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A Digital Dilemma: File Preparation for Archival Storage

By Mr. Frank Wiewandt and Dr. Paul Cesarini

Preface

As digital imaging technology overtakes traditional film-based technology as the photographic medium of choice for both consumers and professionals, serious questions about the future usability of these images remain. Without *de jure* or *de facto* standards governing the development and implementation of digital image file formats, there are no guarantees that tomorrow's photo-imaging applications will be able to access, process, and deliver images created using today digital cameras.

In the absence of any such standards, digital imaging experts (individuals professionally engaged in creating and/or archiving digital images) are charged with the task of creating, storing, and maintaining ever-growing stockpiles of image files with no guidance concerning their long-term viability. The purpose of this article is to examine the best practices of four digital imaging experts in an effort to expose the details of this problematic situation and to share what they believe are reasonable short-term solutions to this yet unresolved, long-term problem.

Introduction

Photographs have acted as visual records of important moments, frozen for all time on film, providing generations of grateful viewers with lasting memories. Photographers have established profitable careers by creating images that can be sold not once but again and again. Neither of these scenarios would be possible without carefully archiving, or preserving, the materials that are needed to successfully reproduce an image.

Over time, archival methods have been established to guarantee the long-term survival of traditional film and printed

materials. Even though the various groups directly involved in the production and preservation of traditional imaging materials differ in their concerns, national and international organizations like the International Standards Organization (ISO) and the American National Standards Institute (ANSI) have taken the lead and developed standards (Adelstein, 1999). In comparison, today's digital cameras create data files instead of latent images on film. No such universally accepted practices exist as standards for either capturing or archiving these digital image files.

Digital imaging technologies are in their relative infancy. As the demands and capabilities of digital cameras continue to escalate and evolve, photographers are faced with the problem of saving their images in a manner assuring viability in a digital environment that has yet to be established. "While the majority of photographers recognize the vulnerability of the digital environment, they cannot identify a singular source for information regarding proper methods and procedures to assist in the protection of their digital assets" (Bushey, 2005, p. 24).

As the shift in photography continues from traditional film technologies to digital imaging technologies, the search for universally accepted archiving techniques is becoming very important. In reference to the Walt Disney Photo Library Lerner (2001) wrote, "It is the long-term issue of archiving the digital assets that looms ominously overhead, waiting to strike the collection down with one small change in format or hardware" (p. 171). Thus, even though the methods used in archiving film have evolved into a set of universally accepted standards, those relating to

archiving digital image files have not. The archiving techniques currently accepted by the film industry evolved along with the rest of its unique technology, and so it will be with digital imaging. Film technology advanced along the parallel, but separate, paths of camera and film development. As a result, two separate industries evolved. Similarly, digital imaging is split between hardware and software development, but there is a paradigm shift away from the shared responsibility of the film industry for the creation and long-term preservation of images, to a proprietary approach favored by today's digital camera manufacturers. Never before has the current and future income that photographers must generate from their images been so captive to the specific technology that facilitates the creation of those image files. The same could be said about the long-term survival of important images that are digitally archived.

There are two technical issues involved in the digital archiving process. The first issue is physical storage. Digital photography pioneers moved image files from floppy disks to Syquest and Zip disks because the new technology provided larger capacities and improved physical properties. As individual image files grew larger, photographers needed to store them on CD-R/RW and DVD-R/RW media, again because these technologies offered larger capacities and a better way to keep the media viable over the long term. A current trend is to store image files on large capacity hard drives and servers and backing them up on DVD-R media. On the issue of storage, Frasier (2005) wrote:

Strictly speaking, there is no such thing as an archival medium for digital storage – any of the even slightly convenient solutions available for recording ones and zeros will degrade over time.

... Any archiving strategy must include periodic refreshing of the data onto new media, preferably taking advantage of improvements in technology. (p. 144)

The other issue that is currently providing a roadblock to a universally accepted archival solution is the file format itself. An image format designated as *RAW* refers to an uncompressed, proprietary formatted file containing image data that has not yet been processed, not one specific file format (TechEncyclopedia, n.d.). There is no universal *RAW* format; rather each manufacturer has developed its own proprietary version. Even though high-end digital cameras have had the ability to output *RAW* files since the early 1990s, most image files were converted to large, uncompressed or minimally (lossless) compressed files (TIFF and PSD are most common) or smaller, more greatly compressed files (JPEG), before saving. The larger files were used for the highest quality reproduction and saved as archival copies that could be repurposed as necessary, with the smaller, lower quality files either transmitted over the Internet, saved for convenience, or deleted. As the demand for higher quality image files increased, photographers increasingly relied on *RAW* format files that allowed them to access and manipulate the unprocessed image data separately from capture and processing data. The proprietary nature of current *RAW* format files has led to problems, though. Each camera manufacturer has taken the *RAW* format concept and developed proprietary versions unique to its own specific camera models. As a result, the digital imaging industry has no universally accepted *RAW* format (OpenRAW, 2005).

Background

Photography pioneers built their own wooden cameras. They formulated and mixed sensitized materials and coated various substrates like metal or glass plates. When exposed to the light reflected off subjects, these plates held the latent images of those subjects (London, 1989). The plates that remain are irreplaceable artifacts of an era that has long ago passed from distant memory only to be found, if at all, in history books. Had more of these plates been preserved, or archived, valuable visual data would be available for

researchers of all persuasions to use in their academic endeavors.

In a similar vein, archiving digital images is an immediate problem that directly affects a photographer's current and future income as well as the long-term survival of important images. Finding a universally acceptable archiving solution is key to the continued advancement of digital imaging technologies, and over the long term the ways in which these digital images will be accessed and utilized. When surveyed, 95.9% of photographers indicated they would follow archival standards if they were implemented (Bushey, 2005). In a conclusion of this survey the author wrote the following:

Photographers have begun to understand the challenges to continuing access and long-term preservation presented by the use of proprietary digital systems and technical obsolescence, as revealed by their habits of saving digital images in more than one format, refreshing digital media, and upgrading older file formats to operate on newer versions of image applications; by their willingness to adopt a standard for image creation and preservation; and by their eagerness to participate in the survey. (Bushey, 2005, p. 24)

It does not matter how recent or removed the film technology being considered is; as soon as it was created, it began deteriorating. Young (2002) wrote, "Since the birth of photography, many processes and materials have been used, all subject to deterioration through time" (p. 281). Researchers have determined the causes of the deterioration and have developed methods proven effective in the conservation of photographic materials, but there are other issues to consider. "The question is, how do you achieve the high quality needed while economically insuring the longest life for any photographic collection" (Ostroff, 1976, p. 2)? The answer to this question is found in balancing the value of the work with the efforts to preserve it.

In order to balance the interests of those in charge of managing traditional photography archives, ISO and ANSI standards were established (Adelstein, 1999). This author explained that, “a key purpose of standards is to resolve such differences and to arrive at a consensus which is technically sound, practical, and which will provide maximum benefit” (Adelstein, 1999, p. 41). Again, no such universal standards currently exist for digital imaging technology. As a result, interested organizations must generate their own standards, but even the U.S. Government admits the limitations of this approach. Consider what Purglia, Reed, and Rhodes (2004) wrote:

The Technical Guidelines are intended to be informative, and not intended to be prescriptive. We hope to provide a technical foundation for digitization activities, but further research will be necessary to make informed decisions regarding all aspects of digitizing projects. These guidelines provide a range of options for various technical aspects of digitization, primarily relating to image capture, but do not recommend a single approach. (p. 1)

There are reasons for archivists to fear digital imaging technology. Young (2002) explained, “Where it might take 100 years or more for a photograph to decay, digital storage is dependent on specific technology, and this could be inaccessible in a matter of five years or less” (p. 282). One author listed first among the rants that “digital is not archival” (Lerner, 2001, p. 172). Lerner (2001) further noted that:

The greatest strength of, and the biggest threat to, any collection is this ongoing and relentless move towards digital photography. The strength is obviously found in the ability to process data quickly and at a reasonable cost, and the danger is not being able to keep up with the evolving technology. (p. 172)

Until these issues are addressed and solutions developed, digital archiving will retain its reputation as a short-term solution at best.

The RAW problem

Organizations like the U.S. Government generally recommend archiving digital images by saving them as processed TIFF formatted files (Purglia, Reed, & Rhodes 2004). This allows the files to be saved with the greatest amount of data and the least amount of compression, assuring the highest image quality. Saving an image as a TIFF creates a very large file, though, and results in additional storage requirements. With the recent implementation of the more compact RAW format by many digital camera manufacturers, TIFF could lose its reputation as archival format of choice among many imaging professionals. RAW is not a file format; rather it describes a group of formats. RAW is a reference to the *raw* data collected directly from the sensor. It is combined with additional data called *metadata* to make up the complete image file. Metadata is the information needed to interpret and process the raw sensor data (Fraser, 2005). When a camera manufacturer combines its proprietary metadata with the raw sensor data it becomes a RAW format, one of the many RAW formats specific to individual camera brands (Fraser, 2005). Nikon uses the NEF designation, Canon uses CRW, Leaf calls its MOS, Minolta uses MRW, and so forth. The list continues for every camera manufacturer making cameras that support RAW file formatting. The separation of raw sensor data and metadata could make RAW files ideal for use as an archival format because all the data is pristine (unaltered or converted). The ability of future generations of software to create even better image files from the untouched raw data is the advantage that Steinmueller (2003) considered when he wrote that, “the raw files also act more like the digital version of an undeveloped film negative. Over time we will get improved RAW file converters to get better and better results from the same data” (p. 150). Unfortunately, the manufacturer’s use of proprietary and encrypted data in their RAW formats is making it unlikely that any of these current RAW formats will ever be acceptable as an archival solution (OpenRAW, 2005). A number of

advocacy groups have petitioned digital camera manufacturers requesting that they “open” their formats by releasing all the data third-party software developers need in order to create format conversion applications. If the manufacturers agree, this would be the first step toward creating a RAW format that could be considered archival.

The current archival format of choice, the TIFF, falls short of the potential promised by RAW formats. Unfortunately, the camera manufacturers are promoting RAW format solutions that include proprietary and encrypted data that limits their archival usefulness. Several interested groups (e.g., OpenRAW and rawformat) have campaigned to persuade the manufacturers to open their files and share all the data in order to give all software developers the opportunity to make converters for their RAW files.

One current trend is to save digital image files in their native, proprietary RAW format as well as one or more of the highest quality format conversions like TIFF or PSD, Adobe Photoshop’s native file format. Because there is no one universally recognized standard file format, the only way to assure even short-term access to these digital image files is by saving them in multiple formats. This adds considerably to the physical storage requirements already straining space and budget limitations.

Methodology

For this study, qualitative research methods were used to investigate what digital imaging experts are doing to prepare their image files for archival storage. The data was collected through in-depth interviews with four male subjects. Participants selected for these interviews were determined based on the emic perspective (Pike, n.d.) where each interviewee was expected to have an insider’s perspective about the subject. This perspective was important in terms of contextualizing the environment in which professional photographers work. The pervasiveness of technology in the field of photography is revealed by the extensive use

of digitally captured, distributed, and archived files.

The research methodology employed for this study was based on interviews with subject matter experts. The first step in carrying out the research was the selection of participants. Professional forums, newsgroups, and lists relating to digital imaging in general and RAW file formats specifically were searched. Authors whose posts demonstrated a high level of experience, a willingness to share their knowledge, and the ability to articulate their views were put on a list. Further research was done on each photographer; visits to their websites screened out non-professionals and those not engaged primarily in the work of digital imaging. A broad potential participant list was divided into two groups. The first group included the four photographers who best suited the purpose of this thesis. The second group formed a pool of alternate candidates.

Bushey (2005) found photographers eager to participate in the survey, and this was true with the photographers asked to participate in this study. The four photographers selected from the first group immediately agreed to be interviewed. Some background information on each participant is presented to establish credibility concerning the opinions that were expressed during the interviews. All four considered the topic of archival file preparation a critical issue for today's digital photographer.

Of the four participants interviewed three were full-time professional photographers and educators, and one was selected to add a manufacturer's viewpoint to the interviews.

Although Participant I (P I) is only a part-time photographer, P I's contributions were important to this paper because P I is a digital imaging industry insider. P I is a General Manager of Technical Support for a major manufacturer of professional digital cameras and was selected for that background and insight as well as his work as a photographer.

Participant II (P II) is a successful commercial, industrial, and advertising photographer working in the Chicago area. P II is also a photography educator with a history of instructing corporate-sponsored national seminars and most recently as the founder of a workshop and training facility located in a Chicago suburb.

Participant III (P III) started professionally as a photojournalist before working at The Maine Photographic Workshops. P III left to begin a long-running career as a professional photographer. P III holds national seminars on analog/digital workflow, website building, and most recently, building stock photography databases. P III is a frequent contributor to many high-level forums and lists and is an active member of several photography trade organizations. P III chairs the Stock Artists Alliance (SAA) Imaging Technology Standards board and the American Society of Media Photographers (ASMP) Digital Photography Standards and Practices committee.

The photography career Participant IV (P IV) began nearly 25 years ago assisting other photographers grew into a commercial photography business. P IV, like the other three participants, contributes regularly to photography forums and lists on the Internet. P IV also reviews imaging technology for several print and on-line publications (Greenspun, 2002).

Findings

The participants were asked to quantify, in percentages, the amount of digital imaging and film being used in their businesses. They were then asked about their preferred file formats for shooting, or capturing, and delivering digital images. These questions provided the background to the important issue of archiving image files and the current best practices of the participants. Additional questions were asked regarding the use of proprietary RAW image file formats as they represent a possible solution to the archiving problem. They also generate a great deal of controversy because of their proprietary, not open, design.

Digital usage

In an effort to gauge the participant's current use of digital imaging in their businesses, a series of questions were asked about image file usage. All four participants are working primarily with digital cameras, capturing 90 to 99% of their work digitally. Film was used either for personal work or when no practical digital solution was available. P II (personal communication, September 24, 2005) still shoots advertising for a film manufacturer, which accounted for most of the film (10%) he reported. P III (personal communication, September 22, 2005), until recently, photographed much of his table-top food assignments using 4" X 5" large-format sheets of film, but has been forced to increase his digital usage because his preferred film lab continues to reduce its services as a direct result of the increased popularity of digital cameras.

All photographers questioned stated they delivered digital files in some form to 100% of their clients. They also regularly delivered some form of printed reference sheet(s) and/or proof print(s).

Capture

The choice of file format for image capture varied among the participants. P IV (personal communication, September 29, 2005) shoots everything in the RAW file format and converts to other formats depending on the intended use. "It just doesn't make any sense to handicap yourself from the start by shooting JPEG, and shooting TIFFs just takes up too much storage in the camera at the original capture, so it make sense to shoot RAW" said P IV (personal communication, September 29, 2005). P II (personal communication, September 24, 2005) only shoots RAW when using a Leaf digital medium-format camera back. The Leaf camera back P II uses outputs a proprietary RAW file that can only be opened in a special application. Everything else is shot as a large, fine-quality JPEG. P III is leery of annotating RAW files so shoots a RAW formatted file plus JPEG formatted file for each image (P III, personal communication, September 22, 2005).

“I wouldn’t consider shooting straight JPEG because I just don’t have that confidence,” said P III (personal communication, September 22, 2005). P I (personal communication, September 20, 2005) shoots mostly JPEGs for wedding, portrait, and event photography. P I reserves shooting RAW for situations requiring the very highest quality and the ability to convert the file to multiple formats for delivery (P I, personal communication, September 20, 2005).

Delivery

When it comes time to deliver the image files to the client all the participants acted in a similar way. They delivered low-resolution JPEG files for previewing images on a computer screen. These thumbnails, as they are called, are not large enough to produce a quality print and are only meant to be viewed on-screen to aid in final selection or to be used as composites in advertising layouts. When larger files are submitted for end use, the client (or printer) will receive processed, high-resolution, 8-bit or 16-bit, color managed, RGB TIFFs.

Archiving practices

The participants were asked how they approached the issue of archiving digital image files, and they all had unique perspectives on the general subject, as well as their own particular approaches to file preparation. They are all aware that digital imaging technology is still evolving, though, and understand the probable need to both migrate their files to currently unknown future formats and upgraded storage media. “The matter of backward compatibility is something I think we all are concerned with,” said P IV (personal communication, September 29, 2005). “I know I’m concerned with it.” P IV continued, “It’s a forced migration. Either you have to accept a certain level and say ‘I’m not going any further’ and will get left behind or you have to keep learning it” (P IV, personal communication, September 29, 2005). P I (personal communication, September 20, 2005) said, “I personally feel confident enough that the NEF format (Nikon’s propri-

etary RAW format) will be around long enough where I’ll be able to process or convert or whatever with it. I’m not worried about it.” P II quipped,

Photographers who panic because, you know, CDs aren’t going to be around forever, and PSD files aren’t going to be around forever, that’s just ‘blond talk’ because its not just going to disappear one night and there’s not going to be a bridge to allow you to get to whatever the new format is. There is always going to be converters, so even if we do have an image that’s an MOS file (Leaf’s proprietary RAW format) and ten years from now we need to resurrect it, there will be a way to resurrect that MOS file. There is no problem there (personal communication, September 24, 2005).

P III (personal communication, September 22, 2005) referred to the archived masters as *pre-purposed*, “a file that has no definite destination but is at that crux where you’ve got to take one of six different forks in the road to get to your end use.” For P III this takes form as a high-resolution, 8-bit or 16-bit, wide color-spaced RGB TIFF with little sharpening or manipulation (P III, personal communication, September 22, 2005).

P I (personal communication, September 20, 2005) converts files to the PSD format and processes them in Adobe Photoshop. P I archives both the original RAW or JPEG file and the processed PSD file.

The method described by P IV was the closest to the common practices revealed in Bushey’s (2005) survey of photographers:

I save the RAW and record that into three places, and then if I do conversions to JPEG or to TIFF. I will save those as well, although I am more likely to save a TIFF for a client on a CD-R and just file it away and not let it take up hard drive space. I can always come back to the RAW and reprocess it later. As I mentioned earlier, my skill level is changing, so as I learn more about how to

do things a better way it pays off sometimes to revisit the work” (P IV, personal communication, September 29, 2005).

Earlier in his career P II (personal communication, September 24, 2005) photographed many famous personalities and celebrities. P II has a concrete vault in the studio for storage of those transparencies and considers them to have long-term value. Little that gets photographed by P II these days gets saved beyond a three-year period. P II does not think they have much value to the photographer beyond that. With a bit of a twist, though, P II lets his clients take the responsibility of archiving important images. P II said:

“Usually our bigger jobs, that’s going to be more product oriented or environmental oriented types of images, we do something kind of crazy. We actually give them the RAW file because it helps us with our archiving and our storage. Heaven forbid we were to lose images for whatever reason like a flood, a fire, even a hurricane, heaven forbid” (personal communication, September 24, 2005).

The RAW format

The biggest hot-button question is whether or not to use RAW files as archival masters. As reported previously, P IV (personal communication, September 29, 2005) is a RAW format evangelist. P IV shoots and archives every image in at least the RAW file format. P I (personal communication, September 20, 2005) archives both RAW and converted files but appreciated that others do not share the same enthusiasm. P II (personal communication, September 24, 2005) sees RAW as a tool, but views the question of format open for archiving purposes. P II is as comfortable archiving a large, fine-quality JPEG as a RAW formatted file.

Not everyone sees the RAW format as the archival format of choice. The core problem in P III’s (personal communication, September 22, 2005) mind is the proprietary nature of the data. “If the manufacturers and develop-

ers would embrace an open standard I think you would have a lot more going, but because everybody is proprietary, everyone wants to protect their trade secrets, everybody wants you to turn to them. They don't get it. They don't get it that people don't want to have something locked up where they can't get it." P III continued, "Basically, RAW is, unless it's converted to something else that's a little bit more open, it's just a ticking time-bomb. . . . Anything I'm really concerned about I tend to convert as soon as possible & keep it as my archive color master" (personal communication, September 22, 2005).

Summary of findings

All of the participants shoot, deliver, and archive the vast majority of their images digitally. They capture files formatted as RAW, JPEG, or both simultaneously depending on the subject matter and the image's intended use. They deliver low-resolution JPEGs for viewing, and high-resolution, 8-bit or 16-bit, color managed RGB TIFFs for reproduction. Considering the growing number of images being created in this digital environment the issue of how to keep digital images viable for the long term may be reaching a critical point.

Each photographer considered the archiving process in a slightly differently way compared to each another. All were at least mildly concerned with the rapidly changing technology and have plans to migrate their image file's format as well as physical storage at some point in the future.

The RAW file format is prominent in any discussion of digital image archiving. The ability to revisit a file at a later date and work on pristine, unprocessed, image data is attractive to all participants. Some of them find it dangerous, though, to rely on a proprietary format and are calling for manufacturers to open their files so they can continue to be supported by software developers in the future. The others have faith that there will always be a conversion solution available to them when they eventually need it. P II (personal communication, September

24, 2005) believes when the current technology begins to show signs of failure, a revenue-hungry industry will come up with a solution. "Will there be a problem? Yes. Will the problem be solved? Absolutely!" P II said (personal communication, September 24, 2005).

The appeal of the RAW-formatted file as an archival solution remains unfulfilled primarily because of its proprietary nature. Without an open RAW standard, depending on the viability of individual companies to support their proprietary secrets indefinitely is unsound.

Implications

Digital is here to stay. Because of the pervasive use of digital imaging technology in professional photography it is imperative to find a solution to the long-term archiving dilemma. We cannot gamble the future of these cultural artifacts on the confidence of future technology. That being said, it is market forces that move companies to action, so the demand for a solution will have to come from current users of the technology and not future beneficiaries of it. Although professionals make up a small portion of all users of digital imaging technology, a large population of consumers considers them as leaders. These professionals also can call on their powerful trade organizations to lobby companies to reconsider their positions concerning proprietary RAW formats.

The cry for more open source RAW formats from manufacturers is falling on mostly unresponsive ears. The desire to protect trade secrets is strong in spite of the eventuality of unsupported formats. P III commented, "As manufacturers discard things left and right as they often do, or just abandon projects, you get these orphans" (personal communication, September 22, 2005). P III argued for a compromise solution involving time-limited protection of proprietary secrets. For example, after a RAW file format is superseded or discarded, all the proprietary information that hobbled competing software developers should be revealed allowing them to fully support the format.

This would be a winning situation for all interested parties. The original manufacturer keeps its secrets while they are still marketable, secondary software developers will find a revenue stream previously unavailable to them, and photographers no longer have to worry about their RAW files becoming "orphans."

Conclusions

Today's world of photography is divided into two groups identified by their use of technology. The use of traditional, film and chemistry-based technology identifies the first group. For this group, methods and practices for conservation have been developed and industry standards established (London, 1989) assuring the survival of even the most delicate of materials required to reproduce photographs. The second group embraces new, still-evolving digital imaging technology; the use of this media is growing steadily, rapidly replacing film as the choice of professional photographers. The long-term viability and ultimate survival of important images created using this transitioning technology is in question due to the lack of industry standards and practices regarding the archiving of these digital assets.

Saving multiple copies of image files converted to multiple formats on multiple storage media and stored in multiple locations is as close to a universally recommended practice as any. "It's the salmon approach to photography," P III said, "lay a lot of eggs and stick them all over the place. When you need one, one of them you'll be able to open" (personal communication, September 22, 2005).

The participants also agreed that eventually their archives would need to "migrate" to new storage media and most probably new file formats as well. This is not a new requirement. Each photographer had already dealt with the issue of keeping up with a technology still in the early stages of development. The probability of migrating file formats could be eliminated or at least delayed indefinitely, though, if an open speci-

fication RAW format were developed and accepted as a standard by both the manufacturers and end users.

Finally, there is a question of what and how much really must be saved indefinitely. Photographers are not psychic – they may or may not be able to tell what images are important to archive for the future. As a result, most seem determined to save everything! P II's (personal communication, September 24, 2005) take on the short- and long-term value of his work is a refreshing departure from that attitude. "We do have times when there are certain things that do need to have long-term archive, and there, that's where we rely on the client," said P II. This is an approach that puts the responsibility of protecting the digital assets into the hands of those who value it the most, an idea that merits serious consideration.

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