceptance and support. The essential component in achieving successful company projects has been the establishment of a working relationship with individuals in the company who had the authority, interest, and willingness to get involved. All companies have been supportive and cooperative once the relationship was established, although it sometimes took patience, perseverance and repeated communications to achieve this cooperation. All contacts were very busy, but were receptive to the idea of providing the opportunity for students to gain first-hand real-world experience in dealing with manufacturing issues. The expectations of both parties and the deliverables are identified in the initial meeting between the students and the company representatives. When the projects were underway, and they found our needs were not very demanding, the willingness to provide support and even encouragement grew. The companies have expressed high satisfaction with the results of the students' work, with offers to provide future projects. Some have also expressed a willingness to pursue opportunities for financial grants and other partnership activities.

Evolutionary Curriculum Changes

The following shows the curriculum as executed this past year, along with the revisions being implemented during the next two years:

Fall Semester — Digital Manufacturing:

1. 3D CAD (CATIA). Teams model components of real products.
2. Assembly Simulation (DELMIA). Individuals simulate/analyze assembly of the team products.
3. Ergonomics: Individuals analyze activities of multiple manikins
4. Robotics: Individuals simulate/analyze activities of multiple robots.

Spring Semester — Manufacturing Simulation

1. Discrete-event material & process flow (DELMIA Quest). Individuals simulate/analyze virtual processes
2. Industrial Team Project:
   - Local manufacturing companies provide projects.
   - Student teams visit companies, gather data, plan projects, simulate/analyze processes using all applications, and present results to management.

A significant component of this new working environment will be utilization of the new server-based operating platform designated V6. The previous V5 platform was Dassault Systèmes evolution to a windows-based environment on PCs. In the new

1. Same, with increased emphasis on FEA and CAM applications.
2. Same, less time
3. Same, less time
4. Same, less time
5. Adding early introduction to company projects to begin geometry creation.

1. Discontinuing. Will instead introduce ENOVIA PDM for collaborative project planning.
2. Company projects already in-progress. Increased scope of team projects with objective of development to level of capstones.
3. Develop collaborations with other schools or companies. Incorporate new 'social network type communication techniques.

platform all files and databases will be maintained on a server, and individual users will access that through the Internet from any location. The ENOVIA[3] application is a very sophisticated project management template, with security control mechanisms to permit various external users (like vendors, suppliers, sales personnel, accounting, competitive partners, etc.) to access the data relative to their needs, without compromising the security or integrity of data or information inappropriate for their access. Several universities have already implemented or are considering ENOVIA installation. We have taken preliminary initiatives for remote project collaborations with Georgia Tech., Purdue and Ohio State University. This will be very significant as it is integrated into this curriculum during our 2012-13 academic year.

There have already been summer camps in Detroit with high-school student teams jointly collaborating on-line, real-time with high school teams at Georgia Tech. to design and model products using these applications. Dialogues were conducted using an Internet social network type product called "Swym"4. This product's objective is to create communities which permit sharing ideas, project collaborations, expressing opinions, getting help and connecting with those having similar interests or needs. This new paradigm will become more prevalent as a powerful tool for technologists and engineers in future years.

Student Issues, Successes and Satisfaction

Our students have frequently struggled with real life project management, division of responsibility, and on-time project completion issues, but have usually come through with results well received by companies. It is anticipated that the use of this new system using the ENOVIA V6 template will guide this students through this process. This curriculum continues to provide graduates with excellent internship and job opportunities. Past placements using these applications include Boeing, General Dynamics, Honda and Lockheed-Martin, along with several tier 2 and tier 3 supplier companies and system integration/simulation development companies. It is anticipated that the use of these new applications will further improve their professional placements.

Other opportunities relate to new visualization and documentation applications using 3D graphics and convenient annotations. New products by Adobe Systems (3D PDF [5]), Dassault Systemes (3DVIA [6]), and others, along with new developments in virtual reality and augmented reality[7] technologies, will permit communications and collaborations that are not language or geometry based, but visually convey information in forms that humans easily understand.

These are already being integrated into Product Lifecycle Management (PLM) systems in some companies. "Digital manufacturing solutions are part of collaborative PLM systems and make up the manufacturing element of PLM, including integrated solutions supporting manufacturing process design, tool design, and powerful 3-D visualization simulation tools. The integration of digital manufacturing into PLM solutions is providing a critical link between design and manufacturing engineering, according to market researcher ARC Advisory Group (Dedham, MA), enabling the collaborative environment that is essential to successfully implementing concurrent engineering practices." [8]

During the 2011-2012 school year requests for graduates, co-ops and internships with simulation experience significantly exceeded our supply of students choosing to follow this career path. This curriculum is a distinctive component of the Department of Technological Studies, and provides excellent opportunities for student field experiences and applications of advanced computer technologies. The curriculum provides the opportunity for real-world projects, internships and jobs for our students, and is providing modern industrial companies with effective management and manufacturing engineering professionals. The local industrial companies have been very receptive and supportive of these partnerships which improve the quality of the students' education and better prepare them for future opportunities in manufacturing.

Summary

Manufacturing companies are pushing the envelope to gain competitive advantages through rapid development of new products, processes and production systems in lean environments that emphasize continuous improvement. Companies are embracing digital manufacturing, product lifecycle management and simulation analysis as tools to achieve their goals. Boeing, General Motors, the United States military, and others are mandating that simulations of major projects are completed prior to implementation.

All of these technologies and applications are tools that our manufacturing technologists need to understand. The objective of our curriculum is not to make them proficient applicators, but for them to know how these tools may help them and their employers. Graduates of engineering and technology programs with an understanding and ability to apply these tools will

find many opportunities in manufacturing and related fields.

Bibliography

http://www.3ds.com/

http://www.plm.automation.siemens.com/en_us/products/index.shtml

http://www.3ds.com/products/enovia/welcome/

http://www.3ds.com/products/3dswym/overview/

http://www.adobe.com/manufacturing/solutions/3d_solutions/

http://www.3dvia.com/

http://mashable.com/follow/topics/augmented-reality/

Society of Manufacturing Engineers, Manufacturing Engineering Magazine, "Enter the Virtual World" October 2007, pp. 67-82

Safety

Safety

Schools at Risk: Technology Applications to Assist in School's Emergency Management Initiatives

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Abstract

As threats of disasters continue to escalate, schools grow in their risk of natural or man-made incidents. According to the National Center for Education Statistics (2012), there were 33 school-associated violent deaths in primary and secondary schools in the United States from July 1, 2009, through June 30, 2010. Of the 33 student, staff, and nonstudent school-associated violent deaths, 25 were homicides; 5 were suicides; and 3 were legal interventions. The Center provided a report from U. S. principals indicating that 85 percent of public schools recorded that one or more of these incidents of violence, theft, or other crimes had taken place, amounting to an estimated 1.9 million crimes. Also during 2009-2010, 60 percent of schools reported one of the specified crimes to the police, amounting to about 689,000 crimes—or 15 crimes per 1,000 students enrolled. In 2012, U. S. A. Today reported the Oikos University shooting where one student shot ten people at the university; seven of which died and another three were injured. Natural disasters, such as Hurricane Katrina and Rita, caused devastation for schools in Mississippi and Louisiana leading thousands to be displaced. These were horrendous incidents jeopardized schools safety, and technology could have assisted in emergency management planning and early notification. In regards to these incidents, technology may not have prevented the incidents; but it may have helped mitigate, prepare, respond, and recover.

This paper will review emergency incidents that have impacted primary, secondary, and post-secondary schools, and emphasize the need for safety improvements. In addition, this paper identifies technologies new technologies and how such technologies enhance mitigation, preparedness, response, and recovery for man-made or natural incidents. Furthermore, it asserts that such technologies will improve emergency management planning, and strengthen the overall safety of schools.

Introduction

Natural and man-made disasters are continuous in today's society. From hazardous weather events to acts of violence, it is essential to have plans in place that effectively and efficiently manages emergency situations. Emergency Management is the paramount concern for both the general public and the academic community. The concern is due to potential loss of life, property, and a disruption of normal daily routines. These plans require continuous improvements of technology that will aid in proper planning, forecasting, detecting/securing, and information sharing. Since emergency incidents continue to increase, strategic plans and access to current technologies must be in place to provide immediate assistance, especially for vulnerable areas of the community (Buck, 2011). In many instances, schools are deemed as vulnerable communities.

Schools are a key component of our communities and have the fundamental goal of providing an education in a safe environment. Primary, secondary, and post-secondary schools hold valuable assets—the students. There are also the administrators, faculty, staff, and other essential stake-holders who assist in developing and implementing educational programs to help students progress. Schools must have safety at the vanguard to promote a productive environment for the students and those who serve them. In addition, school officials should have functional emergency plans to manage incidents.

The U. S. Department of Defense (2010) defined "incident" as an episode caused by either human action or natural phenomena that requires action to prevent or minimize loss of life or property. Typically, those episodes are devised with the intent to pose harm to people, property, and the overall environment. Bennett (2011) contended that some incidents can expand geographic areas and impact people throughout the duration of the incident. These impacts can be severe, pose immediate or delay health results, and possibly spread throughout land and water. Incidents may create unreasonable risks. Although some incidents may not be avoided, there is a mechanism that aid in forecasting and handling disasters when they occur—Emergency Management.

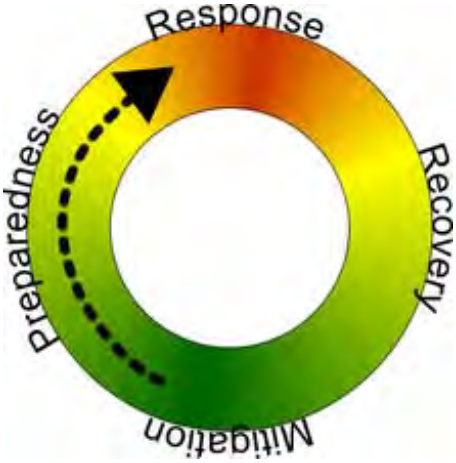
Emergency Management

According to the Federal Emergency Management Agency (FEMA, 2007), Emergency Management is "*the managerial function charged with creating the framework within which communities reduce vulnerability to hazards and cope with disasters*". FEMA also contended that Emergency Management intends to endorse safer and less vulnerable communities with the ability to manage hazards and disasters. The mission of Emergency Management is to protect communities by coordinating and integrating all activities necessary to build, sustain, and improve the capability to mitigate against, prepare for, respond to, and recover from threatened or actual natural disasters, acts of terrorism, or other man-made disasters. Such disasters may include natural (e.g. hurricanes, tornadoes, typhoons, tsunamis, earthquakes, and etc.), and man-made (e.g. terrorism, bio-terrorism, pandemics, school violence, and etc.). Regardless of natural or man-made emergency incidents, there is an urgent need for earlier detection and warning to minimize or prohibit the affects of disasters. Reddick (2010) indicated that the National Association Governors (NAG) established the first broad framework for Emergency Management in 1979 which serves at the foundation of the contemporary definition. This framework is the foundation of the functions of Emergency Management.

There are four functions in Emergency Management: mitigation, preparedness, response, and recovery. FEMA (2007) and Reddick (2010) explained each function as the following:

> ***Mitigation*:** Attempts to prevent hazards from developing into disasters altogether or to reduce the effects of disasters. Mitigation is the effort to reduce loss of life and property by lessening the impact of disasters. This is achieved through risk analysis, which results in information that provides a foundation for mitigation activities that reduce risk.
>
> ***Preparedness*:** Impact of disaster events on people. Preparedness is a continuous cycle of planning, managing, organizing, training, equipping, exercising, creating, evaluating, monitoring and improving activities to ensure effective coordination and the enhancement of capabilities of concerned organizations to prevent, protect against, respond to, recover from, create resources and mitigate the effects of natural disasters, acts of terrorism, and other man-made disasters.
>
> ***Response*:** The response phase includes the mobilization of the necessary emergency services and first responders in the disaster area. This is likely to include a first wave of core emergency services, such as firefighters, police and ambulance crews.
>
> ***Recovery*:** Restore the affected area to its previous state. It differs from the response phase in its focus; recovery efforts are concerned with issues and decisions that must be made after immediate needs are addressed. Recovery efforts are primarily concerned with actions that involve rebuilding destroyed property, re-employment, and the repair of other essential infrastructure.

Figure 1. Four Phases of Emergency Management
(Source: "Emergency Management" adapted from U.S. Department of Homeland Security and FEMA, 2007)



The U. S. Department of Homeland Security and FEMA recently decided to incorporate two additional terms "resilience" and "prevention" as part of the Emergency Management cycle. Resilience generally explains the four phases: an ability to recover from or straightforwardly adjust to misfortune or change. Prevention is 100% mitigation, by definition—alleviating the risk of threat (U.S. Department of Homeland Security, 2011). In implementing the four phases, technology incorporates systematic procedure to solve problems, and should be used to improve the effectiveness and efficiency in which potential emergency events can be lessened or prevented.

Use of Technology in Emergency Management

Information Technology (IT) is an integral tool in Emergency Management, and it assists in planning and time reduction. The internet is an example of IT that performs numerous capabilities that are vital in Emergency Management. The internet heightens awareness through web pages that inform citizens. The internet allows opportunity for community discussion groups, making disaster plans available online, providing educational disaster management material to schools, libraries, other community related places, and providing support for training or practice can be used to support cultural factors (Ozceylan and Coskun, 2008). Reddick (2010) stated that the internet can provide valuable information regarding emergency incidents. To those responding to an emergency incident, the internet allows responders to work with each other and across jurisdictions with the ability to hastily communicate and share resources. This is an inexpensive means to exchange information on particular topics, which reaches across communities and national and international boundaries.

Reddick (2010) expounded on the use of wireless technology, geographic information systems (GIS), and remote sensing utilization in emergency management. He contended that wireless technology had aid in responding to an incident quickly and updating information. Troy (as cited in Reddick, 2010) indicated that wireless technology may include remote communication to responders and collection of digital data. Geographic Information Systems (GIS) is a system that captures, stores, manipulates, analyzes, manages, and presents all types of geographical data. Senior and Copley (as cited in Reddick, 2010) asserted that GIS technology enhances emergency management information systems by digitally capturing, storing, analyzing, and manipulating data. It queries and displays geographic information quickly and presents it in an understandable format.

Reddick further discussed that warning systems forecasts and gathers information on an approaching emergency and communicate that information the vulnerable parties. The author asserted that the National Weather Service has detection and warning systems, and Emergency Managers receive information to broadcast and caution those under potential threat. This is vital to schools, and it is important that schools have appropriate technologies to reduce or alleviate unwanted incidents.

The School Incidents and Appropriate Technology:

New technology is a pertinent for effective security on school campus. Schneider (2010) contended that technological advances continue to modify, and it is imperative to stay abreast of the changes. Basic understanding of technological

advances and devices has become a requirement for well-informed school emergency planning. It is vital that technology be designated to the specific problem or incident for efficient planning and utilization. Schneider further contended that technology should be selected after the problems have been identified. After identified problems are prioritized, feasible solutions can be determined. Nevertheless, secondary and post secondary schools have their own unique problems and vulnerabilities that may render an emergency response.

On the secondary level, there may be bullying, cyber bullying, suicide, bombings, shootings, or other acts of violence. As time progress, such violent acts continue to rapidly escalate. Schuster (2009) reported that from 1999 to 2006, 116 students were killed in 109 school-associated incidents. As of 2012, this number still grows. On February 27, 2012, in Chardon, OH, six (6) students were shot at Chardon High School. One student died at the scene, and two others died the following day. In addition, one of the three others wounded was reported to be in critical condition (NG & Lowe, 2012). In Brindisi, Italy, a three gas cylinder bomb hidden in a large trash bin exploded in front of the Morvillo Falcone High School. This resulted in killing one 16-year old female student being killed and five (5) other students being injured (BBC News, 2012). Such catastrophes may have resulted from bullying or terrorist acts; however, similar incidents may occur in post-secondary environments (i.e. college and university campuses).

Colleges and universities do encounter these same incidents; however, there additional factors that result in violence or pose hazard on campuses. Known as one of the deadliest college campus massacres, Thirty-two people (27 students and five faculty members) were killed by a 23-year-old senior English major, on the campus of Virginia Polytechnic Institute and State University (Virginia Tech) in two separate locations, about two hours apart: West Ambler Johnston Hall dormitory, where two were shot dead, and Norris Hall, where the remaining 30 were shot in an attack lasting nine minutes. The student committed suicide (CBS News, 2009). USA Today (2010) reported that a biology professor, denied tenure at the University of Alabama in Huntsville, shot six faculty members at a faculty meeting. Three faculty members died in the shooting, and the biology professor was arrested after the shooting and charged with capital murder. These man-made incidents exist at schools in various forms; nevertheless, natural incidents, such as inclement weather, leads to possible closure, sudden evacuation, and destruction of facilities.

Since school administrators have safety as the utmost concern for students and staff, each school on all levels have plans that provide specific instructions in case on inclement weather. Inclement weather includes floods, excessive snow and ice, or other severe weather conditions. To better prepare schools for such, Barbara McNaught Wright, National Weather Service Meteorologist, developed a severe weather emergency plan that was adopted by schools on all levels around the country. The guide provides assistance to school administrators and teachers in developing a severe weather emergency plan for their school. Although the guide does not cover all situations, the intent is to provide adequate information to serve as foundation (NWS, 2002). Today, school campuses have active plans where they clarify potential weather hazards for their specific area; engage in disaster drills and test emergency warning devices. In Henryville, ID, Henryville Elementary School and Henryville High School sustained a direct hit of EF4 tornado. Satterly (2012) reported that administrators were forewarned of the severity of the storm and dismissed schools early. There were no fatalities or injuries due to tornado, although several bus drivers taking children home were forced to stop and seek shelter. Although this was commendable, earlier notification and assistance were possible through technology. New technologies, such as mobile phones, social media, and modern security and detection devices greatly impact emergency management and its functions for schools.

Mobile Phones

Mobile phone technology is becoming a major tool in Emergency Management as it continues to grow. Mobile phones serve as a major medium of communications, and students and school staff rely on this source. With this in mind, Emergency Management (2011) state that Personal Localized Alerting Network (PLAN) (formerly the Commercial Mobile Alert System—CMAS) was implemented by the federal government makes emergency alerts geographically targeted and available on mobile phones. The Emergency Management Magazine further explained that the free service send text-like messages to enabled devices based on the user's location. The emergency alerts are not stalled by user location congestion, and using cell towers, wireless providers will push the emergency alerts provided by government officials. Schools have incorporated similar alert systems, especially on secondary and post campuses, which send students warning of any incident or potential danger. Students can then notify others and immediate seek safety or evacuate if possible. Nevertheless, phone apps can greatly assist as well.

A vast majority of students own smartphones and consistently download phone apps. Most apps are for entertainment,

communication, and information purposes. However, students, school staff, and administrators can download phone apps that forecast and give warning of those approaching hazards and incidents. In 2011, FEMA implemented a text messaging alerts and smartphone app to aid the general public, including the academic community, on preparation and disaster recover. The public and the academic community may sign-up for to receive alerts by texting "PREPARE" to 43362 (4FEMA) for monthly preparedness tips. Those using the alerts may text also "INFO", "SHELTER", and "DRC" for general information, local shelter information, and local disaster recovery centers, respectively (FEMA, 2012).

According to Ellmers (2011), the new FEMA smartphone App will help make disaster preparedness and recover information available for growing mobile society. To users, there is access safety tips for various disasters, an interactive checklist for their emergency kits, emergency meeting locations and plans, and maps to help locate nearby shelters or FEMA Disaster Recovery Centers. Additional smartphone apps include smart-ICE, store the current medical problems, the medications, allergies, any medical devices such as defibrillators or pacemakers, medical history, any past medical problems, the surgeries, hospitalizations, immunizations; Droid 911, locates you via GPS and finds the nearest hospital, police station, tow truck, ATM or bank, and etc; Peace of Mind (POM), takes your geographic location and when things happen that are in your area, whether it be a weather alert, whether it be an earthquake, tornado, etc.; and others (Romero, 2010). Schools on all levels will benefit by ensuring the all essential staff are knowledge able of such applications to ensure that they are equipment for all types of incidents. However, social media expanding and society relies greatly in it as a means of communication.

Social Media

As social media flourishes as a web-based and mobile based technology that establishes dialogue among individuals, organizations, and society at large, it presence in Emergency Management also enhances. Premiere emergency agencies, such as Red Cross and FEMA utilizing this method to ensure that the public had needed information. According to Yasin (2010), Federal Emergency Management Agency, state and local entities, and emergency operators are using social media and Web 2.0 technology to reach out and interact with the public and enhance communications among collaborators.

Yasin further stated that Social media, Web 2.0 (e.g. blogs, wikis, video sharing, and etc.) provide a way for emergency management personnel to resolve data and other types of interoperability and communications concerns. Social media allow emergency managers to distribute information to wider audiences, interact with the public, monitor social media networks current during a crisis, enhance situational awareness, improve information sharing and collaboration during an emergency, and share best practices and lessons learned. Some featured social media sites that premiere emergency agency, as well as state and local entities, are Facebook, Twitter, LinkedIn, YouTube, and others. Lopez (2011) asserted that numerous colleges and universities are promoting the use of social media among students to communicate during emergencies as lifesaving tools. Lopez provided examples where the University of Oregon's security staff uses social media to football games, and the UCLA's report of a person near campus with a crossbow in 2007. With social media reporting, it is imperative to ensure the information is not misleading, exaggerated, or presents excessive commenting. The web manager at University of Texas-Austin indicated that there should have been a Facebook alert about their campus shooting, and the comment section should have been disabled to reduce high volumes of response. With Facebook's popularity, the addition of an emergency application is instrumental.

The feature, b-Reddi, is an application addition to Facebook where the uses connect to three friends who serve as lifelines during an emergency incident. The sophisticated feature evaluates threat levels and specifies disaster categories, and it provides survival resource information in lied of major disasters (Ellmers, 2011; FEMA, 2012). As social media use continue to aid schools in emergency preparedness, security and detection device leads in mitigating incidents.

Security and Detection Devices

Security and detection devices are critical in preventing an incident or reducing its affects. Such devices monitor designated areas, send alerts to emergency personnel of alarming events, restrict access, detect hazardous chemicals and weapons, and more. Schools greatly benefit from sufficient and useful security and detection devices. Schneider (2010) described the Emergency Notifications Systems for primary and secondary, and challenged that these schools districts to enhance their systems. The author contended that contemporary notification systems would go beyond the standard warning bells and alerts, but they have the capacity to send such notifications as conducting surveys, advising of student absences or school closures or to recruiting volunteers on short notice to various types of devices.

Regarding detections, the traditional metal detectors are still in place on some school campuses. However, metal detectors

are may be expensive, and a perpetrator may find alternative entrances to avoid the stationary detectors. Schneider indicated that hand wands may be are more affordable and portable. This will work when randomly chosen classroom for security scanning. In 2012, the New York Police Department is evaluating the Terahertz Imaging Detection, which measures the energy radiating from a body up to 16 feet away, and can detect anything blocking it, such as a gun (CBS New York, 2012). Once Terahertz Imaging Detection has been tested and adopted, this technology may help schools officials in detecting weapons before perpetrators enter on campuses.

Conclusion

The provided evidence explains how incidents affect society-at-large, and constant efforts must be made to improve preparedness. Since schools are one of the center-points of communities, effective and efficient mitigation, preparation, response, and recovery is vital. With increasing natural or man-made incidents, schools are becoming more vulnerable and approaches must be enforced to reflect the current age of technology. Such contemporary technologies will greatly assist in strengthening efforts that will minimize or alleviate potential harm to students, faculty, and the campus community at large. With safety being at the vanguard of societal concern, technological innovations must be developed and utilized in a manner that will strongly facilitate goals for a safer society, especially on school campuses.

References

BBC News (2012). Bomb kills girl outside school in Brindisi, Italy. Retrieved from http://www.bbc.co.uk/news/world-europe-18128170 on July 10, 2012.

Bennett, B. (2011). Effective Emergency Management: a closer look at the incident command system. *Professional Safety*. 56 (11), 28-37.

Buck, J. L. (2011). State of security: the growing presence of emergency management technologies on college campuses. *Technology Interface International Journal.* 12(1), 43-45.

Campus Security Magazine (2012). Recent Tornado Outbreaks That Have Affected Schools.

Retrieved from http://www.campussafetymagazine.com/Channel/Emergency-Management/Articles/2012/04/Recent-Tornado-Outbreaks-That-Have-Affected-Schools.aspx on July 11, 2012.

CBS News (2009). *At least 33 killed in VA Tech Massacre*. Retrieved from http://www.cbsnews.com/2100-201_162-2686709.html on July 10, 2012.

CBS New York (2010). NYPD, Feds Testing Gun-Scanning Technology, But Civil Liberties

Groups Up In Arms. Retrieved from http://newyork.cbslocal.com/2012/01/17/nypd-testing-gun-scanning-technology/ on July 12, 2012.

Department of Defense (2010). *Incident.* Dictionary of Military and Associated Terms. Retrieved from http://www.dtic.mil/doctrine/dod_dictionary/ on June 26, 2012.

Ellmers, R. (2011). FEMA launches its first-ever smartphone app and text message update. Retrieved from http://www.facebook.com/note.php?note_id=231810130198676 on July 12, 2012.

Emergency Management (2011). *Geo-Targeted Emergency Alerts to Cell Phones to Go Live in New York City.* Retrieved from http://www.emergencymgmt.com/safety/Geo-Targeted-Emergency-Alerts-Cell-Phones-051011.html on July 11, 2012.

Federal Emergency Management Agency (FEMA) (2007). *Emergency Management.* Retrieved from http://www.training.fema.gov/ on September 01, 2010.

FEMA (2012). Official FEMA Accounts. Retrieved from http://www.fema.gov/help/social_media.shtm on July 11, 2012.

Lopez, V. B. (2011). More universities relying on social media for emergency communication. USA Today: College. Retrieved from http://www.usatodayeducate.com/staging/index.php/ccp/more-universities-relying-on-social-media-for-emergency-communication on July 12, 2012.

National Center for Educational Statistics: Institute of Education Science (2012). *Fast Fact.* Retrieved from http://nces.ed.gov/fastfacts/display.asp?id=49 on July 10, 2012.

National Weather Service (2002). A guide to developing a severe weather emergency plan for schools. Retrieved from http://www.erh.noaa.gov/lwx/swep/swep.pdf on July 11, 2012.

Ng, G. & Lowe, B. (2012). *Chardon High School shooting: second student dies as alleged gunman is identified.* ABC News. Retrieved from http://abcnews.go.com/US/chardon-high-school-shooting-gunman-identified-tj-lane/story?id=15799815 on July 10, 2012.

Ozceylan, D. & Coskun, E. (2008). Defining critical success factors for national emergency management model and supporting the model information systems. 5th International ISCRAM Conference – Washington, DC, USA.

Reddick, C. (2010). Information technology and emergency management: preparedness and planned in US states. *Disasters*, 35 (1), 45-61.

Romero, R. (2010). *Smartphone apps offer support in emergencies.* ABC Local News. Retrieved from http://abclocal.go.com/kabc/story?section=news/consumer&id=7683535 on July 12, 2012.

Schneider, T. (2010). School Security Technologies. National Clearinghouse for Educational Facilitates. Retrieved from http://www.ncef.org/pubs/security_technologies.pdf on July 07, 2012.

Schuster, B. (2009). Preventing, preparing for critical incident in schools. U. S. Department of Justice, Office of Justice Programs: National Institute of Justice-The Research, Development, and Evaluation Agency. Retrieved from http://www.nij.gov/journals/262/critical-incidents-in-schools.htm on May 10, 2012.

Walsh, D. W., Christen, H. T., Callsen, C. E, Miller, G. T., Maniscalco, P. M., Lord, G. C. & Dolan, N. J. (2012). *National Incident Management System: Principles and practices* (2nd Ed.). Sudbury, MS: Jones & Bartlett Learning.

Wikipedia (2012). *Emergency Management*. Retrieved from http://en.wikipedia.org/wiki/Emergency_management on May 09, 2012.

Worrall, J. (2012). Are emergency care staff prepared for disaster? *Emergency Nurse.* 19 (9), 31-37.

United Nations Foundation: Vodafone Foundation (2009). *New Emergency Management*. Retrieved from http://www.vodafone.com/content/dam/vodafone/investors/annual_general_meeting/2010_review_of_the_year_and_notice_of_agm.pdf on May 30, 2012.

Homeland Security Advisory Council: United State Department of Homeland Security (2011). Community Resilience Task Force Recommendations. Retrieved from http://www.dhs.gov/xlibrary/assets/hsac-community-resilience-task-force-recommendations-072011.pdf on July 10, 2012.

USA Today (2010). Alabama campus reels after shooting. Retrieved from http://www.usatoday.com/news/nation/2010-02-15-professor_N.htm on July 11, 2012

Yasin, R. (2010). 5 ways to use social media for better emergency response. Government *Computer New*. Retrieved from http://gcn.com/Articles/2010/09/06/social-media-emergency-management.aspx?Page=6&p=1 on July 09, 2012.

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Safety

Smart Device Applications: Implementation into Safety

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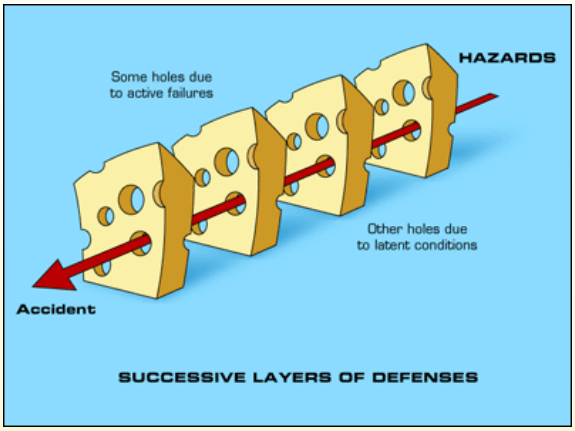
Abstract
There is a still a need for educational institutions to re-evaluate safety programs. Traditionally safety programs have been done face-to-face in a classroom setting. However, after this training, students are considered trained. This creates a false since of security. By adding smart device applications program to the training material a continuing education program can be developed to reaffirm the in-class training. This gives students a chance to study anytime they want. While creating a social network were they can ask questions of each other. This type of program takes the classroom training and can be applied in real word applications.

Introduction
This new methodology is being driven by several factors in university environments: Continued laboratory accident, changing pedagogy of the student population, improvements in technology and availability. The benefits of this type of program can be used in industry as well. This paper will focus on the driving factors but will also include the benefits of operating such a program, ethical concerns, and future applications. The goal of this program is to engage students, in a manner that is enjoyable for learning, while providing the necessary information to fulfill all regulation requirements.

Driving factors

Continued accidents
In the past few years there have been several high profile laboratory accidents in universities which have led to the death or permanent injury of students. These continued accidents have drawn the attention of several agencies including the United States Chemical Safety Board. There are several factors that have caused these accidents but after reviewing most can be taken back to human error by not following basic safety procedures: Ether because they were unknown to the student (lack of training) or forgotten (continuing education). This is not just a condemnation on the students but as an educational system as a whole. Administrators, Professors, Laboratory Directories, Graduate Assistance and Students all have a responsibility for safety. A good example of this is the accident that took place at Texas Tech University. In the United States Chemical Safety Board review of the accident that left a graduate student permanently disabled. A systematic break down was found. With the illustration of a Swiss cheese model. ("Texas Tech University," 2011)

("Swiss cheese model," 2012)



This accident could have been prevented at many different levels. But, if the student had proper training this accident might not have happened. This is an example of one of the most dangerous cycles in university laboratory safety a type of academic inbreeding. There is little chance for safety growth of professors and graduate assistances with students. Graduate assistance pick-up their safety habits for their professors pass them on to the next set of students. Over time these habits get water down and safety policy and procedures can be forgotten causing lack of training. ("Texas Tech University," 2011)

Student like many of us have tend to forget what they have learned and need consent reminders about safety. This is where continuing education in training comes in. Smart devices can fill this need by providing away for students to have access to information or provide warnings.

Changing Pedagogy

Students are learning differently now. Currently we are in the middle to late Generation Y entering into the universities and industry. This generation has grown up with the internet and computers. Overall these students have an inherent trust of technology and readily use technology at all hours day or night. (United Nations, 2011 p. 7) There has been a phrase coined that student's now are "always on" Students want and demand an answer when they want it and very quickly. This is sometime impossible but by using smart devices applications to be used in a safety program they can access information on their schedule with easy. One major learning style change of this generation in the use of social networking, today's students like to be connected with others and value an online community. This can be done through various means including but not limited to social media websites like facebook and youtube but, to various wikis and blogs as well. By developing a program that uses these elements students are more likely to be engaged in that activity. (Kelly, 2010)

Generation Y learning style:

- Multi-tasking
- Visual Learning
- Using Technology
- Goal-Oriented
- Socially Networked

(Kelly, 2010 p. 4)

Technology Improvements

Technology has improved over the last ten years to the point that technology enables students to be connected at all times. Smart devices include: smartphones and tablets. These devices have become a requirement for this generation to stay connected in their world. Recent studies show that this 81% of college students own a smartphone. (Flacy, 2011). Students are very active with them as well. Other studies have shown that 94 % of college students send text messages and 95% update facebook, via their smartphone. (Fox, 2011). With these types of numbers student uses these devices every day. It makes since to have a program that incorporates the devices that college students use most. The improvements with technology have made this possible.

Benefits

There are many benefits for operating a smart device application based program. However, the underling factor is cost per contact with students. This type of program can be cost effective with the amount of use that is gained by students having access anytime that the information is required. By allowing students to use their current smart device, cost to the university can be cut. Because there will not be an investment in infrastructure. This lesson is currently being learned by Research In Motion makers of Blackberry. Blackberry were the first smart device that was adopted by industry. Because of this they have enjoyed a corner on the market for several years within industry. But as other smart devices have become available companies are looking for devices that fulfill their business needs. This requires business to do a cost benefit analyzes to see if it valuable to change the operating platform.

By developing the applications, if a new smart device becomes more popular the safety information can be copied and place in the new operating system. As regulations are updated this can be easily changed in the application. This means in class training material does not have to be tossed and recreated. This saves the both time and money to the university.

Ethics

This is an important subject and need to be understood by both the students and developers. There is a lot of information that can be taken from users of the safety app. This information can be used to adjust content so that students are receiving the information they require. This is important as a feedback loop. However, other personal information of the user can also be obtained. What is done with this information is a matter for each intuition. As smart devices are developed with more personal communication e.g. (apple's Siri), workers at IBM that bring in their personal smartphones with this application have to turn this function off while at work. This is due to the fact that apple stores all inquiries made to this application. This means that Siri can gain private information from competitors. (McMillan, 2012) This is just but one example. However, when creating an application for safety training purposes there is an ethical responsibility for the information given to students to be accurate, easy to understand, and fulfills legal requirements.

Future

Smart devices have been rapidly developed over the last 5 years with the amount, complexity, usability, and connect-ability of applications that can be used by students. As a broad statement smart devices as a whole will become more integrated into everything that we do through the day. This can have a profound effect on a safety program. For example as the cost of Radio Frequency Identification Tags (RFID's) become cheaper all laboratory equipment could have a RFID tag attached. When a student wants to use the machine all he or she would have to do is take out there smart device scan it by the RFID. The smart device would then be directed to the information in the application which could show the student: the operator's manual, video or other information that could be very helpful. Also by using the GPS system located in most smart devices a laboratory monitoring system could be developed to notify the laboratory director or university official that a student in working in a laboratory alone or after hours. The future of applications depends on what is wanted or required.

Conclusion

Traditional training methods have become outdated with the current student learning styles. These students have a trust of technology and are describe as always on. An implementation of smart device applications training program can engage these students to work safely. Several factors are pushing for such a development continued accident, changing pedagogy of students, and improved technology. There are several benefits to this type of program which included cost savings to the university or institution and easy of updating information. As with any program there are ethical questions that need to be understood before a program goes forward. The future for the impact of smart devices and applications is limitless has our need for understanding and connections grow.

References

Flacy, M. (2011, November 30). *Study: Nearly 80 percent of college students can't figure out qr codes*. Retrieved from http://news.yahoo.com/study-nearly-80-percent-college-students-cant-figure-050317849.html

Fox, Z. (2011, October 31). *How cellphones shape the lives of college students*. Retrieved from http://mashable.com/2011/10/31/cellphones-college-students/

Kelly, P. J. (2010, November 19). *Generation y students in pa education*. Retrieved from http://www.paeaonline.org/index.php?ht=a/GetDocumentAction/i/128806

McMillan, R. (2012, May 24). *IBM worries iphone's siri has loose lips*. Retrieved from http://edition.cnn.com/2012/05/23/tech/mobile/ibm-siri-ban/index.html

Swiss cheese model. (2012, July 5). Retrieved from http://patientsafetyed.duhs.duke.edu/module_e/swiss_cheese.html

Texas tech university laboratory explosion case study. (2011, October 19).Retrieved from http://www.csb.gov/investigations/detail.aspx?SID=90

United Nations.(2011). *Overcoming generational gap in the workplace*. Retrieved from http://www.un.org/staffdevelopment/pdf/Designing%20Recruitment%20Selection%20&%20Talent%20Management%20Model%20tailored%20to%20meet20UNJSPF's%20Business%20Development%20Needs.pdf

Appendix A

Definition of Key terms

Smart device- Is an electronic device that is cordless (unless while being charged), mobile (easily transportable), and always connected.

Generation Y- Individuals generally born from 1982-2000.

Application (app) - Is a software application designed to run on smartphones, tablet computers and other mobile devices.

Teaching Innovations

Teaching Innovations

Implications of Personality Traits and Attitudes Towards Sustainability on Information Technology Education

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Introduction

There is a demand for information technology (IT) professionals who can incorporate Green IT strategies in how they design their systems. To address this issue, faculty in information technology disciplines can incorporate sustainability into their curriculum design. The dilemma is that despite exposure to these materials, it does not predict that students will incorporate sustainable practices once they enter into the workforce. One of the first steps in engaging students in sustainable practices is the foster a positive attitudes towards sustainability. This study looks to see whether there are linkages between sustainability attitudes and personality traits. If it can be determined that there are linkages, then strategies can be developed to encourage students to commit to developing technology solutions that minimize the negative impact of technology on the environment and society, while having a positive economic impact.

Fostering Sustainable Practices

To increase the likelihood that students will engage in sustainable IT practices upon graduation, there are a number of theories that provide frameworks for changing behavior. Early frameworks tended to follow a linear model (Eden, 1998; MacNaghten & Urry, 1998) where the belief when individuals were provided with information, they would make a rationale choice to change their behavior. There has been little support for the linear model as evidenced by the many governmental programs that have failed to yield measurable improvements (Barr, 2003; Kollmuss & Agyeman, 2002).

Fisher and Fisher (1992) provided an extension to the linear model with their IMB 3-factor model. This model proposes that information (I), motivation (M), and behavioral skills (B) are the primary contributors to behavioral change. The information component consists of providing the concepts, theories, or knowledge associated with, in this case, sustainability in information technology. The behavioral skills component moves from theory to practice. It is the providing students with the applied skills needed to make a change. Again, this should be a standard approach to information technology education. The final component of the model is motivation. In Oskamp's (2002) description of the IMB model, motivators for pro-environmental behavior include external circumstances such as environmental disasters, climate changes, or depletion of natural resources. Though it does not appear to be indicative of the original model (Fisher & Fisher, 1992), Oskamp fails to acknowledge the influence of internal factors on motivation. The limitation of the IMB model is that it does not account for barriers that decrease the likelihood of an individual engaging in pro-environmental behavior.

The models of pro-environmental behavior have become more complex as they try to incorporate a broad spectrum of motivators and barriers (Coleman, 1986; Kollmuss & Agyeman, 2002; Melville, 2010). A recent framework proposed by Kollmuss and Agyeman (2002) highly interactive model in which external factors and internal factors are counterbalanced against barriers to pro-environmental behaviors. The external factors include political, social, cultural, or economic incentives for pro-environmental activities. Included in the internal factors are knowledge, value systems, attitudes, and personality traits. Barriers to pro-environmental behavior include the lack of internal incentives, lack of perceived opportunity to engage in pro-environmental activities, lack of external incentives, and old behavior patterns.

Attitudes, Personality Traits and Sustainability

One of the commonalities among each of the models of behavior change is a positive attitude towards the change. Diekmann and Preisendoerfer (1992) proposed that the degree to which environmental attitudes impact pro-environmental

behaviors is a function of the cost or barriers to such behavior. Positive environmental attitudes serve as an indirect influence on pro-environmental behaviors (Kollmuss & Agyeman, 2002). Without a positive attitude towards environmental issues, the likelihood that an individual will acknowledge the value of the environmental information, strategies, or incentives will be minimized.

Researchers have tried to find links between personality traits and pro-environmental behavior. The personality traits investigated include prosocial (Kaiser, 2006; Kaiser & Byrka, 2010), locus of control (Kollmuss & Agyeman, 2002), and the Big Five personality traits (Hirsh & Dolderman, 2007). The Big Five (Goldberg, 1993) personality traits are agreeableness, conscientiousness, extraversion, neuroticism, and openness. Among these, only the Hirsh and Dolderman (2007) study provided an empirical investigation of the correlations between personality traits and environmentalism. Of the five personality traits, only agreeableness and openness were found to positively predict environmentalism.

Another psychological factor that should be considered is self-efficacy. Self-efficacy (Bandura, 1994) refers to an individual's perception of control over life's circumstances. Those with a high level of self-efficacy are confident in their ability to overcome the challenges set before them. It could be predicted that those with a strong sense of self-efficacy would have a more positive outlook towards sustainable practices since they would be less likely to be dissuaded by the perceived barriers of such activities.

Sustainability in Information Technology Education

The focus of information technology education should be on preparing students to be the next generation of leaders in information technology. This is accomplished by developing a "big picture" approach to designing technology systems that facilitate the accomplishment of an organization's goals and objectives. They need to be solution providers. In addition to designing systems based on efficiency and productivity, IT initiatives should also be based on sustainability. This has been recognized by the IT industry with the large volume of trade articles about "Green IT". Higher education needs to follow suit be teaching students how to incorporate sustainability into how the solutions they design.

Research Objectives

Phase 1: Assessment Tool Development

Ultimately, the assessment tool is intended to be used to gauge an individual's attitudes towards the sustainable use of technology. In a review of the existing literature, it was found that most of the assessment tools for attitudes towards sustainability were focused primarily on a general ecological aspect of sustainability. Issues related to the societal aspect of sustainability were less prominent. Very little was found with respect to the financial or economic aspect of sustainability. Sustainability has thought to have been the intersection of ecologic, economic, and societal considerations (Gibson, 2006). As Gibson noted, many sustainability research projects and policy decisions have started by focusing on the individual pillars and then have unsuccessfully tried to integrate them later. Instead, the integration of the three aspects of sustainability should serve as the foundation upon which such activities are developed.

To support the goal of assessing attitudes towards the sustainable use of technology, ecologic, economic, and societal issues related to consumer electronics were explored during the question development of the survey. Questions related to the environmental aspect of sustainability included topics such as recycling, e-waste, and carbon emissions. To address the economic aspect, the questions covered financial incentives or detractors from pro-environmental behavior. The impact of consumer electronics on the human condition was the basis for questions assessing the societal aspect of sustainability. From these topic areas were develop an initial set of 46 survey questions using a Likert-type scale. Of interest is whether the assessment items would separate into the factors along the three pillars of sustainability, or if there would be a single overarching factor for an integrated concept of sustainability.

Participants

Data collection for this study was conducted at a Midwestern public university. Subjects were drawn from the pool of students enrolled in introductory psychology classes. Students (N=93) participated in the study in partial fulfillment of course requirements.

Results

The data analysis began with an exploratory factor analysis to determine whether there would be a single sustainability

factor, three factors for the aspects of sustainability, or an unanticipated number of factors. Principal components extraction was ran for eigenvalues, a scree plot, and tests of factorability. The first concern of EFA is the factorability of the data. The Kaiser-Meyer-Olkin Measure of Sampling Adequacy = .79 which is significantly larger than the .6 cutoff for factorability. The test for sphereicity was significant at $p < .001$. As the test for sphereicity suggests the null hypothesis rejected that the items are correlated above .0. The two previous measures show that the data is factorable. Nine factors are shown to have eigenvalues greater than one, the percentage of variance decreases substantially with each subsequent factor.

Maximum likelihood extraction was used with a 1 factor solution. The goodness-of-fit test showed significance at $p < .001$. Items were removed from the measure that had inter-correlations lower than .3. The Cronbach's alpha for the final 31 item measure was .903 showing strong internal reliability. A MAP analysis was performed on the data suggesting that a 5 factor solution would be the ideal fit. The smallest minimum average partial was .204 for the 5 factor solution. For a one factor solution the smallest minimum average partial of .022. A one factor solution is shown to be supported by the results of the exploratory factor analysis.

Discussion

The factor analysis found that the single factor solution based on the overarching concept of sustainability was the most appropriate interpretation. The evidence did not support the possibility that each of the three pillars of sustainability. That is, the questions related to the environment were not statistically distinct from the questions that had an economic or societal basis. Instead, the analysis indicates that subjects scoring high on the survey expressed a strongly positive attitude towards sustainability. This was supported when a statistical analysis for 2, 3, 4, and 5 factors failed to yield significant results.

The original assessment tool development process created a survey of 46 questions. The inter-correlation analysis was used to isolate the questions that most closely supported the single sustainability factor. Those questions that did not correlate strongly were dropped from the final version of the survey. The end result was a survey of 31 questions with a Cronbach's alpha above .90. The high value provides support for the assertion that the final survey is a strong measure of sustainability attitudes with respect to consumer electronics.

Phase 2: Personality Traits and Sustainability Attitudes

The second phase was to determine whether there are any statistically significant relationships between personality traits and sustainability attitudes. The existing research has found that there are correlations between personality traits and pro-environmental attitudes. Of interest is whether these relationships exist when using a comprehensive sustainability attitudes assessment tool. The purpose of the second objective was to determine if there are statistically significant correlations between personality traits and sustainability attitudes and whether they differ from pro-environmental attitudes.

Participants

As in Phase 1, subjects were students recruited from an introductory psychology course as partial fulfillment of their course requirements. There were 58 female and 29 male (N=87) students who participated in this phase of the study.

Instruments

Sustainability Attitudes towards Consumer Electronics. The attitudes measure developed in stage one was used for stage two. With a Cronbach's alpha of .902, the measure provides high internal reliability in assessing attitudes towards personal technologies such as consumer electronics. The assessment tool included 31 self-report questions measured with a Likert-type scale where responses ranged from 1 – 7. A low score indicated that the individual disagreed with the statement and a high score represented agreement with the statement. A low score on the overall assessment indicates negative attitudes towards sustainability with consumer electronics, while a high score represents a highly supportive attitude towards sustainability.

Five-factor Model**.** The first set of personality traits assessed were agreeableness, conscientiousness, extraversion, neuroticism, and openness (Goldberg 1993). Previous research into personality traits and pro-environmental behavior has used the "big five" as the core set of traits in their investigations. They were included in this study to see whether a measure of all three aspects of sustainability would support or contradict the findings from these other studies. Subjects were administered a self-report assessment that used a 7 point Likert-type scale where 1 was extremely inaccurate and 7 was extremely accurate. Each of the factors was assessed with a series of twenty items consisting of single-trait descriptive adjectives.

Locus of Control. Locus of control refers to one's perception of whether life's circumstances are influenced by choices made or are a result of outside influences (Rotter, 1966). Those with a high internal locus of control believe that they influence the world around them through the decisions that they make and the actions that they take. Individuals with a high external locus of control believe that their choices make little difference in the world. They believe that what happens is influence by those in authority, government, society, or fate. Subjects completed a survey consisting of dichotomous personal descriptors. The outcome of the survey was based on the number of internal versus external locus of control descriptors chosen by the participant.

Self-Efficacy**.** Self –efficacy is the belief in his or her own confidence to achieve personal goals (Bandura 1977). The 10 item self-report measure is a Likert type scale that is rated from 1 to 7 where 1 indicates strongly disagree and 7 indicates strongly agree with the statements. Those who score high on the scale claim to be highly able to achieve life goals, whereas one who scores low on this measure believes that they may be less able to achieve personal goals.

Pro-social Behavior**.** The pro-social behavior scale was developed to assess tendencies to be empathetic and altruistic (Carlo & Randall, 2002). The 23 item self-report measure is a Likert-type scale that is rated from 1 to 7 where 1 indicates strongly disagree and 7 indicates strongly agree. Those who score high on the measure claim that their behaviors are often pro-social in nature.

Results

Correlations were performed to compare the attitudes toward sustainability with the pro-social, self-efficacy, locus of control, and the big five personality measures. Correlations between the attitudes measure and the pro-social, self-efficacy, and locus of control scales were shown to be non-significant at $p>.05$. The attitudes of sustainability measure and conscientiousness had a medium positive correlation $r(85) =.301$, $p<.01$. The attitudes measure also positively correlated with openness $r(85) =.266$, $p<.05$.

Phase 2 Discussion

The attitudes of sustainability in consumer electronics measure correlated positively with conscientiousness and openness. The correlation of attitudes and personality traits indicated that more positive attitudes are more associated with internal state traits. The other measures included in the current study were more focused on the ability to behave in various manners. The pro-social measure is geared towards behaviors dealing with altruism and empathy as a function of social exchanges. The self-efficacy questionnaire measures ones confidence that they will be able to perform behaviors or make changes in behavior. The locus of control measure differentiates between those who believe in the ability to change things lies within themselves or without.

The results may indicate that participants in this study do not doubt their ability to behave in a particular manner such as sustainable practices, but seem more likely to do so if they have certain personality traits such as being conscientious and/or open. A person who is conscientious is often described as having a high inner sense of right and wrong and governs their lives with a high moral compass. The open individual is thought to be open to new experiences. If positive attitudes correlate with people who either have a high moral compass or are open to new experiences may demonstrate that they would be more willing to perform sustainable practices.

Implications for Information Technology Education

The findings suggest that students with a high level of conscientiousness or openness are likely to have a favorable attitude towards sustainability. While positive attitudes are not a definitive predictor of behavior, it does serve as a barrier to sustainable behavior if not present. Students who score high on conscientiousness and openness are more likely retain and utilize the sustainable practices in information technology taught in class than those who do not.

The next phase of the research needs to investigate whether external motivators can influence sustainability attitudes for those who do not score high on conscientiousness or openness. Specifically, will appeals targeting specific aspects of sustainability have differentiated effects on attitudes towards sustainability? Instructors can then present information that positively influences attitudes towards sustainability among those that are not already predisposed by virtue of personality characteristics. Through this, an initial barrier to adopting sustainable practices in information technology will be reduced.

References

Bandura, A. (1994). Self-efficacy. In V. S. Ramachaudran (Ed.), *Encyclopedia of human behavior* (Vol. 4, pp. 71-81). New York: Academic Press.

Barr, S. (2003). Strategies for sustainability: citizens and responsible environmental behavior. *Area, 35*(3), 227-240.

Carlo, G., & Randall, B. A. (2002). The development of a measure of prosocial behaviors for late adolescents. *Journal of Youth and Adolescence, 31*(1), 31-44.

Coleman, J. S. (1986). Social theory, social research, and a theory of action, *American Journal of Sociology, 91*, 1309-1335.

Diekmann, A. & Preisendoerfer, P. (1992) Persoenliches Umweltverhalten: Die Diskrepanz zwischen Anspruch und Wirklichkeit *Koelner Zeitschrift fuer Soziologie und Sozialpsychologi e*, *44*, 226–251.

Eden, S. (1998). Environmental issues: Knowledge, uncertainty, and the environment. *Progress in Human Geography, 22*(3), 425-432.

Gibson, R. B. (2006). Beyond the pillars: Sustainability assessment as a framework for effective integration of social, economic and ecological considerations in significant decision-making. *Journal of Environmental Assessment Policy and Management, 8*(3), 259-280.

Goldberg, L. R. (1993). The structure of phenotypic personality traits. *American Psychologist, 48*, 26-34.

Fisher, J. D., & Fisher, W. A. (1992). Changing AIDS - risk behavior. *Psychological Bulletin, 111*(3), 455-474.

Hirsh, J. B., & Dolderman, D. (2007). Personality predictors of consumerism and environmentalism: A preliminary study. *Personality and Individual Differences, 43*, 1583-1593.

Kaiser, F. G. (2006). A moral extension of the theory of planned behavior: Norms and anticipated feelings of reget in conservationism. *Personality and Individual Differences, 41*, 71-81.

Kaiser, F. G., & Byrka, K. (2010). Environmentalism as a trait: Gauging people's prosocial personality in terms of environmental engagement. *International Journal of Psychology, 46*(1), 71-79.

Kollmuss, A., & Agyeman, J. (2002). Mind the gap: why do people act environmentally and what are the barriers to pro-environmental behavior? *Environmental Education Research, 8*(3), 239-260.

MacNaghten, P., & Urry, J. (1998). *Contested Natures*. London: Sage

Melville, N. P. (2010). Information systems innovation for environmental sustainability. *MIS Quarterly, 24*(1), 1-21.

Oskamp, S. (2002). Environmentally responsible behavior: Teaching and promoting it effectively. *Analyses of Social Issues and Public Policy, 2*(1), 173-183.

Rotter, J. (1966). Generalized expectancies for internal versus external control of reinforcements. *Psychological Monographs*, *80*, Whole No. 609.

Teaching Innovations

An Integrated Approach to Engineering a Collaborative Success - The Baja SAE Kansas Project

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Abstract

Through this paper, the audience will understand how Baja SAE Kansas, an international collegiate design competition, served as a catalyst for integration and collaboration by various technical and academic disciplines. The paper shares about the collaborative efforts of diverse academic groups to hold an international event (23% were international competitors). The integrative, collaborative approach and related ideas presented in the paper can be applied by other institutions to local, state, and regional events

Major components of this paper include:

- An approach to problem solving that integrates real world experiences, teamwork, and collaboration is desired by today's industry and business. A model of various industry and academic groups working together is presented.
- Specific collaborative activities/projects/contributions associated with various program areas, include:
  - Construction Management and Construction Engineering – track and site planning/construction (senior capstone project)
  - Graphics and Imaging Technologies – design and printing shirts, brochures, signage, etc.; web/social media activities; and event photography and videography
  - Information Systems, Communications, and Technology and Engineering Education – logistics and wireless video stream production
  - Automotive Technology – overall event coordination; track design input; design/build skid-pull equipment; and co-build vehicle for competition.
  - Engineering Technology – coordinate judging of engineering design reports;
  - Industry partners – providing heavy equipment for site preparation, equipment, vehicles, construction materials, funds, and donated labor.
  - Lessons learned regarding integrative approach and future preparations for Baja SAE Kansas 2014.

Introduction

In today's world, successful industry and business areas do not exist in a vacuum nor do they have a "silo" mentality. Collaboration is a key to success. Industry requests that we provide students and faculty with real world opportunities to solve problems, make decisions, develop life skills, plan, and execute solutions. Castner-Lotto notes, "Teamwork/collaboration skills rank second in importance for new entrants to the workforce, regardless of educational level, and critical thinking and problem solving are among the top five "most important" applied skills for all educational levels" (Castner-Lotto & Barrington, 2006, p. 24).

The Baja SAE Kansas collegiate design competition provides such an opportunity for faculty and students from the College of Technology, Department of Communications, Office of Information Systems, and other university service areas to work together. With SAE and corporate partners, these groups work to solve problems through collaboration--from the initial

planning and track/competition site construction through live video streaming the event throughout the world.

The Event—Baja SAE Kansas

Baja SAE consists of three regional United States competitions and three events outside the United States (Brazil, Korea, and South Africa), that simulate real-world engineering design projects and their related challenges. Baja SAE Kansas 2011 (and 2014 in the future) is one of the United States events. The event registered 100 teams with 23 teams from outside the United States, including teams from Argentina, Brazil, Canada, France, India, Israel, Mexico, and Venezuela. For the competition, engineering and technology students are required to design and build an off-road vehicle that will survive the severe punishment of rough terrain and sometimes water hazards.

The competition provides SAE student members with a challenge to plan and manufacture a new, single occupant, off-road vehicle for the consumer market. Each team competes to have their vehicle design accepted for manufacture by a fictitious off-road vehicle company. Students are required to function as a team to design, build, test, promote, and race a vehicle within the limits of the rules, and also obtain financial support for their project (http://students.sae.org/competitions/bajasae/about.htm).

Each vehicle is powered by an identical ten-horsepower Intek Model 20 engine donated by Briggs & Stratton Corporation. Using the same power plant creates a more challenging engineering design test that focuses on other aspects of vehicle design

Baja Kansas consists of three major areas of competition—static events, dynamic events, and endurance race. These areas and their respective components and point values are noted in the following table. (See Table 1)

Table 1. Baja Kansas SAE Events

Events	Activities/Components	Point Value	Judging
Overall Static		**300**	
	Cost Report and Costs judging	100	SAE officials
	Design Report	100	Regional engineers
	Static Judging, including:		
	- Manufacturability		
	- Serviceability		
	- Powertrain	100	Honda and Polaris engineers
	- Suspension & Steering		
	- Aesthetics & Creativity		
	- Craftsmanship		
Overall Dynamic		**300**	SAE officials and volunteers
	Acceleration	75	
	Land Maneuverability	75	
	Pull Event (Sled Pull)	75	
	Suspension & Traction	75	
Overall Endurance	Endurance Race (based on place and no. of laps completed in four hours)	**400**	SAE officials

Baja SAE Kansas—A Collaborative Problem Solving/Teamwork Learning Opportunity

All Baja SAE events must follow detailed guidelines; and overall coordination and logistics are determined by the planning team. In order to successfully host and compete in the Baja SAE Kansas event, the planning team had to identify specific event problems and assign them to various academic and support (non-academic/industry) groups. These problems actually became senior design projects, class projects for undergraduates, and special problems for graduate students. Selected problems include: track and site planning and construction; logistics and video stream production; design and production of graphic products and signage; organization and coordination of event, logistics, design judging, and liaison activities; and building a vehicle to compete in the competition. Three program groups—Construction, Information Systems and Communication, Graphics and Imaging Technologies, and their respective problems, problem descriptions, project facts, project processes, and project outcomes are highlighted in the following narrative.

Construction Management and Construction Engineering Technology

The School of Construction's programs have a unique approach to preparing graduates. Each freshman, sophomore, and junior in the program is routinely required to provide 10 hours of service in working on non-profit construction projects each semester as part of their methods courses. Each senior is required complete a senior design project and serve in a management position for a non-profit construction project. Therefore, CMCET faculty and students are uniquely prepared to take on construction-related problems associated with Kansas Baja SAE. Their problem is noted below.

Problem: Design, engineer, and build the following:

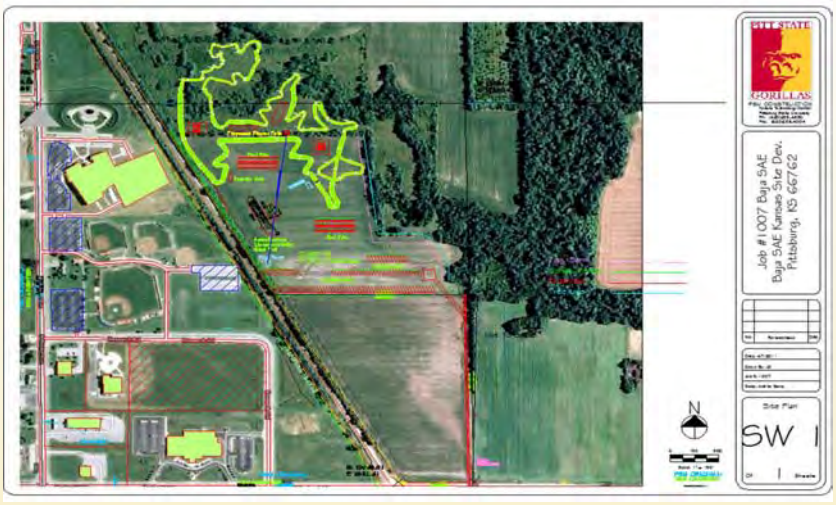
- 1.5 mile endurance track with approximately 30 obstacles
- Land maneuverability course
- Suspension and traction course
- Test track.

Determine all specifications and secure all necessary permits, heavy equipment, materials, and workforce to complete the projects in two semesters.

Project Facts: The following project facts were recorded by the senior project manager:

- Four (4) tracks totaling approximately seven (7) acres of disturbed area
- Design-build contract
- 34-week schedule
- Phase I
  - Overall site development
  - Design and layout of tracks (See Figure 1)
- Phase II
  - Finish design and layout of tracks
  - Implement Storm Water Pollution Prevention Plan (SWPPP)
  - Construction of Tracks
  - Finish Site Development.

Figure1. Site Plan and Layout of Tracks—Land Maneuverability, Suspension and Traction, Endurance and Test Tracks

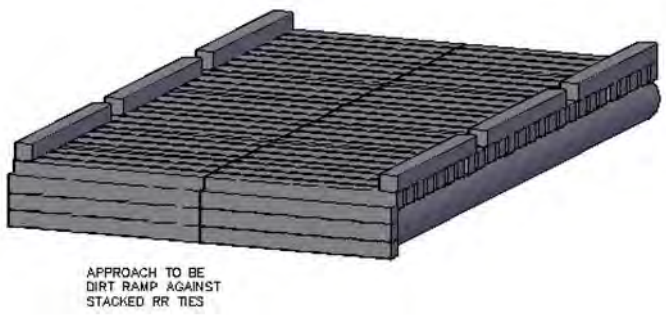


Process and Outcome: Under the leadership of the senior project manager, three management teams were formed: Endurance Track Team, Test Track Team, and Site Work Team. Each management team consisted of a project manager, superintendent, chief field engineer, and field engineer.

Each of these teams developed organizational charts, roles and responsibilities, scope of work (e.g., implementation of SWPPP; layout of paddocks, fuel pits, tracks, etc.; create, edit, and maintain all AutoCAD drawings; submit "Notice of Intent"; etc.), developed a safety plan; developed material lists and procured materials; developed schedules; procured equipment; completed site layout activities; excavated and constructed barriers, tracks and obstacles according to plans (See Figure 1); and completed project punch list.

Figure 2. Model of Railroad Tie Obstacle (a) and Actual Railroad Tie Obstacle (b)

a.



b.

Upon completion of the Baja SAE Kansas site construction, a dozen seniors presented their senior project reports in a collaborative report to the faculty and CMCET Advisory Council. The overall project provided CMCET seniors and underclassman a rich, real-world learning experience, which included rigorous compliance requirements, fixed deadlines, and lots of hard work. CMCET was also assisted by volunteers from the entire College of Technology—faculty, staff, and students and community volunteers. Industry donated much of the material and provided heavy equipment for excavation and construction of the competition tracks (Pressgrove, 2011).

Office of Information Systems (OIS) and Department of Communication

Office of Information Systems was tasked with providing infrastructure for networking computer and communication technologies on the university campus. Communications was responsible for providing live broadcasting and editing of university activities, including sporting events, news broadcasts, and radio programming. For Baja SAE Kansas, these major groups along with volunteers from Electronics Engineering Technology and Technology and Engineering Education and other volunteers were tasked to address the live video streaming of a Baja SAE event. There specific problem follows.

Problem: For the first time in Baja SAE history, live video stream Baja SAE dynamic events and the endurance race. This includes:

- Stream video of land maneuverability testing, suspension and traction testing, sled pull and endurance race from a remote location to the world via the web. Access problems with this remote location, include:
  - Railroad right-of-way precludes any wired or fiber optic network extensions.
  - No electrical power delivered by utility company; only power from portable generators.
  - Areas of the dynamic venue are widely spaced (>100 meters).
- Publish near real-time scoring data to participants and public via the web.
- Provide open wireless Internet access to participants and to the public attending the dynamic events and viewers throughout the world. [Note: Over 5000 people logged on to watch portions of the competition and hear live commentary.]

Project Facts: The following fact sheet provides specific information about the design and implementation of infrastructure and live video streaming of the event:

- OIS provided two teams—OIS Infrastructure Team and OIS Application Development Team. At least two infrastructure team members and one development team member were on-site throughout the competition.
- A 160 megabit -full duplex wireless bridge with QoS was used. One transceiver was on the Student Recreation Center and one on the pole at the venue to allow wireless delivery of signal from the venue over the railroad right-of-way to the campus. This provided carrier class QoS enabled trunked connectivity—temporarily extending the University's backbone to the venue.
- Infrastructure also included:
  - Ethernet switches with gigabit fiber optic GBICS
  - Two virtual LANs (VLANs)—general purpose wireless Internet, and dedicated video and administration (assigned "real time" QoS priority)
  - Fiber-optic cable on the ground, in the trees, and under the track using inter-duct as temporary conduit.
- Wireless access points were located on the telephone poles, in the trees, and under tables.
- Encoder PC in the production trailer sends multiple bit rates to Flash server in the university data center.
- Borrowed generators (with dedicated fuel replenishment teams powered) provided power to the infrastructure, three camera locations, and video production equipment.
- Laptops and HD monitors display real time score data using a custom web application.
- In the data center, Server 2008 virtual machine with four (4) virtual CPUs running Adobe Flash Media Server were used. Gigabit connection to the Internet was via the Kansas Research and Education Network (KanRen). (Comeau, Iley, Pearson, & Stolifer, 2011)

Outcome: With the infrastructure in place, Communications employed three cameramen on three donated sky lifts to video record all dynamic events and the endurance race. The video feed to the production trailer was monitored by the director and production crew. (See Figure 3) Two commentators (part of a three-man rotating team) provided color commentary of the video they saw, which was then sent out to the Baja audience as a live video stream via the Internet. SAE officials and fans expressed appreciation for the video stream to Baja SAE Kansas Organizers.

Figure 3. Cameraman Shooting Live Video from Sky Lift (a), and Video Production Trailer (b)

a.

b.

Graphics and Imaging Technologies

The Department of Graphics and Imaging Technologies (GIT) prepares students for graphics-related industries, including graphics design, printing, photography, web design, and integrated digital media. GIT faculty and students are therefore well prepared in terms of technical skills, equipment, and facilities to address graphics and media-related problems associated with the Kansas Baja SAE event. Their problem follows.

Problem: Design and produce all graphic products associated with Baja SAE Kansas. These include:

- Official event t-shirts with original Baja SAE Kansas graphic
- Official event brochure
- Event-at-a glance brochure
- All event signage
- Videotape highlights. (Alselmi, 2011)

Determine media content, design all graphics, coordinate all volunteers involved, and produce all printed products. Also, photograph all teams and post to the web.

Project Facts: The following project facts are noted:

- T-shirts required for team members of 100 teams registered for event, as well as for visiting guest and spectators.
- Approximately 3000-4000 people were expected to attend the Baja SAE Kansas event.
- *Event Guide Brochure* needed to include: team information—number, school, team name, and country; small maps of Kansas Technology Center static events area and street map with dynamic events venue; schedule of events; design judging schedule for all teams; and large map of dynamic competition area.
- Signage—area signs and banners for all locations, and signs to provide directions and convey critical information throughout the event.
- Photos of 87 participating (actually competed) teams in the event and posted to the web.

Outcome: Several hundred t-shirts sporting original Baja SAE Kansas graphics, designed by GIT faculty member, were screen printed on-demand by GIT students and faculty, using a fully automatic textile screen printing machine. (See Figure 4)

GIT students competed in developing the graphic design for brochure cover. The winning design was used on the brochure designed by a senior and printed by other students using a Xerox variable data printer. (See Figure 5) Banners and other large signage was printed on one of two wide format printers. Students and faculty gained essential real-world experience as they worked to satisfy SAE constituents and meet required specifications and deadlines (Iley, Klenke, Neden, 2012).

Figure 4. Automated Screen Printing (a), Baja SAE Kansas T-Shirt Design (b), Drying Shirts (c)

a.

b.

c.

Figure 5. Printing with Xerox Variable Data Printer (a), and Baja SAE Kansas Brochure (b)

a.

b.

Summary

The Baja SAE Kansas event provided participating College of Technology and other university a rich and successful experience in real world collaboration and teamwork. The model of integrating real world problems into senior design projects and learning experiences for other undergraduates is transferrable to other events. For example, in Fall 2011, programs collaborated similarly in another major event, *Extreme Home Makeover—Joplin* ("*7 Houses in 7 Days*"). This event provided collaborative, real-world opportunities for approximately 250 students and faculty associated with Construction, Safety, Wood Technology, Technology & Engineering Education, Nursing, and Engineering Technology programs—Electronics, Manufacturing, Mechanical, and Plastics.

In 2014, PSU will be hosting Baja SAE Kansas 2014. With the experience and success gained from Baja SAE Kansas 2011 and the additional time to plan for the event, programs plan to incorporate more activities over a two-year period. Several programs (e.g., Nursing, Electronics Engineering, Business, and others) not as involved in 2011, plan to be more involved for 2014 and develop curricular activities and field experiences in conjunction with the event. Several area businesses and civic organizations have indicated a desire to sponsor various activities and assist with the event.

In conclusion, the successful model and benefits associated with Baja SAE Kansas can be replicated by other institutions --- from hosting regional competitions to promoting a regional or state-wide event; creating capstone projects; and real world learning.

References

Alselmi, J. (Producer). (2011) SAE Kansas Baja competition recap [DVD]. Available from http://www.youtube.com/watch?v=AEe4zjQ99qs

Casner-Lotto, J., & Barrington, L. (2006). *Are they really ready to work? Employers' perspectives on the basic knowledge and applied skills of new entrants to the 21st century U.S. workforce*. USA: The Conference Board. Available online at http://21stcenturyskills.org/documents/FINAL_REPORT_PDF09-29-06.pdf

Comeau, T., Iley, J., Pearson, T., Stolifer, A. (November, 2011) *Live video streaming Baja SAE Kansas: Logistics and Production*. Paper presented at the Four State Regional Technology Conference, Pittsburg, KS.

Iley, J. , Klenke, A., Neden M. (March 2012) *Baja SAE Kansas: collaborative success—design to streaming.* Poster session presented at International Technology and Engineering Educators Association Conference, Long Beach, CA.

Pressgrove, J. et al. (May 2011) *Baja SAE project #1007, phase II*. Paper presented at Construction Management and Construction Engineering Senior Design Seminar, Pittsburg State University, Pittsburg, KS.

Society of Automotive Engineers. (2012). *About Baja SAE*. Retrieved from http://students.sae.org/competitions/bajasae/about.htm

Strengthening Our Connections

2012 Graduate Student Research Presentation Competition Abstracts

ATMAE
LEAD • INNOVATE • COLLABORATE

The Association of Technology, Management, and Applied Engineering

The 2012 ATMAE Conference Graduate Student Research Presentation Competition

Each year the ATMAE Conference provides an opportunity for graduate students to submit presentation proposals for peer-refereed review by a panel of faculty. Those selected to present at the conference do so in a competitive format with awards presented for best presentation, judged upon the written abstract, the oral presentation, and supporting presentation media. In 2012, nine presentation abstracts were submitted, and four were selected for the final conference presentation competition after a faculty panel review process.

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Towards Environmentally Conscious Manufacturing

Ms. MariEtta Joleen Byerline 4
How Kaizen Event Group Leader Selection Affects Group Participation

Mr. Blake Cvengros 5
The Environmental Effect of High and Varying Costs in LEED Construction

Mr. Charles M. "Matt" Watson 6
Integrated CAD/CFD Analysis of HVAC Fresh Air Intake System Design of an On-Highway Crane

ATMAE 2012 Graduate Student Research Competition Abstract

Generative Reduction of Energy Emissions via Numerical – Adaptive Control: A Step Towards Environmentally Conscious Manufacturing

Mr. Dean L. Bartles,
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Need: Manufacturers need to develop ways to use less energy in producing the same amount of product in order to reduce the amount of greenhouse gas emissions they create through the consumption of energy derived from the burning of fossil fuels.

Overview: According to the National Association of Manufacturers, "US manufacturing produces $1.7 trillion of value each year, or 11.7 percent of U.S. GDP" (retrieved 07/18/2012 from http://www.nam.org/Statistics-And-Data/Facts-About-Manufacturing/Landing.aspx). Although manufacturing is an extremely important economic sector to the US, it comes with a price. Offsetting the positive attributes of its contribution to US Gross Domestic Product, job creation, knowledge production, etc., is the toll that US manufacturing has taken on the environment. Rahiimiifard (2007) found that the manufacturing industry is one of the biggest sources of negative environmental impact.

Major Points:

- "Adaptive Control" is a method using automatic means to change the type and/or influence of control parameters to achieve near optimum processing performance. (Drozda & Wick, 1983)
- "Adaptive Control" allows the machine to automatically adapt the operating parameters to conform to newer circumstances. (Kalpakjian and Schmid, 2007)
- An adaptively controlled machine is able to adapt to the dynamic changes of the system caused by the variability of machining process due to changes in the cutting conditions such as the hardness of the work material, tool wear, deflection of the tool and the work piece, and so on. (Davim, 2008)
- There is paucity in the literature related to how "adaptive control" might be employed to reduce the amount of energy consumed by machine tools in manufacturing.
- This study will encompass field research directed at reducing the amount of energy consumed by machine tools in manufacturing through the employment of "adaptive control" technology.
- This study will investigate the relationship between seven independent variables (adaptive control, feed rate, spindle speed, depth of cut, coolant temperature, coolant flow volume, and tool condition) with energy used during a machining cycle.

Summary: Since the literature has already shown that a high level of greenhouse gas emissions are attributable to manufacturing through the energy that is consumed by machine tools, reducing the amount of energy consumed will not only have a positive impact on the environment, but a positive impact on business performance through lower energy costs. Details on above cited references available upon request.

ATMAE 2012 Graduate Student Research Competition Abstract

How Kaizen Event Group Leader Selection Affects Group Participation

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Need: Organizational communication research indicates group member contributions increase when the participant with the greatest legitimate power, or hierarchal status, does not serve as the group leader. Lean principles and practices indicate Kaizen Event members will contribute regardless of group leader selection, due to member training, education, and the Lean team-oriented culture. Further study is needed to determine if Lean culture and training maximizes group member contribution, or if participation increases in Lean environments when the chosen leader does not hold the greatest legitimate power. The study provides insight to Lean organizations for maximizing member participation at Kaizen Events, consequently maximizing efficacy of the event.

Overview: Organizations that have practiced Lean principles for at least two years and have completed a Kaizen Event within three months previous to the beginning of the study may participate. The participating organizations will indicate if the leader of the Kaizen Event group or subgroup possessed the greatest legitimate power, or highest bureaucratic authority. Kaizen Event participants will receive a voluntary survey consisting of Likert scale-scored questions regarding his or her perceptions of level of contribution, encouragement for contribution, and comfort in contributing. The data will be assessed to determine if Kaizen Event groups scored higher when the leader did not possess the greatest legitimate power.

Major Points:

- Lean literature emphasizes the importance of each member contributing during group activities, such as Kaizen Events.
- Lean literature advises selecting group leaders based on KSA (Knowledge, Skills, Abilities) and/or employee development, rather than selecting leaders in order to maximize group participation.
- Organizational communication literature suggests group leader selection can affect the level of group participation.
- A study with an interdisciplinary approach will determine if Lean group participation increases using leader selection tactics other than KSA and employee development.

Conclusion: Estimates suggest up to 60% of U.S. companies are implementing some form of Lean practices. Given the potential for maximizing the efficacy of Kaizen Event groups and the importance Lean organizations place on incremental improvement, this research is an important contribution to American industry.

ATMAE 2012 Graduate Student Research Competition Abstract

The Environmental Effect of High and Varying Costs in LEED Construction

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Need: The impact of high and varying costs in LEED certification on the environment will be examined in this research. The research involved will compare the extra and varying costs of building using LEED certification methods to the decisions made by Project Managers during the building process. In order to advance and improve upon the LEED certification process, the way builders make decisions based on costs must be examined. The research will give distinct comparisons to allow for examination and discovery of potential improvements in the LEED certification process.

Overview: Extra costs in LEED construction and the varying costs to obtain certain certifications encourages builders to take the cheapest and potentially less environmentally friendly route to obtaining LEED certification. A qualitative strategy of inquiry will allow for industry professionals to support or refute the evidence shown to them. A survey to several project managers who have built LEED structures will determine whether their approach to achieving a certain LEED rating is the most environmentally friendly or the most cost friendly.

Major Points

- LEED construction is commonly more expensive than general construction.
- The costs of LEED construction can vary within the same rating.
- The cheaper alternative to achieve the same rating could potentially be less environmentally friendly than the more expensive option.
- Project managers tend to choose the most cost efficient way to obtain a LEED rating as opposed to the most environmentally efficient.
- The occasionally high costs of LEED construction promote cutting corners and not building the most environmentally efficient structure.

Summary: Green and sustainable building has promoted many new building practices and processes in the relatively recent past. These new methods of construction are continually developing and will be around for years to come. LEED certification promotes such practices. Although LEED construction continues to become more affordable, there are still varying costs to obtain a specific LEED rating. The extra costs of LEED and the varying costs within each individual rating could cause a decision-making project manager to choose a cheaper option when faced with the opportunity. This cheaper option could affect the environmental impact of the structure as a whole and promote a less environmentally friendly building. When complete, this study should promote less varying costs in each LEED rating, and a potentially more refined and specific point system for LEED certification.

ATMAE 2012 Graduate Student Research Competition Abstract

Integrated CAD/CFD Analysis of HVAC Fresh Air Intake System Design of an On-Highway Crane

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Need: There has been a consistent need regarding on-highway cranes for a means to introduce outside fresh air into the HVAC system of the driver's cab in order to better de-fog the windshield and side windows when a humid and/or wet outside environment is encountered. An initial design for this system resulted in the air conditioning system expelling hot air in spite of the temperature controls being set to the coldest position. Thus, there was a need to perform an integrated CAD (computer aided design) / CFD (computational fluid dynamics) analysis and graphics visualization to improve upon the existing design.

Overview: In this presentation, I will present the graphical methods used to determine the means by which we are now able to effectively introduce outside fresh air into the HVAC system from a viable location, of which the previous location was not functional, and allow the air conditioning system to function as expected. The existing design of the fresh air intake system was not functional and introduced hot air into the air conditioning system, thus it was required to be re-designed to function properly. With CFD simulation on 3D CAD models, the problem was identified with the existing design, and ultimately the intake for the system was re-located to a viable location that yielded the best possible airflow. The integrated CAD/CFD analysis approach required minimal field testing of current equipment, thus minimizing the overall cost of the redesign.

Major Points:

- Problem identification and preliminary research.
- Field testing and data logging of various pertinent temperatures
- 3D CAD model creation for use in CFD study.
- CFD analysis of crane front end from 3D CAD model.
- CFD results interpretation and component relocation.
- Final implementation of optimal solution.

Summary: The focus of this presentation is on demonstrating the use of integrated CAD/CFD analysis to solve real-world engineering design problems and how the integrated approach can help save countless hours of physical modeling and mock-ups. The presentation will be of interest to engineering design researchers and professionals.