DIGITAL IMAGING: NEW TECHNOLOGY IN FIRE PREVENTION

Executive Leadership

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ABSTRACT

The problem identified for this research project is that digital photography is a new technology offering potential benefits as well as potential challenges for use in the Lubbock Fire Marshal's Office, yet the actual nature of the benefits and challenges are unknown. The purpose of this project was to assess the benefits and challenges in order to recommend best use of new technological advancements in digital photography for the Fire Marshal's Office.

Descriptive research to assess the benefits of incorporating digital photography into the Prevention Division and the challenges that will be faced answer the following questions: What services do we provide to the citizens of Lubbock where digital images would be beneficial? What are the challenges of incorporating digital photography into fire prevention? What types of digital cameras are available for fire prevention activities and which cameras would best suit these activities? What are the legal issues of digital photography when presented in court? What are the practical uses of digital imaging in the field of fire investigations and fire inspections?

The author reviewed current literature, visited pertinent Internet sites, and interviewed qualified professionals to assess the benefits and challenges of using digital photography in the Lubbock Fire Marshal's Office (LFMO).

The results of the project determined that there were a number of digital cameras on the market that would benefit the activities in the fire prevention bureau. The challenges would be the cost of the cameras, developing standard operating policies (SOP) for their use and training personnel on the technical aspects. The project also illustrates the variety of agencies that use digital photography in West Texas.

It was recommended that the Lubbock Fire Marshal's Office develop an SOP for the use of digital images in fire investigations and purchase the cameras within this budget year. Recommendations were also given to those law enforcement agencies that might be interested in using digital cameras for investigation activities.

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INTRODUCTION

Law enforcement agencies have recognized the benefits of photography in criminal investigations for many years. Photography is incorporated in crime prevention activities through surveillance and security cameras, and during investigations for documentation of physical evidence, which become an integral part of the case for prosecution. These same benefits have also been recognized by the fire service for code enforcement and fire/arson investigations.

Computer technology has developed at an astounding rate over the past 20 years. Computers have become smaller and more powerful with each passing year. With this rapid pace of development, advancements carry over into other areas of the technological world. One area that has seen an impact in the professional and consumer related market is photography. Computer memory chips and compact disc are slowly taking the place of a roll of film and the one-hour photo mat is being replaced with instant photo images on an LCD display attached to the camera. Images are quickly downloaded on a computer and printed as needed. Images that once were grainy and difficult to use are now crisp and easily manipulated.

With these significant advancements come benefits and challenges for fire prevention bureaus. Digital photography is new and exciting providing departments with technology that is on the cutting edge. The question remains: Are they ready?

The problem identified for this research project is that digital photography is a new technology that offers potential benefits as well as potential challenges for use in the Lubbock Fire Marshal's Office, yet the actual nature of the benefits and challenges are unknown.

The purpose of this project was to assess the benefits and challenges in order to recommend the best use of new technological advancements in digital photography in the Fire Marshal's Office. Descriptive research was used to assess the benefits and challenges of incorporating digital photography into the Prevention Division. The research questions to be answered are:

1. What services do we provide to the citizens of Lubbock where digital images would be beneficial?
2. What are the challenges of incorporating digital photography into fire prevention?
3. What types of digital cameras are available for fire prevention activities and which cameras would best suit these activities?
4. What are the legal issues of digital photography when presented in court?
5. What are the practical uses of digital imaging in the field of fire investigations and fire inspections?

BACKGROUND AND SIGNIFICANCE

Technological advancements throughout the computer industry have had an influence on all areas of the public and private sector. Computer speed and storage capacity increases with each new model placed on the market. Businesses are able to tap into this technology by automating data collection and processing and by creating new products for the consumer. Federal, State and local government agencies are also venturing into this interesting world of technology. Local governments are able to access satellite images for mapping and community development. Police departments

have computer terminals in their vehicles to access criminal history on possible suspects. Fire departments now have thermal imaging cameras that allow them to enter a house obscured by smoke and look for victims. All of these advancements can find their origins in computer technology. Digital photography is no exception. Camera companies are beginning to experience the benefits of the computer age. Digital technology is rapidly finding its place in the consumer and professional camera markets. Cameras capable of taking multiple images and downloading them on to a personal computer are commonplace. Point and shoot 35mm cameras are quickly being replaced with inexpensive point and shoot digital cameras and the consumer is beginning to welcome them into their homes.

Investigation agencies are also starting to realize the benefits from this consumer driven market. Digital databases for criminal information are now able to incorporate a digitized image of suspects, vehicles and crime scenes. Volumes of mug shot books are being replaced with computer databases that will quickly search thousands of pieces of information for characteristics of involved suspects. More recently this technology has been introduced into crime scene photography. The potential for success increases exponentially by the advancements made by camera companies. They are developing digital cameras that are affordable and produce images as good as the quality of most 35mm cameras. The Lubbock Fire Marshal's Office wanted to incorporate digital cameras into its fire prevention activities but did not have enough information to begin the process.

The City of Lubbock, Texas has a population of 200,000 and is located on the South Plains of the Texas panhandle. The Fire Department has approximately 260

personnel with 10 of those being assigned to the Fire Prevention Division. The Fire Prevention Division, as directed by its mission statement, provides hazard abatement programs through inspections, fire and life safety education, fire investigations, and severe weather storm spotting for the City's Emergency Operations Center. City ordinance mandates fire inspections be performed for all commercial properties within the city limits of Lubbock two times a year. City ordinance also mandates the Fire Marshal's office investigate the cause of every fire within the incorporated city limits.

The Lubbock Fire Department has made dramatic changes in their focus on reducing the number of fires within the city over the last 10-12 years. Fire prevention had been part of the mission statement for years, but had not been given the resources to provide the quality services needed to help combat the nature of fire losses and loss of life. Bottom line cost of the prevention division has risen from $350,000 in 1990 to $810,000 in 2002. Staffing has increased from 8 employees in 1990 to 10 in 2003. The increase in the bottom line cost, while directly related to the increase in staffing, also reveals the changing mindset. Certification and assignment pay has been added to address tenure, consistency, and professionalism within the division. Overtime pay has doubled to allow after-hours inspections, fire investigations, and public education programs. Travel and training has increased from $3,000 in 1990 to $19,000 in 2000. Line item expenditures have remained relatively the same over the last ten years until the beginning of 2003. Decline in the national economy and stock market has had a dramatic impact on the money available for supplies and items needed to work day to day in the Division. The overall budget for the Fire Prevention Division was reduced by 5% in the revised budget for 2002-2003. The only money that was left in budget was a

limited amount of money for training, public education supplies and the digital cameras and digital video camera that was approved for the budget year 02-03.

The problem of purchasing these cameras is proving that they are needed during these times of reductions and proving that they would benefit the activities of the office. In 1995 two Sony Mavica digital cameras were purchased for the Lubbock Fire Marshal's Office but they were part of the early technology that Sony had developed. The camera used 3.5 floppy discs as the media to collect the photos. The storage space of the discs limited the number of photos that could be taken and the quality was very poor. Due to the quality of the images taken, investigators refused to use the cameras for investigative purposes. Several years have passed since these first cameras were purchased and they have hardly been used. It has difficult to convince Fire Administration that it is time to replace these cameras when they were never used in the first place. New advances in digital cameras and a new Fire Chief who understands technology is the only reason that money was allocated for their replacement. It will be this author's responsibility to prove that the new cameras will be used and to develop the procedures necessary to produce significant improvements.

The best process for researching the possibilities of using digital technology is networking. This idea of networking and learning what others are doing with digital cameras was reinforced from information presented in the *Executive Leadership* (2000) course guide written by the National Fire Academy. The course guide states that networking is "the ability to create and maintain an effective, widely based system of resources that works to the mutual benefit of oneself and others" through the skill of dimensions of using relevant information, having good working relations, and

maintaining and communicating a good track record. The Networking Skills inventory (NSI) measures an individual's skill in the following three dimensions: relevant information, working relations, and track record. Networking with people in the areas of criminal investigations assisted this author in gaining significant insight into their processes and interpretations of the benefits and challenges of using digital cameras.

LITERATURE REVIEW

The literature review for this project provided a focus on various issues related to photographic images produced by traditional cameras, digital cameras and digital video cameras. Information gathered from personal interviews, articles, journals, textbooks and Internet web sites, was evaluated and the relevant sites were included in this review. The review will be divided into five separate areas: (1) traditional use of photography in criminal investigations and fire prevention activities, (2) reasons to go digital, (3) legal foundation guiding photographic use in criminal cases, (4) evidentiary challenges facing digital photography, and (5) other agency programs.

Traditional Use of Photography

Law enforcement agencies have long recognized the value of photography in the investigation and prosecution of criminal cases. The regular use of photographic images by police began in Paris in 1841 when photographs of criminals were taken as a means of establishing a rogues' gallery – the first primitive mug-shot database. Since then, photography has become such an intrinsic part of law enforcement activities that it is almost impossible to imagine an investigation that did not involve photography in some way. (Blitzer, Jacobia, 2002).

Over a half century ago, Charles C. Scott, in his book, *Photographic Evidence,* made the statement that “Photographic evidence is not treated adequately in law schools; hence, the embryo lawyer rarely is impressed with the importance of photography. The active attorney, however, soon discovers that a knowledge of the principles of photography is necessary for the general practitioner. Indeed, whether he realizes it or not, the modern lawyer would be as handicapped should he be deprived of the use of photographs as evidence as would the physician were he forced to practice without his clinical camera and X-ray apparatus (Siljander, Fredrickson, 1997).

Photographs can be extremely valuable evidence. They allow the judge and jury to quickly and clearly understand specific situations. Photographic evidence can be stored indefinitely and be readily available when necessary. It also provides the investigator with a record of the crime scene and any items connected with the investigation (Robbins, Nichols, Harrelson, 1990).

The proper inspection and accurate documentation of a fire/crime scene is the most important initial step in any investigation. The notes, photos, and sketches generated to document the scene and the discovered evidence serve as an aid and ready reference throughout the investigation. More importantly, they provide the foundation for any criminal prosecution or civil action that follows. Fire scenes have traditionally been one of the most poorly documented and underrated classifications of crime scenes. The chief reason for this lack of documentation has been the investigator’s traditional reliance on sketchy notes and personal recollections when preparing official reports or describing the circumstances of the fire to a jury or other judicial body (Redsicker, O’Connor, 1997).

Fire investigation photography is a challenge because it requires you to document a wide variety of environments. From characterizing the overall fire scene to depicting the device, appliances, or electrical wiring that caused the fire, you often must be able to communicate and prove the various aspects of your case despite difficult photographic circumstances (Sanderson, 1999).

Photography serves as a tool of police and other investigators to make a record of the scene of a crime or other incident, to show particular items of evidence and their relationship to the scene, and to make close-up records of significant portions of the scene. Some items of evidence are transient or perishable and must be recorded at the scene. Others can be removed to the laboratory where they can be examined at leisure and photographed with special techniques. Usually, a photographer can record and preserve essential information using straightforward photographic techniques (Eastman Kodak Company, 1985).

It can be very difficult to photograph a fire scene. Photos of the interior can be especially hard to take because of poor light and extensive carbonization. Regardless of the difficulty, such documentary photographs are an absolute necessity. Juries have come to expect them (prints, slides, and video), and prosecutors relay on them for graphic corroboration of verbal testimony. The technical language of fire science can be disquieting to a jury. Such intricate testimony can be better deciphered if its essence is clarified or illustrated photographically (Redsicker, O'Connor, 1997).

The photographs taken at a crime scene are critical to an investigation. The purpose of crime scene photographs is to give a documented record of the scene as it is observed. There is a special skill and technique to crime scene photography.

Therefore it takes training and practice for the photographer to be proficient in the task (Blitzer, Jacobia, 2002).

Reasons to Go Digital

The art of photography, although still quite young, is entering a period of radical transition. Computer technology now allows photographers to capture, store, and display digital images without the use of film or paper. With this capability comes a great deal of opportunity, and some foreseeable risk – at any point in this process, the image may be degraded or altered, intentionally or accidentally. Although the integrity of visual evidence has always been open to question, as noted by the court in *Cunningham,* statutory and common law evidence doctrines developed in response to the problem and photographs are now routinely admitted into evidence in both criminal and civil trials. Digital photography, however, is fundamentally different from conventional photography. It seems appropriate, as digital imaging becomes more common and more affordable, to ask whether existing safeguards in the rules of evidence are well suited to verify the integrity of visual evidence captured and stored in digital form (McCarvel, Internet, 1995).

Digital cameras are taking over a major segment of the consumer photography marketplace. Only at the very high end (large format, professional cameras with interchangeable and highly adjustable lenses) and the very low end (inexpensive automated snapshot cameras) are traditional film cameras holding their own. All of the major camera companies, worldwide, recognize this trend and are major players in the development and marketing of digital cameras. It is thus natural to consider the use of

these cameras for, and their impact upon, the field of forensic photography (Russ, 2001).

More and more businesses are seeing the benefits of utilizing digital cameras. Many businesses are attracted to the benefits of the digital photography age because it has the great potential of expanding their target markets. Business analysts assert that "the biggest demand is coming from those users who want computerized photos for World Wide Web sites, engineering projects, real estate estimates and police work" (Dillon, 53). Jim Verrall, MIS operations manager at Brandt Engineering Co. in Dallas and an owner of three digital cameras states that, when you shoot film it might sit in your pocket for two days, and then professional processing usually takes another day. Verrall, continues, "with the pictures saved to a floppy disk we can print them out and incorporate them into WordPerfect documents in five minutes" (Dillon, 56). Not only is time saved here but also is money that can be redistributed within the business (Fried, Internet, 2003).

Digital cameras are also gaining popularity within the field of forensic science. "For forensics technologies collecting evidence at crime scenes, digital camera preview screens can help prevent errors." Warren Stewart, a forensics investigator at Alabama Department of Forensic Science, states, " they give us the capability to see if we have the exact images we need on the spot" (Dillon, 56) (Fried, Internet, 2003).

Once photographers understand digital imaging they will find the digital camera to be an excellent imaging tool. A digital camera gives you the ability to see the captured image immediately. It also gives you the ability to make a judgment on

exposure and quality immediately. The image can also be transmitted electronically for others to evaluate (Blitzer, Jacobia, 2001).

Digital camera operate much like a conventional camera inasmuch as a lens focuses an image onto a recording medium with the intensity and duration being controlled by the lens opening and shutter speed. But unlike the conventional camera that records the image onto a film coated with light sensitive material (emulsion) that must later undergo chemical development, the digital camera records the image electronically as is the case with a camcorder. The resultant information is then downloaded to computer to be viewed, stored, printed, or transmitted via modem (Siljander, Fredrickson, 1997).

Fingerprints lifted using fingerprint tape can be photographed or scanned using a flatbed scanner. The preferred method is to photograph the lifted fingerprints with a digital camera. A typical scanner usually has about a 600-pixel resolution, versus 1500-pixel resolution or higher with a good digital camera. Higher resolution allows you to see much more detail in the fingerprint, which is essential for fingerprint comparison and enhancement of a poor print (Blitzer, Jacobia, 2002).

Digital imaging systems offer many benefits not immediately available with film or traditional analog video. Among these benefits include the ability to instantly review an image once it has been taken and the ability to easily import and image into digital image processing applications, where the image can be enhanced to improve the visibility of details in the image. Another major benefit of digital imaging is the ease with which images can be filed, stored, and transferred between locations and investigators. Digital imaging also offers an easy means of building image databases that have a

variety of applications in law enforcement, such as mug shots or gang tattoos (Bruegge, 2002).

The potential advantages of digital imaging for forensic purposes are fairly obvious, if often overstated. First, the stored image can be examined immediately without any need to wait for the chemical development of the image, not even the minute or so required for Polaroid™ instant prints, so the photographer can be assured that the desired information has been captured. Second, the stored image can be transmitted via the Internet, exact duplicates can be made for all interested parties, and the images can be filed archivally with no degradation. Indeed, writing images in a "tamper-proof" format such as CD-R disks is recommended to guarantee the integrity of the images. Maintaining the chain of control for evidence is thus simplified (Russ, 2001).

Legal Foundation Guiding Photographic Use

Photographs have been used in the court system since 1875, with the first use of color prints in 1946. Initially only photographs taken by professional photographers could be introduced in a court of law. However, by 1940, with the technological advances over time allowing cameras and photographic equipment to be more accessible and affordable to the ordinary person, a Pennsylvania court ruled in *Adamczuk* v. *Holloway* that "any competent investigator can take photographs which will be suitable for the introduction as evidence" (Redsicker, O'Connor, 1997).

In order to be admitted as evidence in either a civil or criminal court trial, a photograph must be an accurate representation of the subject matter as it was at the moment the photograph was taken. Evidence photographs can really be considered

record pictures. They record the situation as it existed at the time the pictures were taken. Bear in mind while photographing a scene that the photographs will be used for many things, not just the court. Examples: education of jury, accident reconstruction, refreshing the memory of officers or witnesses, demonstrating a particular point, review of the case by officers and others, as well as negotiation for a settlement (Varney, 1993).

It is normally impractical to take physical evidence from a fire scene to a courtroom. Therefore, the investigator must rely on the use of photographs to document much of the evidence and to support the observations, opinions and conclusions the investigator wishes to make as to the cause of the fire, which might be suggested at a later date. Photographs are also useful for jogging the investigator's memory at the time of writing the report or before appearing in court (Cafe, 1997).

The trial court determines the admissibility of all evidence, including photographs. This judgment – to decide what is and is not admissible – is based upon legal precedents that have established certain points of law. The first of these is that the object portrayed in the photograph must be material and relevant to the question at issue. Further, the photograph must not appeal to the emotions of, or tend to prejudice, the court or jury. Finally, the photograph must be free of distortion and not misrepresent the scene or the object it purports to reproduce (Robbins et al. 1990).

There is no question that fire investigators may take photographs during and following extinguishment operations. These pictures serve as incidental tools in establishing the cause and origin of the fire, or can be used in evidence to establish the commission of a crime. However, where a fire has not yet occurred, and the

investigator's only purpose for entering the premises is to photograph fire hazards, valid objections may be raised by the occupant. In the absence of specific provisions in the ordinance or statute granting fire inspectors the right to enter, inspect and photograph premises for fire hazards, it is highly doubtful that they have the right to take pictures. Note also that rights of property owners for the protection of proprietary information may override the fire department's authority to take pictures, even of fire hazards. Particular caution is advised (Callahan, 1987).

Under the Federal Rules of Evidence, a photograph can be admitted into evidence if it is a fair representation of what it shows and relevant to the issues disputed in the case. In California, the rule is the same as long as the photograph is a fair, accurate, true or good depiction of the object or scene at the relevant time. Traditional photographs depict the scene/object as it actually was when the picture is taken (Lynch, 2000).

If counsel lays a proper foundation of accuracy and reliability, photographs and sound recordings may be accepted as evidence if they are relevant and material to the issues and if they are not unduly prejudicial. Photographs are probably the most commonly used form of demonstrative evidence. The reliability of their reproduction is generally accepted, they are relatively inexpensive means of representing the actual physical evidence, and they are very convenient. As with all other evidence, a photograph must be shown to have some relevance to the matter in controversy at the trial in order to be admitted. The trial judge determines the relevance, which is based on the relevance of the photograph itself, not that of the fact the offering party is attempting to establish. If it is determined that the photograph is not relevant to the

purpose of the trial, the fact may be established through the use of some other evidence (Hanley, Schmidt, Robbins, 1991).

Evidentiary Challenges of Digital Photography

When digital imaging is considered for law enforcement, the concern of the admissibility of digital photographic evidence in court is often raised. The fact that digital photographs are more easily altered than film-based photographs is usually cited. Some even believe digital photographs are not admissible in court (Staggs, Internet, 2003).

The Scientific Working Group on Imaging Technology (SWGIT), operated under the leadership of the U.S. Federal Bureau of Investigation, has explored the issues extensively and provides good guidelines for dealing with the technology. One fundamental distinction they have pointed out is that criminal justice images that might be used at trial fall into two categories. Some, in fact most, are “visually verifiable,” and others are “analyzed.” In the case of visually verifiable images, the witness uses the image to illustrate his or her memory of a scene. In essence, they will say that they were at the scene, saw the circumstances, describe key features and use the image to help the listener understand what they are describing. They could just as easily us a hand-drawn sketch. The burden is on the memory of the witness. When a photo is used, they will inevitably be asked, “Is this a fair and accurate representation of the original scene?” And the answer had better be, “Yes.” The technology employed to produce the illustration is not really at issue (Blitzer, Jacobia, 2002).

The story is very different when one presents an analyzed image. As an example, consider a latent fingerprint image – a dirty finger on a halftone newsprint

photo. Since it is very hard to separate the halftone dots from the ridge or trough detail, it can be very difficult to read the print. In this case one might apply a Fourier analysis to selectively remove the background. This would be a clear case of an analyzed image. In this case the witness cannot say that he or she was there, saw the original object, and it looked like the image that resulted from the analysis. It did not look that way. In fact the processes used to enhance the image were specifically chosen to change the appearance, so as to render the fingerprint readable. In this case it can be argued that the witness is introducing scientific evidence, and as a result, it must be able to withstand a test in order to be admissible. In the United States, two such tests are used and referred to as the "Kelly-Frye," or "Daubert" tests – the choice of test varies by state (Blitzer, Jacobia, 2002). Blitzer and Jacobia (2002) list the key issues of these tests as; (1) Is the science that was employed valid? (2) Was the science applied in a valid way? (3) Was the equipment (and software) that was used working properly at the time?

Federal rules of Evidence, Article X (Contents of Writings, Recordings and Photographs), Rule 101(1) defines writings and recordings to include magnetic, mechanical or electronic recordings. Rule 101(3) states that if data are stored in a computer or similar device, any printout or other output readable by sight, shown to reflect the data accurately, is an "original". Rule 101(4) state that a duplicate is a counterpart produced by the same impression as the original…by mechanical or electronic re-recording, … or by other equivalent techniques which accurately reproduces the original. And Rule 103 (Admissibility of Duplicates) states a duplicate is admissible to the same extent as an original unless (1) a genuine question is raised as

to the authenticity of the original or (2) in the circumstances it would be unfair to admit the duplicate in lieu of the original. This means a photograph can be stored digitally in a computer, that a digital photograph stored in a computer is considered an original, and any exact copy of the digital photograph is admissible as evidence (Staggs, Internet, 2003).

California Evidence Code Section 1500.6(a) (Admissibility of Printed Representation of Images Stored on Video or Digital Media to Prove Existence and Content of Image) states a printed representation of an image stored on video or digital media shall be admissible to prove the existence and content of the image stored on the video or digital media. Images stored on video or digital media, or copies of images stored on video or digital media, shall not be rendered inadmissible by the best evidence rule. Printed representation of images stored on video or digital media shall be presumed to be accurate representations of the images that they purport to represent (Staggs, Internet, 2003).

Digital photography presents a profound challenge to the existing rules of evidence. Although a digital photograph may be cosmetically identical to a conventional photograph, it represents an entirely different species of evidence. Because a digital image may be precisely copied at will (until it is printed or displayed on a computer monitor) there exists no way to distinguish a copy from the original. And, because digital data may be copied absolutely perfectly, any discrepancy between two versions of a single digital image is likely to be the result of intentional alteration, either innocent or malicious. Unless the individual responsible for the alteration is identified, there may be no way to identify which image is derivative of the other (McCarvel, Internet, 1995).

Digital images are simply arrays of numbers (the pixel brightness values), and can be stored with any of the storage devices used for other computer data or programs, such as tapes, disks, writable CD's, etc., provided they offer enough space for the rather large files. However, for evidence purposes it is important to use a medium that can provide security from tampering (Russ, 2001).

Russ (2001) goes on to say the requirements for image evidence can be met for traditional film by keeping control of the original negatives, preferably as an intact roll. This prevents images from being deleted, altered, or added to the set. For Digital images, the equivalent security can be achieved by writing all of the images in a set to a permanent storage medium such as a writable CD-R disk, particularly one that has a serial number. It is not possible to modify, remove, or add images to this set, which can easily and confidently be copied in its entirety. Magnetic storage media, including tape and computer disks, and rewritable memory such as Compact Flash, do not have this security aspect and it would in principle be possible to edit and replace an image, remove an image from the set, etc.

It is commonly believed that film-based images are very secure, whereas digital images are very susceptible to tampering. When proper SOPs are employed, this is not the case. When proper SOPs are not employed, both are very susceptible (Blitzer, Jacobia, 2002).

According to Staggs (2001), there are guidelines for ensuring your digital photographs are admissible in court. (1) Develop a Standard Operating Procedure (SOP), Department Policy, or General Order on the use of digital imaging. The SOP should include when digital imaging is used, chain of custody, image security, image

enhancement, and release and availability of digital images. The SOP should not apply just to digital, but should also include film-based and video applications as well. (2) Most importantly, preserve the original digital image. This can be done a variety of ways including saving the image to a hard drive or recording the image file to a CD. Some agencies elect to use image security software. (3) Digital images should be preserved in their original file formats. The saving of a file in some file formats subjects the image to lossy compression. If lossy compression is used critical image information may be lost and artifacts introduced as a result of the compression process. (4) If images are stored on a computer workstation or server, and several individuals would have access to the image files, make the files read-only for all but your evidence or photo lab staff. As an example, detectives could view any image files but they would not have rights to delete or overwrite those files. (5) If an image is to be analyzed or enhanced the new image files created should be saved as new file names. The original file must not be replaced (overwritten) with a new name file.

Staggs (2001) lists two court decisions regarding digital images. *State of Washington vs. Eric Hayden, 1995*: A homicide case was taken through a Kelly-Frye hearing in which the defense specifically objected on the grounds that the digital images were manipulated. The court authorized the use of digital imaging and the defendant was found guilty. In 1998 the Appellate Court upheld the case on appeal. *State of California vs. Phillip Lee Jackson, 1995*: The San Diego (CA) Police Department used digital image processing on a fingerprint in a double homicide case. The defense asked for a Kelly-Frye hearing, but the court ruled this unnecessary on the argument that

digital processing is a readily accepted practice in forensics and that new information was not added to the image.

Other Agency Programs

The Texas State Fire Marshal's Office is currently using digital photography in documenting fire/arson scenes. The camera they are currently using is a Canon Powershot G3. They have had very good success with the camera but don't currently have any SOPs regarding camera usage (Vandygriff, personal communication, 2002).

Robert Byers (personal communication, 2003), a Lubbock County Medical Examiner's Office Investigator is very confident that digital photographs are beneficial to his investigation process. Their office has used digital photography for approximately three years. The camera they are currently using is one of the early model Nikons. They have never had a challenge in court regarding the digital images. Their process is to take the photographs and download them from the camera to a writable CD. The CD is kept in the Morgue Manager's file for each case and copies of the original images are made as needed. Federal funding is in place to upgrade their cameras with the new technology. Byers stated that the new technology would allow the doctor performing the autopsy to have a video link with an investigator in another location. There would be instant viewing of the procedure as well as audio communication between both parties allowing discussion of the procedure. The benefit of this process is the time and travel expenses for the investigator from another community not having to travel to the autopsy. Also, information on specific details of the autopsy is instantaneous. The Medical Examiners Office is in the process of writing a policy on the use of digital photography. Mr. Byers stated that they have worked cases with the Texas Department

of Public Safety, the Texas Rangers and the Lubbock Police Department and have not had problems or challenges where they have introduced digital images into court. He also stated that all three of the previous listed agencies used digital cameras in their investigation process.

The Amarillo, TX Fire Marshal's Office is using digital photography for inspections and investigations. They have a cheaper digital camera that is basically a point and shoot model for inspections. They have purchased a Minolta 5-megapixel camera for fire investigations and have two more budgeted for next year. Mr. McKinney stated that things have moved at such a rapid pace they have not yet written a policy regarding digital photographs. They have an informal process of downloading the photographs from the memory card to a stand-alone computer. If copies are needed they are copied to writable CDs. The Fire Marshal's Office based their process on the Amarillo Police Department's use of digital photography (McKinney, personal communication, 2003).

Rick Womack (personal communication, 2003), a private investigator for Kellough & Associates, is using digital photography to document the investigations he performs on fire and arson scenes. The camera he is currently using is a Nikon Coolpix 5000. He does not have a written policy since he is the only investigator but has talked to the Fire Marshal in Amarillo and uses a procedure similar to theirs. His main concern is the challenge to originality of the images and feels that this can be met by downloading the images to a limited access computer and making an original copy of the images on a writable CD (Womack, personal communication, 2003).

The Odessa, TX Fire Marshal's Office does not currently use digital cameras. The limiting factors are budgeting constraints and the fact that it is a new process and they want to see what other departments are doing before jumping out and buying cameras (White, personal communication, 2003).

Bruce Short (personal communication, 2003), an ID officer with the Lubbock Police Department stated that they have two digital cameras but use them on a limited basis. They currently do not have a policy for use but download any digital images made to a writable CD and file them with the original film photographs taken of the crime scene.

PROCEDURES

The research procedure used in preparing this paper began with a literature review at the Learning Resource Center at the National Fire Academy in November of 2002. Additional literature reviews were conducted from November 2002 through April 2003 at the Lubbock Fire Marshal's library and the Mahon Library located in Lubbock, Texas. Internet web sites were visited and reviewed from December 2002 through April 2003. Descriptive research to assess the benefits of incorporating digital photography into the Prevention Division and the challenges that will be faced was used to develop this project.

In May of 2002, the author met with Lubbock Fire Chief Steve Hailey (personal communication, 2002) and presented the idea of possibly changing the process of how the Fire Marshal's Office photographed fire and arson investigation scenes. It was agreed this would be the appropriate time to add the cost of digital cameras and video equipment into the budget process since the Fire Department budget would be adopted

in October 2002. The Fire Chief was informed that prior to actual implementation of the use of digital cameras, practical and legal issues would be explored.

To determine the amount of money that would be put into budget required the author to review several websites that specialized in digital photography. Five websites were specifically used during this process: www.pricescan.com, www.sony.com, www.pricegrabber.com, www.canon.com, and www.bhphotovideo.com. Not knowing exactly what cameras would be used posed a problem determining exact cost estimates. Camera ranged in price from $200 up to several thousand dollars. By establishing a midline cost estimate the author determined that approximately $700 would be needed to purchase the digital cameras and approximately $3000 would be needed for the digital video camcorder. The amount budgeted was approved through the budget process pending City Council approval in October 2002. The justification given during the budget review was to replace two outdated digital cameras purchased in 1996 and to replace an old VHS camcorder that was purchased in the early 90's. Justification also centered on requests by the Municipal Court Prosecutor to use digital video for use in court presentations for overcrowding violations in assembly occupancies (Salari, personal communication, 2002).

In October of 2002, the author received a book through the mail titled *The Digital Photography Sourcebook* from B&H Photo, Video, and Pro Audio. The web site is www.bhphotovideo.com. This sourcebook was a very detailed guide to the different makes and models of digital cameras and accessories on the market. It was obviously designed to solicit orders on the web site but purchasing information was limited to less than 10 pages of a book that was 446 pages in length. The sourcebook divided the

digital cameras into digital still cameras and digital SLR cameras. Each camera was then separated by model and make. This document was very useful in understanding the different types of cameras and their capabilities and limitations.

Kelly Vandygriff from the Texas State Fire Marshal's Office demonstrated the new digital camera that the State Fire Marshal's Office assigned it's investigators to use for fire and arson investigations (Vandygriff, personal communication, 2002). The camera they were given was a Canon Powershot G3. This camera is equipped with a 4-megapixel CCD sensor, which allows the operator to produce high-resolution photographs on a memory card. It also has a 4-power zoom lens that allows macro photographs to be taken. Multiple test photographs were taken with this camera exploring the range of use from very close photographs or macros to photographs exceeding 20 feet. Low light photographic situations were also tested.

The author also met with Lubbock Fire Department (LFD) Training Lt. Mark Ethridge. The LFD Training Division uses a Sony CD Mavica Digital Camera; model MVC-CD400 for developing training presentations and documenting the various recruit training activities. The unique feature that the Sony Mavica presents is its ability to save pictures to a writable compact disc. Multiple pictures were taken by the author to test the range of the camera and Lt Ethridge provided over 200 digital photographs depicting the capabilities of the camera (Ethridge, personal communication, 2002).

A meeting was held with the Board members of the West Texas Fire/Arson Investigators Association to discuss the types of digital cameras that were being used within the area departments of West Texas. Several of the members expressed an interest in using digital cameras for fire investigations but were limited in funding to

purchase the cameras. One member voiced a concern for the digital photograph's admissibility in court (Hamilton, personal communication, 2003).

Interviews were held with Fire Marshals from Amarillo, TX and Odessa, TX, a fire investigator for the State of Texas, an Identification officer from the local police department, the Lubbock County Medical Examiner's lead investigator and with a private investigator working for a private investigation company specializing in fires and arsons. Questions asked were; (1) are you currently using digital cameras for photographing fire scenes, (2) what brand of cameras are you using and how many do you have, (3) what is the megapixel rating for the camera you are using, (4) how much did the camera you are using cost, (5) do you have a policy in place for use of digital images, (6) do you have any concerns over the admissibility of digital images in court, and (7) do you know of any other agencies or departments using digital cameras.

Limitations

There are definite limitations to incorporating digital photography into fire prevention programs. The cost of the camera needed to provide a professional image is in the range of $350 - $700. Most small departments do not have this much money in their budgets to buy the cameras. Accessories such as an external flashes and batteries adds approximately $100 - $150 per camera. Most investigators have little or no experience with using the new technology so there will be a learning curve that has to be worked through. The ability to send personnel to training sessions will limit the ability to gain proficiency in the process.

Terms Defined

CCD – Charged Coupled Device – a computer chip with light receptors and a key element in digital cameras and scanners.

Digital image – An array of pixels, each of which has its own color. When viewed on a monitor or paper, the digital image appears like a photograph.

Digital Photography – Producing or reproducing an electronic image represented by a series of numbers, which can be manipulated by computer and then reconstructed as a photographic image.

Lossy Compression – An approach to compression known as JPEG (Joint Photographic Experts Group). This is called "lossy" compression routine because in the process of reducing the file size, some information is lost and is not recoverable when the image is opened. With JPEG, the user can select the degree of compression desired. But caution is needed, since the amount of loss increases as the level of compression increases. JPEG can be used to reduce file sizes by a factor of 100, but much will be lost in the process.

Kelly-Frye Test - ***People v. Kelly***, 130 Cal.Rptr. 144 (Cal. 1976) (The *Kelly/Frye* test states that the *Frye* decision was deliberately intended to interpose a substantial obstacle to the unrestrained admission of evidence based upon new scientific principles. A new scientific technique must be established by expert testimony and must be

shown to generally be accepted in the scientific community before evidence based on the technique will be admitted.)

RESULTS

What services do we provide to the citizens of Lubbock where digital images would be beneficial?

The services provided by the LFMO cover a wide spectrum from inspections, investigations, to public education. In each of these areas of responsibility, photographs are currently being taken. Photographs are taken during fire investigations to document the scene and serve as a reminder to the investigator as to what the scene looked like during the investigation. Photographs are taken during inspections to provide file documentation as to how a building was built, specific fire protection features or violations or deficiencies found during the inspection. Photographs are taken to show the activities of public education and some photographs are added to the Department's web site for public viewing. Video footage taken with a camcorder is used in court settings to give the jury an accurate picture of what was seen during a fire/arson investigation or an overcrowding situation at an assembly occupancy. The video camcorder is also used to create pubic education presentations for television and videotapes.

All of the activities listed above would benefit from the use of digital imaging. The process of sending out film for development takes a minimum of an hour by the time the film is taken out of the camera, marked for identification, placed in an envelope, and delivered to the photo shop. There is a minimum of one week before the developed pictures are delivered back to the office. The packets of photographs must then be separated and delivered to the person that took the pictures. Then the investigator must confirm that all the pictures are in the packet, create a file sleeve for the photos

and place them in the filing cabinet. The process for taking pictures with a digital camera that writes pictures to a writable CD reduces the time needed for processing the regular film. The photographs are taken, instant review of the images ensure that the photo represents what the investigator or inspector wants to record, the CD is then transferred to a protective sleeve and placed in the file. Cost of a role of color 400-speed film is approximately $4.00 not including the processing fee. The cost of a CD is approximately $1.00.

Digital images taken of public education programs benefit the fire department by the ease in which the photographs are transferred to the pubic education web site. The quality of the digital images allows them to be included presentations and on brochures. Digitalized photos can be inserted into most computer programs with greater quality of resolution.

What are the challenges of incorporating digital photography into fire prevention?

There are general challenges to using digital photography in any profession. The main challenges for fire departments are budgetary costs, unfamiliarity with the technology, legal issues, and training employees.

Fire prevention divisions across the nation are faced with budget constraints during these times of war, lower returns on investments, declining tax dollars and uncertain times. Traditional funding for a fire department focused on suppression activities, hazardous material response teams, medical response units and rescue squads. Little funding is allocated for fire prevention bureaus and the majority of that funding is directed toward salaries and benefits. Grant money is available for prevention activities but appears that funding for investigative camera equipment is

unavailable. FEMA may make grants for the purpose of establishing or enhancing a fire prevention program. Appropriate activities in this program include, but are not limited to the following: public education, public awareness, enforcing fire codes, inspector certification, purchase and installation of smoke alarms and fire suppression systems, and arson prevention and detection activities. Applicants can apply for funding for as many fire prevention initiatives under this function as necessary (USFA, Internet, 2003).

The USFA (Internet, 2003), website also states; We believe that the public as a whole will receive the greatest benefit from fire prevention funds directed to fire departments that currently do not have a prevention program. Also, we believe the public will benefit more from long-term fire prevention programs than to limited efforts. Therefore, we will give a higher competitive rating to programs that will be self-sustaining after the grant period. Because of the benefits to be attained, we will give a higher competitive rating to programs that target one or more of USFA's identified high-risk populations (i.e., children under fourteen years of age, seniors over sixty-five and firefighters), and programs whose impact is/will be periodically evaluated. The listed requirements for grant funding for prevention programs presents a challenge for those departments trying to get funding. It doesn't have the appearance that they are willing to help those agencies with a program in place.

Grant funding is also available for those fire prevention divisions that have law enforcement officers for arson investigation. Police departments have the ability to get federal grant money for investigation activities (Short, personal communication, 2003). The challenge to getting these grants is actually finding the grant that is available.

Using the search engine www.google.com, the author was able to access the web site for the National Criminal Justice Reference Service www.ncjrs.org. That site has grants and funding opportunities from the Office of Justice Programs, other federal agencies and has an area for tracking forthcoming opportunities. The problem is being able to find a grant that will specifically work for digital cameras. This author visited the site on multiple occasions and spent approximately three total hours trying to find an appropriate grant. The attempts were unsuccessful but with many grant opportunities available, one would have to think that a grant would be available for these cameras.

What types of digital cameras are available for fire prevention activities and which cameras would best suit these activities?

The World Wide Web provides the greatest number of locations to determine the types of digital equipment available in the market place. Web sites are set up to allow research by type, make, model, cost and availability. This author collected information from multiple sites on pricing and capabilities. Appendix A lists a comparison chart of the cameras surveyed. To determine the cameras that would be included in the list it became necessary to determine which feature would be the deciding factor. Resolution and how the images were stored stood out as two most significant factors when looking at using digital images in fire investigations. As indicated in Appendix B, the greater the capture resolution, the better quality of image is produced. Cameras with 4-megapixels or higher give a better overall chance of increasing the size of the image without loosing a significant amount of quality. Information for Appendix A and B was reproduced from information given at www.bhphotovideo.com. As also shown in Appendix A, how the images are saved in the camera is considered to be the media. Most of the cameras

looked at use some type of Compact Flash, Smart Media, or memory stick. Each of these presents a challenge in the collection of the images due to how the media is stored and collected. Most media collection techniques use a compression feature to store the photos. According to Russ (2001), recording the image in a “lossless” format (often TIFF – tagged image file format – is used as a standard format recognized by many programs and computer platforms) requires much more memory for storage…Only the higher end consumer cameras and professional cameras include or allow the addition of enough storage memory (in the form of Compact Flash, Smart Media, or a small hard disk) or provide a direct high-speed interface to the computer (e.g., a SCSI or USB connection) to allow the use of lossless storage.

Each of the cameras included in the comparison had similar focal lengths and focus range. These two features determine how close or how far away the camera can be from the object being photographed. The majority of the cameras allowed short clips of audio and video to be included with the image. With the exception of the Sony Mavica camera, all of the cameras had a viewfinder to look through (similar to a regular camera) and an LCD Display attached to the camera. The Sony only had an LCD display. In testing this proved to be a slight disadvantage depending on the outdoor lighting conditions. Bright sunny days tended to wash out the display. To overcome this problem, Sony has developed a viewfinder attachment that goes over the LCD Display. Through angled mirrors the image on the display can be seen through the viewfinder.

What are the legal issues of digital photography when presented in court?

When digital imaging is considered for law enforcement, the concern of the admissibility of digital photographic evidence in court is often raised. The fact that digital photographs are more easily altered than film-based photographs is usually cited. Some even believe digital photographs are not admissible in court (Staggs, Internet, 2003). This statement is representative of the misconceptions that surround the use of digital photographs is court. How a photograph is presented will be the main focal point on its admissibility in court. Is the photograph being used as a original and accurate representation of how the crime scene appeared on the date is question? If the investigator can answer yes to that question, all of the material researched for this project indicates that there will be no legal challenge.

If a digital image has been taken and “analyzed” for the court presentation there is the potential for a Kelly-Frye test or Daubert test to be administered. Courts hold that once a photo has been enhanced, altered or changed from its original condition, the potential for that image being admitted into evidence requires testimony from an expert in the field of forensic photography or someone specializing in analyzing digital images. According to Byers (personal communication, 2003), none of his digital images taken during autopsies and none of the digital images taken by the Texas Department of Public Safety and the Texas Ranges in cases they have shared have ever been challenged in court. Byers stated that as long as the investigator is honest and does not misrepresent the images in the case, the challenges would be limited.

What are the practical uses of digital imagery in the field of fire investigations and fire inspections?

The practical uses of digital cameras in fire prevention are only limited to the imagination of the user. Using digital photography for fire investigations allows the user to take the images and immediately look at the image to see if it is a good representation of what the investigator is seeing. According to Byers (personal communication, 2003), the Lubbock County Medical examiners office sees the use of digital technology as a significant benefit. The practical side is the ease of use and being able to view the picture immediately. They also plan to use the most recent technology to allow an investigator from another town, view the autopsy through a digital link. The investigator can have photos taken of specific details, receive them through the link and download them to their computer. This cuts costs for the investigator to travel to another town to view the autopsy and it also adds an immediate current element in the investigation process. Byers goes on to say that they also have the capability to use the digital images in a PowerPoint presentation to be presented in court.

Another practical side is the ability to reduce the storage space of photographs and the negatives. In one year the Lubbock Fire Marshal's office investigates approximately 200 fire and arson incidents. At each scene investigated, there are approximately two to four rolls of film used. Some are 24 pictures per roll and some are 36 pictures per roll. With that number of rolls used there could be a range of 48 to 120 pictures taken for each investigation. That would account for approximately 9600 to 12,000 individual pictures and their negatives that have to be filed and stored. If digital

cameras were used and the images were downloaded to a CD that would correlate to approximately 200 CDs being stored. The size of the CD allows it to be placed in the file taking up little space. This practical use would also apply to the inspection situations where photographs are taken and stored in the inspection file. All of the current inspection data is compiled in an Access database. The used of digital images would allow the images to be downloaded into the database and retrieved from any computer terminal thereby reducing the file storage.

The practical use of digital images for public education is substantial. The Lubbock Fire Marshal's Office has a clown program called Fire Pals. The fire pals have a web site that is being developed for children of the community to visit and learn about fire safety and risk hazards. The web site has been difficult to develop because regular photographs are difficult to scan into the computer and produce a high quality image. Digital images of events will allow the site to be updated regularly showing the clowns interacting with the children around the community.

DISCUSSION

Traditional Use of Photography

Law enforcement agencies have long recognized the value of photography in the investigation and prosecution of criminal cases. The regular use of photographic images by police began in Paris in 1841 when photographs of criminals were taken as a means of establishing a rogues' gallery – the first primitive mug-shot database. Since then, photography has become such an intrinsic part of law enforcement activities that it is almost impossible to imagine an investigation that did not involve photography in some way. (Blitzer, Jacobia, 2002). This is evident in the process used by the Lubbock

Fire Marshal's Office. A considerable amount of budget dollars have been spent over the last ten years paying for point and shoot cameras, professional 35mm cameras and flashes as well as film and film development. Procedures are in place that requires photographs to be taken as a record of each investigation and to provide future reference of the scene as it was viewed on the date of the investigation.

Over a half century ago, Charles C. Scott, in his book, *Photographic Evidence,* made the statement that "Photographic evidence is not treated adequately in law schools; hence, the embryo lawyer rarely is impressed with the importance of photography. The active attorney, however, soon discovers that a knowledge of the principles of photography is necessary for the general practitioner. Indeed, whether he realizes it or not, the modern lawyer would be as handicapped should he be deprived of the use of photographs as evidence as would the physician were he forced to practice without his clinical camera and X-ray apparatus (Siljander, Fredrickson, 1997). Any investigator that has been through a deposition process understands the necessity of having proper photographs and understanding how and why the photographs were taken. Lawyers will spend a considerable amount of time questioning the investigator as to the location from which the photo was taken, why the photo was taken, what was being represented in the photo, how the photographs were developed and stored and who took the photographs. Lawyers for both sides of the issue will look for ways of either making the photographs admissible or inadmissible depending on their viewpoint.

Photographs can be extremely valuable evidence. They allow the judge and jury to quickly and clearly understand specific situations. Photographic evidence can be stored indefinitely and be readily available when necessary. It also provides the

investigator with a record of the crime scene and any items connected with the investigation (Robbins, Nichols, Harrelson, 1990). As the old adage goes, a picture is worth a thousand words. In a court setting, visual images allow the judge and jury to see the scene as the investigator saw it. Photographs provide the investigator a record of the events and serve as a recall device for faded memory. It cannot be stressed enough during the training process of an investigator just how important photographs can be for future court cases. One quickly learns the importance of photographic evidence the first time photos become lost or inadmissible. All recollection is focused on the memory of the investigator and challenges from the defense attorney will be significant.

The proper inspection and accurate documentation of a fire/crime scene is the most important initial step in any investigation. The notes, photos, and sketches generated to document the scene and the discovered evidence serve as an aid and ready reference throughout the investigation. More importantly, they provide the foundation for any criminal prosecution or civil action that follows. Fire scenes have traditionally been one of the most poorly documented and underrated classifications of crime scenes. The chief reason for this lack of documentation has been the investigator's traditional reliance on sketchy notes and personal recollections when preparing official reports or describing the circumstances of the fire to a jury or other judicial body (Redsicker, O'Connor, 1997). Fire scene documentation is vital for many different reasons. Fires occur the majority of the time due to either unintentional acts or intentional acts. Some occur through acts of nature or catastrophic events. Regardless the reason, most jurisdictions are assigned the responsibility to investigate the cause of

the fire. It may be to settle a civil issue for an insurance company or it may be to prosecute the perpetrator of a crime.

Fire investigation photography is a challenge because it requires you to document a wide variety of environments. From characterizing the overall fire scene to depicting the device, appliances, or electrical wiring that caused the fire, you often must be able to communicate and prove the various aspects of your case despite difficult photographic circumstances (Sanderson, 1999). One particular factor of fire scene investigation that is different from most crime scenes is the destruction of property by the fire. The average crime scene is usually in a setting where the property is still readily distinguishable and in its normal form. If the crime scene is indoors there is usually electricity to provide normal lighting conditions and conditions are normally suitable for crime scene photography. Fire scenes on the other hand are usually very dark and damp with no electricity or overhead lighting. Most of the property is difficult to recognized due to its charred state and has usually be moved from its original location during the extinguishment and overhaul activities performed by the suppression personnel. It is the investigators job to work through the scene from the unburned portion of the property toward the area of fire origin. Items must be identified as evidentiary material or fire debris. Photographs must be taken of those items that may be relevant to the fire investigation. If appliances are determined to be the involved with the origin of the fire, model numbers, operational controls and the power source must be photographed. All of this must be done in conditions where the appliances are covered in products of combustion or soot. The dark black conditions require a camera flash that will illuminate the item enough to be recognizable.

Photography serves as a tool of police and other investigators to make a record of the scene of a crime or other incident, to show particular items of evidence and their relationship to the scene, and to make close-up records of significant portions of the scene. Some items of evidence are transient or perishable and must be recorded at the scene. Others can be removed to the laboratory where they can be examined at leisure and photographed with special techniques. Usually, a photographer can record and preserve essential information using straightforward photographic techniques (Eastman Kodak Company, 1985). This article in the journal illustrates a very good example of the similarities and difference of normal criminal investigations and fire investigations. Most items cannot be taken from the scene so they must be documented as they are found. If a fire has occurred and the cause of the fire is determined to be unintentional in nature, evidence is left at the scene for insurance investigators to examine. Once the cause or origin of the fire has been determined and no criminal element is involved, the fire investigator's responsibility is concluded. They then have the responsibility not to destroy or move the evidence. Taking evidentiary materials from the scene that may be involved in a civil case is not a generally accepted practice for most investigative agencies. Photographs play an important role in the civil process because it allows the insurance investigator to see how the original fire investigator found the scene. Most of these scenes can be photographed with straightforward techniques with the exception of additional lighting or flash.

It can be very difficult to photograph a fire scene. Photos of the interior can be especially hard to take because of poor light and extensive carbonization. Regardless of the difficulty, such documentary photographs are an absolute necessity. Juries have

come to expect them (prints, slides, and video), and prosecutors relay on them for graphic corroboration of verbal testimony. The technical language of fire science can be disquieting to a jury. Such intricate testimony can be better deciphered if its essence is clarified or illustrated photographically (Redsicker, O'Connor, 1997). Crime scene investigators that work homicides, burglaries, assaults or blue-collar crimes typically have a more difficult time working in a fire scene. This author has worked several bombing cases and murder cases where the evidence was burned and the police officers present were discouraged. They felt that all the evidence was destroyed and unusable. This couldn't be further from the truth. The evidence is there it has just taken on a different form. Evidence and photograph collection becomes a greater importance during these types of investigations because the misconception in the minds of the jury that all the evidence has been destroyed must be changed. Quality photographs assist in educating the jury and working them through the process.

The photographs taken at a crime scene are critical to an investigation. The purpose of crime scene photographs is to give a documented record of the scene as it is observed. There is a special skill and technique to crime scene photography. Therefore it takes training and practice for the photographer to be proficient in the task (Blitzer, Jacobia, 2002). Proficiency in using a regular 35 mm camera usually comes from on the job training. It is very difficult to replicate a fire scene and all of the obstacles that present themselves during an investigation. Classes are available for general camera familiarization and are definitely recommended so the investigator will become proficient in how the camera operates. Photographic classes for fire scene investigations are generally limited. Law enforcement academies and continuing

education programs offer crime scene photography classes. These are generally useful in gaining an understanding of how the photographs are to be collected and documented but actual fire scene techniques are not discussed in great detail.

Reasons to Go Digital

The art of photography, although still quite young, is entering a period of radical transition. Computer technology now allows photographers to capture, store, and display digital images without the use of film or paper. With this capability comes a great deal of opportunity, and some foreseeable risk – at any point in this process, the image may be degraded or altered, intentionally or accidentally. Although the integrity of visual evidence has always been open to question, as noted by the court in *Cunningham,* statutory and common law evidence doctrines developed in response to the problem and photographs are now routinely admitted into evidence in both criminal and civil trials. Digital photography, however, is fundamentally different from conventional photography. It seem appropriate, as digital imaging become more common and more affordable, to ask whether existing safeguards in the rules of evidence are well suited to verify the integrity of visual evidence captured and stored in digital form (McCarvel, Internet, 1995). This statement, made in 1995, is indicative of a response to a new technology being introduced into crime scene investigation. It is important to remember that if the integrity of the investigation and investigator is professional and untarnished, admissibility standards remain consistent for both film and digital photography.

Digital cameras are taking over a major segment of the consumer photography marketplace. Only at the very high end (large format, professional cameras with

interchangeable and highly adjustable lenses) and the very low end (inexpensive automated snapshot cameras) are traditional film cameras holding their own. All of the major camera companies, worldwide, recognize this trend and are major players in the development and marketing of digital cameras. It is thus natural to consider the use of these cameras for, and their impact upon, the field of forensic photography (Russ, 2001). Analyzed forensic digital images will benefit more from the large format professional cameras with interchangeable and highly adjustable lenses. With costs of $1000 to $4000, most crime scene investigators will never be able to have these types of cameras. Municipal budgeting processes generally will not allow this amount of money to be spent in an area that does not generate income. The mid-level priced cameras with 2-5 megapixels provide a very good image that will work for the majority of the crime scenes encountered. As the market matures and prices decline, higher priced cameras and better technology will filter down to those that need it.

More and more businesses are seeing the benefits of utilizing digital cameras. Many businesses are attracted to the benefits of the digital photography age because it has the great potential of expanding their target markets. Business analysts assert that "the biggest demand is coming from those users who want computerized photos for World Wide Web sites, engineering projects, real estate estimates and police work" (Dillon, 53). Jim Verrall, MIS operations manager at Brandt Engineering Co. in Dallas and an owner of three digital cameras states that, when you shoot film it might sit in your pocket for two days, and then professional processing usually takes another day. Verrall, continues, "with the pictures saved to a floppy disk we can print them out and incorporate them into WordPerfect documents in five minutes" (Dillon, 56). Not only is

time saved here but also is money that can be redistributed within the business (Fried, Internet, 2003). The majority of city managers and councils work in the business sector. They are confronted with new technology and the benefits provided on a daily basis. This helps the investigator working for a municipality to show the benefits of incorporating technology used in the business sector into the criminal investigation process.

Digital cameras are also gaining popularity within the field of forensic science. "For forensics technologies collecting evidence at crime scenes, digital camera preview screens can help prevent errors." Warren Stewart, a forensics investigator at Alabama Department of Forensic Science, states, " they give us the capability to see if we have the exact images we need on the spot" (Dillon, 56) (Fried, Internet, 2003). It is not uncommon for an investigator to leave a scene of an investigation and be unsure if the photographs just taken document the scene correctly. Camera glitches and user error are not uncommon. Most fire departments and small police departments do not have the funding available to hire a full-time photographer. The investigators are usually taken from the firefighters and police officers working shift assignments that have little or no experience in photography. This is the case with all the investigators in the Lubbock Fire Marshal's office. They perform duties ranging from inspections to investigations and are on a rotational call status for fire scene investigations. They generally work two weeks on call and are off of call rotation for 4 weeks. That does not give them sufficient opportunity to become experts in the field of photography. They are proficient but not experts. The digital displays on the cameras will make their process considerably easier by allowing them to know immediately if the image is good or bad.

Once photographers understand digital imaging they will find the digital camera to be an excellent imaging tool. A digital camera gives you the ability to see the captured image immediately. It also gives you the ability to make a judgment on exposure and quality immediately. The image can also be transmitted electronically for others to evaluate (Blitzer, Jacobia, 2001). According to the interview given by Byers (personal communication, 2003), he was able to send autopsy images of an automobile accident victim through the email system to an accident scene investigator. The investigator wanted details regarding a specific injury and the medical examiner was able to take the images and email them to the investigator within a few minutes.

Digital camera operate much like a conventional camera inasmuch as a lens focuses an image onto a recording medium with the intensity and duration being controlled by the lens opening and shutter speed. But unlike the conventional camera that records the image onto a film coated with light sensitive material (emulsion) that must later undergo chemical development, the digital camera records the image electronically as is the case with a camcorder. The resultant information is then downloaded to computer to be viewed, stored, printed, or transmitted via modem (Siljander, Fredrickson, 1997). Digital technology has made the use of film for the normal operator almost a thing of the past. The cost of a compact disc is about 1/3rd the cost of a roll of film and there is no processing fee associated with downloading the images to a computer. Computers have become commonplace and each one usually comes with an image viewing program already installed. The era of boxes and boxes of duplicate pictures is slowly being replaced with computer discs with enormous capacities.

Fingerprints lifted using fingerprint tape can be photographed or scanned using a flatbed scanner. The preferred method is to photograph the lifted fingerprints with a digital camera. A typical scanner usually has about a 600-pixel resolution, versus 1500-pixel resolution or higher with a good digital camera. Higher resolution allows you to see much more detail in the fingerprint, which is essential for fingerprint comparison and enhancement of a poor print (Blitzer, Jacobia, 2002). The cameras that were surveyed have a 3 to 5megapixel resolution. The images taken of a fingerprint will be significantly better than the average flatbed scanner will be able to produce.

Digital imaging systems offer many benefits not immediately available with film or traditional analog video. Among these benefits include the ability to instantly review an image once it has been taken and the ability to easily import and image into digital image processing applications, where the image can be enhanced to improve the visibility of details in the image. Another major benefit of digital imaging is the ease with which images can be filed, stored, and transferred between locations and investigators. Digital imaging also offers an easy means of building image databases that have a variety of applications in law enforcement, such as mug shots or gang tattoos (Bruegge, 2002). The benefit of using digital images instead of regular film will be recognized immediately. The ease of taking the digital images and storing them on CD makes the process much easier. For the LFMO, the SOP will prohibit enhancing or improving the digital images once they have been copied to a CD.

The potential advantages of digital imaging for forensic purposes are fairly obvious, if often overstated. First, the stored image can be examined immediately without any need to wait for the chemical development of the image, not even the

minute or so required for Polaroid™ instant prints, so the photographer can be assured that the desired information has been captured. Second, the stored image can be transmitted via the Internet, exact duplicates can be made for all interested parties, and the images can be filed archivally with no degradation. Indeed, writing images in a "tamper-proof" format such as CD-R disks is recommended to guarantee the integrity of the images. Maintaining the chain of control for evidence is thus simplified (Russ, 2001). This selected reference continues to support the concept of using CD writable disks for storage of the images. As discussed in previous sections the images will have the capability to be sent through the email system as copies of the original. This will allow sharing information between two separate investigating agencies.

Legal Foundation Guiding Photographic Use

Photographs have been used in the court system since 1875, with the first use of color prints in 1946. Initially only photographs taken by professional photographers could be introduced in a court of law. However, by 1940, with the technological advances over time allowing cameras and photographic equipment to be more accessible and affordable to the ordinary person, a Pennsylvania court ruled in *Adamczuk* v. *Holloway* that "any competent investigator can take photographs which will be suitable for the introduction as evidence" (Redsicker, O'Connor, 1997). Automatic point and shoot cameras and digital cameras make the process of taking crime scene photographs or images available to all law enforcement agencies. The reference represents the history of film usage in investigations and sets the foundation for using cameras.

In order to be admitted as evidence in either a civil or criminal court trial, a photograph must be an accurate representation of the subject matter as it was at the moment the photograph was taken. Evidence photographs can really be considered record pictures. They record the situation as it existed at the time the pictures were taken. Bear in mind while photographing a scene that the photographs will be used for many things, not just the court. Examples: education of jury, accident reconstruction, refreshing the memory of officers or witnesses, demonstrating a particular point, review of the case by officers and others, as well as negotiation for a settlement (Varney, 1993). As long as the photograph is an honest representation of what the investigator saw at the scene and it is stored in its original state there will be few challenges to using it in court.

It is normally impractical to take physical evidence from a fire scene to a courtroom. Therefore, the investigator must rely on the use of photographs to document much of the evidence and to support the observations, opinions and conclusions the investigator wishes to make as to the cause of the fire, which might be suggested at a later date. Photographs are also useful for jogging the investigator's memory at the time of writing the report or before appearing in court (Cafe, 1997). As with the case during an arson or bombing investigation, it is very difficult and dangerous to bring the actual elements of the ignition source into the courtroom. Explosive devices, flammable liquid containers or other chemical sources of ignition cannot be brought into the courtroom due to the safety factor. Photographs allow the jury to see the evidence in a safe controlled setting.

The trial court determines the admissibility of all evidence, including photographs. This judgment – to decide what is and is not admissible – is based upon legal precedents that have established certain points of law. The first of these is that the object portrayed in the photograph must be material and relevant to the question at issue. Further, the photograph must not appeal to the emotions of, or tend to prejudice, the court or jury. Finally, the photograph must be free of distortion and not misrepresent the scene or the object it purports to reproduce (Robbins et al, 1990). Again, it is important that the photographs be representative of the original scene. Photographs that show fire or explosion victims may be ruled inadmissible due to their graphic nature. It is always advisable to make photos of victims with both color and black and white film. Black and white photographs are less graphic and prejudicial to the jury. Digital cameras have the capability of making the images black and white without having to use separate film.

There is no question that fire investigators may take photographs during and following extinguishment operations. These pictures serve as incidental tools in establishing the cause and origin of the fire, or can be used in evidence to establish the commission of a crime. However, where a fire has not yet occurred, and the investigator's only purpose for entering the premises is to photograph fire hazards, valid objections may be raised by the occupant. In the absence of specific provisions in the ordinance or statute granting fire inspectors the right to enter, inspect and photograph premises for fire hazards, it is highly doubtful that they have the right to take pictures. Note also that rights of property owners for the protection of proprietary information may override the fire department's authority to take pictures, even of fire hazards. Particular

caution is advised (Callahan, 1987). This is one issue that will have to be addressed in the SOPs in regard to taking pictures of hazards during inspections. In most instances, city ordinances require that business occupancies be inspected twice a year. The inspector gains admittance by either responding to an inspection request from the owner or by responding to a complaint from an anonymous caller. In either case, consent is given to enter the premises allowing the inspector to view the property. Hazards found are violations of the adopted city ordinances adopted by the local jurisdiction and are therefore considered evidence in an administrative procedure. Consent to take photographs will also have to be obtained. Proprietary information will have to be protected and addressed in the SOP.

Under the Federal Rules of Evidence, a photograph can be admitted into evidence if it is a fair representation of what it shows and relevant to the issues disputed in the case. In California, the rule is the same as long as the photograph is a fair, accurate, true or good depiction of the object or scene at the relevant time. Traditional photographs depict the scene/object as it actually was when the picture is taken (Lynch, 2000). Federal rules of evidence and State rules of evidence will guide the development of SOPs on presenting photographs and images in court. In Texas the rules of evidence are listed in the Texas Criminal Procedure Code and Rules. Texas rules are consistent with Federal rules and the rules established in California.

If counsel lays a proper foundation of accuracy and reliability, photographs and sound recordings may be accepted as evidence if they are relevant and material to the issues and if they are not unduly prejudicial. Photographs are probably the most commonly used form of demonstrative evidence. The reliability of their reproduction is

generally accepted, they are relatively inexpensive means of representing the actual physical evidence, and they are very convenient. As with all other evidence, a photograph must be shown to have some relevance to the matter in controversy at the trial in order to be admitted. The trial judge determines the relevance, which is based on the relevance of the photograph itself, not that of the fact the offering party is attempting to establish. If it is determined that the photograph is not relevant to the purpose of the trial, the fact may be established through the use of some other evidence (Hanley, Schmidt, Robbins, 1991). Photographs are an excellent form of evidence when done properly and professionally. Court cases and precedents allow photographic images to be used and set the foundation for the future of digital images. Technical differences will be explored but the basic premise will remain the same as taking pictures with regular film. The digital images will be relevant and serve as an accurate representation of the scene as it existed during the investigation.

Evidentiary Challenges of Digital Photography

When digital imaging is considered for law enforcement, the concern of the admissibility of digital photographic evidence in court is often raised. The fact that digital photographs are more easily altered than film-based photographs is usually cited. Some even believe digital photographs are not admissible in court (Staggs, Internet, 2003). This reference is indicative of what investigators and people uncomfortable in using digital technology are espousing. It is not representative of what this author found in talking to investigators that are currently using the technology. As long as SOPs are in place and the technology is used correctly, challenges are not being seen. Research

shows that digital images are being allowed in court serving as reference material as well as analyzed images.

The Scientific Working Group on Imaging Technology (SWGIT), operated under the leadership of the U.S. Federal Bureau of Investigation, has explored the issues extensively and provides good guidelines for dealing with the technology. One fundamental distinction they have pointed out is that criminal justice images that might be used at trial fall into two categories. Some, in fact most, are “visually verifiable,” and others are “analyzed.” In the case of visually verifiable images, the witness uses the image to illustrate his or her memory of a scene. In essence, they will say that they were at the scene, saw the circumstances, describe key features and use the image to help the listener understand what they are describing. They could just as easily us a hand-drawn sketch. The burden is on the memory of the witness. When a photo is used, they will inevitably be asked, “Is this a fair and accurate representation of the original scene?” And the answer had better be, “Yes.” The technology employed to produce the illustration is not really at issue (Blitzer, Jacobia, 2002). This reference anchors the issue of admissibility for this author. The term visually verifiable will become an intricate portion of the SOPs developed for the LFMO. Our office will not be analyzing the images or altering them in any way. The images will only be used as a image to illustrate the memory of the investigator.

The story is very different when one presents an analyzed image. As an example, consider a latent fingerprint image – a dirty finger on a halftone newsprint photo. Since it is very hard to separate the halftone dots from the ridge or trough detail, it can be very difficult to read the print. In this case one might apply a Fourier analysis

to selectively remove the background. This would be a clear case of an analyzed image. In this case the witness cannot say that he or she was there, saw the original object, and it looked like the image that resulted from the analysis. It did not look that way. In fact the processes used to enhance the image were specifically chosen to change the appearance, so as to render the fingerprint readable. In this case it can be argued that the witness is introducing scientific evidence, and as a result, it must be able to withstand a test in order to be admissible. In the United States, two such tests are used and referred to as the "Kelly-Frye," or "Daubert" tests – the choice of test varies by state (Blitzer, Jacobia, 2002). Blitzer and Jacobia (2002) list the key issues of these tests as; (1) Is the science that was employed valid? (2) Was the science applied in a valid way? (3) Was the equipment (and software) that was used working properly at the time? When digital images are used for analytical purposes it will be necessary to have that process done by someone considered an expert in the field. Original images must be kept free of manipulation and alteration. A copy of the original digital images should be image that is used for the analyzing process. Fire investigation processes have been subject to these types of tests in the last few years. Defense attorneys have found that questions focused on the scientific nature of fire investigations force the investigator to make a choice on the witness stand. Is the process a scientific process or a series of wild guesses? If the process is scientific in nature a Daubert test will be applied. Digital images will face this same type of testing until a fundamental history has been established.

Federal rules of Evidence, Article X (Contents of Writings, Recordings and Photographs), Rule 101(1) defines writings and recordings to include magnetic,

mechanical or electronic recordings. Rule 101(3) states that if data are stored in a computer or similar device, any printout or other output readable by sight, shown to reflect the data accurately, is an “original”. Rule 101(4) state that a duplicate is a counterpart produced by the same impression as the original…by mechanical or electronic re-recording, … or by other equivalent techniques which accurately reproduces the original. And Rule 103 (Admissibility of Duplicates) states a duplicate is admissible to the same extent as an original unless (1) a genuine question is raised as to the authenticity of the original or (2) in the circumstances it would be unfair to admit the duplicate in lieu of the original. This means a photograph can be stored digitally in a computer, that a digital photograph stored in a computer is considered an original, and any exact copy of the digital photograph is admissible as evidence (Staggs, Internet, 2003). This is the fundamental reference for admissibility of digital images in a federal court. SOPs established that address these fundamental procedures will be based on a firm foundation when presented in court.

California Evidence Code Section 1500.6(a) (Admissibility of Printed Representation of Images Stored on Video or Digital Media to Prove Existence and Content of Image) states a printed representation of an image stored on video or digital media shall be admissible to prove the existence and content of the image stored on the video or digital media. Images stored on video or digital media, or copies of images stored on video or digital media, shall not be rendered inadmissible by the best evidence rule. Printed representation of images stored on video or digital media shall be presumed to be accurate representations of the images that they purport to represent (Staggs, Internet, 2003). California has taken a very direct approach to digital

images admissibility in court. This is more direct and to the point than the current rules of evidence for Texas. Both the California Code and the Federal rules do help support the process of using digital images.

Digital photography presents a profound challenge to the existing rules of evidence. Although a digital photograph may be cosmetically identical to a conventional photograph, it represents an entirely different species of evidence. Because a digital image may be precisely copied at will (until it is printed or displayed on a computer monitor) there exists no way to distinguish a copy from the original. And, because digital data may be copied absolutely perfectly, any discrepancy between two versions of a single digital image is likely to be the result of intentional alteration, either innocent or malicious. Unless the individual responsible for the alteration is identified, there may be no way to identify which image is derivative of the other (McCarvel, Internet, 1995). This reference can be disputed by the copying of the images directly to a CD. An original CD that is writable only will be earmarked with a serial number. As long as the investigating officer collecting the image is credible and the processes incorporated are fundamentally sound, the original image will normally be accepted as such.

Digital images are simply arrays of numbers (the pixel brightness values), and can be stored with any of the storage devices used for other computer data or programs, such as tapes, disks, writable CD's, etc., provided they offer enough space for the rather large files. However, for evidence purposes it is important to use a medium that can provide security from tampering (Russ, 2001). This research has firmly established that digital images must be transferred to a medium that cannot be rewritten. The Sony Mavica digital camera uses a small CD that can hold multiple

images. The CDs that are used are writable but cannot be rewritten or the information changed. This information has helped this author make the recommendation to use a camera that writes directly to a CD to meet the admissibility issue of originality.

Russ (2001) goes on to say the requirements for image evidence can be met for traditional film by keeping control of the original negatives, preferably as an intact roll. This prevents images from being deleted, altered, or added to the set. For Digital images, the equivalent security can be achieved by writing all of the images in a set to a permanent storage medium such as a writable CD-R disk, particularly one that has a serial number. It is not possible to modify, remove, or add images to this set, which can easily and confidently be copied in its entirety. Magnetic storage media, including tape and computer disks, and rewritable memory such as Compact Flash, do not have this security aspect and it would in principle be possible to edit and replace an image, remove an image from the set, etc. This is another deciding factor for using the Sony Digital Mavica camera.

It is commonly believed that film-based images are very secure, whereas digital images are very susceptible to tampering. When proper SOPs are employed, this is not the case. When proper SOPs are not employed, both are very susceptible (Blitzer, Jacobia, 2002). This author will recommend that SOPs be written for the LFMO to assist in assuring that the digital images collected will be admissible in court.

According to Staggs (2001), there are guidelines for ensuring your digital photographs are admissible in court. (1) Develop a Standard Operating Procedure (SOP), Department Policy, or General Order on the use of digital imaging. The SOP should include when digital imaging is used, chain of custody, image security, image

enhancement, and release and availability of digital images. The SOP should not apply just to digital, but should also include film-based and video applications as well. (2) Most importantly, preserve the original digital image. This can be done a variety of ways including saving the image to a hard drive or recording the image file to a CD. Some agencies elect to use image security software. (3) Digital images should be preserved in their original file formats. The saving of a file in some file formats subjects the image to lossy compression. If lossy compression is used critical image information may be lost and artifacts introduced as a result of the compression process. (4) If images are stored on a computer workstation or server, and several individuals would have access to the image files, make the files read-only for all but your evidence or photo lab staff. As an example, detectives could view any image files but they would not have rights to delete or overwrite those files. (5) If an image is to be analyzed or enhanced the new image files created should be saved as new file names. The original file must not be replaced (overwritten) with a new name file. These five guidelines provide the greatest basis for an agency considering the use of digital cameras. These principles will be the guiding factor for the rules and procedures of the LFMO.

Staggs (2001) lists two court decisions regarding digital images. *State of Washington vs. Eric Hayden, 1995*: A homicide case was taken through a Kelly-Frye hearing in which the defense specifically objected on the grounds that the digital images were manipulated. The court authorized the use of digital imaging and the defendant was found guilty. In 1998 the Appellate Court upheld the case on appeal. *State of California vs. Phillip Lee Jackson, 1995*: The San Diego (CA) Police Department used digital image processing on a fingerprint in a double homicide case. The defense asked

for a Kelly-Frye hearing, but the court ruled this unnecessary on the argument that digital processing is a readily accepted practice in forensics and that new information was not added to the image. Court cases that permit the use of digital images are fundamentally the acceptance needed for the new technology to be accepted. Most opinions in court cases are based on the history of decisions made in other court cases. These two listed cases help serve as a base for the future of digital technology. Many cases and divergence will be encountered throughout the process but the beginning shows great promise.

Other Agency Programs

The Texas State Fire Marshal's Office is currently using digital photography in documenting fire/arson scenes. The camera they are currently using is a Canon Powershot G3. They have had very good success with the camera but don't currently have any SOPs regarding camera usage (Vandygriff, personal communication, 2002). There is little history of use by the Texas State Fire Marshal's Office. They are a very large agency that is spread across many miles. Procedures will have to be established and guidelines put in place to ensure that their process runs smoothly. SOPs will have to address the storage of the images.

Robert Byers (personal communication, 2003), a Lubbock County Medical Examiner's Office Investigator is very confident that digital photographs are beneficial to his investigation process. Their office has used digital photography for approximately three years. The camera they are currently using is one of the early model Nikons. They have never had a challenge in court regarding the digital images. Their process is to take the photographs and download them from the camera to a writable CD. The CD

is kept in the Morgue Manager's file for each case and copies of the original images are made as needed. Federal funding is in place to upgrade their cameras with the new technology. Byers stated that the new technology would allow the doctor performing the autopsy to have a video link with an investigator in another location. There would be instant viewing of the procedure as well as audio communication between both parties allowing discussion of the procedure. The benefit of this process is the time and travel expenses for the investigator from another community not having to travel to the autopsy. Also, information on specific details of the autopsy is instantaneous. The Medical Examiners Office is in the process of writing a policy on the use of digital photography. Mr. Byers stated that they have worked cases with the Texas Department of Public Safety, the Texas Rangers and the Lubbock Police Department and have not had problems or challenges where they have introduced digital images into court. He also stated that all three of the previous listed agencies used digital cameras in their investigation process. The Lubbock County Medical Examiner's Office has established a very successful history of using digital technology. They have used digital images for documenting their cases for three years. The cameras they use are outdated as far as digital technology goes but the process is sound and successful. The only thing that they have not done is written an SOP on camera usage. They have not been challenged and probably never will considering their professional image and approach. As defense attorneys become more proficient and comfortable in their challenges of digital images, the lack of SOPs may present problems in the future.

The Amarillo, TX Fire Marshal's Office is using digital photography for inspections and investigations. They have a cheaper digital camera that is basically a

point and shoot model for inspections. They have purchased a Minolta 5-megapixel camera for fire investigations and have two more budgeted for next year. Mr. McKinney stated that things have moved at such a rapid pace they have not yet written a policy regarding digital photographs. They have an informal process of downloading the photographs from the memory card to a stand-alone computer. If copies are needed they are copied to writable CDs. The Fire Marshal's Office based their process on the Amarillo Police Department's use of digital photography (McKinney, personal communication, 2003). The Amarillo Fire Marshal's process is fundamentally sound but may provide the opportunity for challenges based on the multiple steps that are needed to save the original image. SOPs should be written and training of their investigators on the new procedures should protect them from future challenges.

Rick Womack (personal communication, 2003), a private investigator for Kellough & Associates, is using digital photography to document the investigations he performs on fire and arson scenes. The camera he is currently using is a Nikon Coolpix 5000. He does not have a written policy since he is the only investigator but has talked to the Fire Marshal in Amarillo and uses a procedure similar to theirs. His main concern is the challenge to originality of the images and feels that this can be met by downloading the images to a limited access computer and making an original copy of the images on a writable CD (Womack, personal communication, 2003). Mr. Womack is a good example of a private sector investigator recognizing the need for expanding evidence collection through digital technology. Written procedures for a single employee will only serve as a basis for his testimony. Mr. Womack understands the Daubert test and incorporates that into his use of the camera. He serves as President

for the West Texas Fire/Arson Investigators Association. His expertise and interest in the new technology will be a benefit for those agencies in West Texas entertaining the thought of using digital cameras.

The Odessa, TX Fire Marshal's Office does not currently use digital cameras. The limiting factors are budgeting constraints and the fact that it is a new process and they want to see what other departments are doing before jumping out and buying cameras (White, personal communication, 2003). Probably the only way that this small agency will be able to incorporate digital technology into their investigation process will be to look into grants provided by FEMA and other law enforcement agencies. As illustrated before in this process, this will be a challenge for their agency.

Bruce Short (personal communication, 2003), an ID officer with the Lubbock Police Department stated that they have two digital cameras but use them on a limited basis. They currently do not have a policy for use but download any digital images made to a writable CD and file them with the original film photographs taken of the crime scene. It should be just a matter of time before the Lubbock Police Department goes completely over to digital images. Their ID division is very competent and professional. It would stand to reason that once the funding becomes available to buy the digital cameras and it becomes a priority, they will develop the necessary procedures and excel in the process.

RECOMMENDATIONS

Based on the comparison of fire and police investigation agencies in Amarillo, TX, Lubbock, TX, Odessa, TX, and California, the literature review, personal interviews,

the author offers these recommendations for incorporating digital cameras into fire prevention activities of the Lubbock Fire Marshal's Office and other interested agencies.

1. **Develop standard operating procedures for use of digital imaging for inspections and investigations for the Lubbock Fire Marshal's Office that will be implemented over the next year.**

It will be recommended that SOPs be developed for the Lubbock Fire Marshal's office within the next year. Procedures will incorporate the type of camera to use and how the images are to be recorded. Writable CDs will be used to store the images and specific details on documenting the storage will be listed. Custody control of the images will be required as well as the physical process of storing the discs. Training will be provided to the investigators that will be using the digital cameras. Fire scene use of the cameras, recording the images, developing exhibits for court and PowerPoint presentations will be the central focus.

2. Present recommendations to the Fire Chief and City Administration.

Meetings will be held with the Fire Chief to discuss the type of camera that will be used, the cost of the cameras and flash attachment, as well as the SOPs. This will give the author a better sense of what will need to be presented to City Administration. Discussions previously held with the Fire Chief gave the impression that digital cameras will be approved at the fire administration level and the request will be allowed to be taken to the next level. The type of camera that will be recommended to the Chief is the Sony Mavica MVC–CD500 with an external flash attachment. It will be recommend that the camera be purchased thought www.sony.com in the government contract section. At the time this was suggested, the CD500 model was being offered through this web

site at a price of $672.00. This model is a 5megapixel camera that stores the images directly to a writable CD. This price is in the upper range of the models listed but it has the highest megapixel available in this price range that writes images directly to CD.

3. **Recommendations made to other agencies considering incorporating digital cameras into their fire investigation programs.**

Agencies considering adding digital cameras into their investigation programs should first be sure that their fire administration is comfortable with the concept. There is a significant cost associated with the purchase of digital cameras and flash attachments that will provide the images necessary for a professional presentation. SOPs should be developed completely outlining the use of the cameras and training must be incorporated to make sure that those using the cameras become proficient.

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APPENDIX A
Digital Camera Resolution Chart

		Print Size***					
Capture Resolution	**Video Display***	**2X3"**	**4X5"/4X6"**	**5X7"**	**8X10"**	**11X14"**	**16X20"**
320x240	Acceptable	Good	Acceptable	Poor	Poor	Poor	Poor
640x480 - 0.3 Megapixel	Good	Excellent	Good	Poor	Poor	Poor	Poor
800x600	Excellent	Photo Quality	Very Good	Acceptable	Poor	Poor	Poor
1024x768	Excellent	Photo Quality	Excellent	Good	Acceptable	Poor	Poor
1280x960 - 1 Megapixel	Excellent	Photo Quality	Photo Quality	Very Good	Good	Poor	Poor
1536x1180	Excellent**	Photo Quality	Photo Quality	Excellent	Very Good	Acceptable	Poor
1600x1200 - 2 Megapixel	Excellent**	Photo Quality	Photo Quality	Photo Quality	Very Good	Acceptable	Acceptable
2048x1536 - 3 Megapixel	Excellent**	Photo Quality	Photo Quality	Photo Quality	Excellent	Good	Acceptable
2240x1680 - 4 Megapixel	Excellent**	Photo Quality	Photo Quality	Photo Quality	Photo Quality	Very Good	Good
2560x1920 - 5 Megapixel	Excellent**	Photo Quality	Photo Quality	Photo Quality	Photo Quality	Excellent	Very Good
3032x2008 - 6 Megapixel	Excellent**	Photo Quality	Photo Quality	Photo Quality	Photo Quality	Photo Quality	Excellent

Poor	Noticeably Grainy (pixelated)
Acceptable	Obviously not a real photo, but some details are visible
Good	Can tell it is not a photo but most details are discernable
Very Good	Can tell it is not a photo at normal distance, but good enough for many uses
Ecellent	Difficult to tell from real photo at normal viewing distance
Photo Quality	On a photo-quality printer, the human eye should not be able to tell the difference at a normal viewing distance

* Either television or computer display (e.g. Web Page)

** Will produce an excessively large file size that would be inappropriate for web applications

*** Using a typical Photo Quality Desktop printer

APPENDIX B
Point-and-Shoot Digital Cameras with Optical Zoom Comparison Chart

	Maximum Resolution (optical /interpolated)	Media	Image File Formats	Focal Length (35mm equiv.)	Focus Range (Normal /Macro)	Digital Zoom	Video Mode Audio Record	Optical Viewfinder /LCD Display (size)	Battery	Cost
Canon PowerShot S40	2272x1704	Compact Flash (type I)	RAW, JPEG	35mm-105mm	34" - infinity/ 4" - 34"	3.2x	Yes/Yes	Yes/Yes (1.8")	NB-2L Lithium-ion battery	$440.00
Fuji FinePix F401	1600x1200 2304x1728	SmartMedia	JPEG	35mm - 114mm	24" - infinity /4" - 24"	3x	Yes/ Yes	Yes/ Yes (1.5")	NP-60 Lithium-ion Battery	$499.95
Fuji FinePix F601	2048x1536 2832x2128	SmartMedia	JPEG	36mm - 108mm	24" - Infinity/ 8" - 32"	4.4x	Yes/ Yes	Yes/ Yes (1.5")	NP-60 Lithium-ion Battery	$399.98
Hewlett-Packard Photosmart 812	2272x1712	Secure Digital (SD)/ MultiMedia (MMC)	JPEG	37-111mm	20" - infinity/ 6" - 28"	7x	Yes/Yes	Yes/Yes (1.5")	2x AA Batteries	$399.95
Kodak EasyShare DX4900	2272x1712	Compact Flash (type I)	JPEG	35mm - 70mm	20" - Infinity/ 2.8" - 28"	3x	No/No	Yes/Yes (1.5")	2x AA Batteries	$359.00
Konica Revio KD-400Z	2304x1704	SecureDigital & Memory Stick	JPEG	39mm-117mm	20" - Infinity/ 4" - 20"	2x	Yes/Yes	Yes/Yes (1.5")	Proprietary Lithium-ion Battery	$399.00
Minolta DiMAGE F100	2272x1704	Secure Digital (SD)/ MultiMedia (MMC)	JPEG, TIFF	38mm - 114mm	20" - infinity/5.7" - 21.5"	2.5x	Yes/Yes	Yes/Yes (1.5")	1x CR-V3 lithium battery or 2x AA batteries	$450.00
Olympus D-40 Zoom	2272x1704 3200x2400	SmartMedia	JPEG, TIFF	35mm - 98mm	31" - infinity/ 3.9" - 31"	7x	Yes/Yes	Yes/Yes (1.8")	4x AA Batteries or 2x LB-01 lithium Batteries (CR-V3)	$519.00
Panasonic Lumix DMC-LC40	2240x1680	Secure Digital (SD)/ MultiMedia (MMC)	JPEG, TIFF	33mm - 100mm	19.7" - infinity/ 5.9" - 27.6"	2x	Yes/Yes	Yes/Yes (1.5")	CGA-S101A Lithium Battery	$471.00
Pentax Optio 430RS	2304x1712	Compact Flash (type I)	JPEG	37.5 - 112.5mm	16" - infinity/ 5.5" - 20"	1x & 2x	Yes/No	Yes/Yes (1.6")	D-L12 Lithium-Ion Battery	$395.00
Samsung Digimax 410	2272x1704	Compact Flash (type I)	JPEG	34mm - 102mm	32" - Infinity/ 8" - 32"	2x	Yes/Yes	Yes/Yes (1.6")	4x AA Batteries	$398.00
Sanyo VPC-AZ1	2288x1712 3264x2448	Compact Flash (type I & II)	JPEG TIFF	35-98mm	20" - infinity/ 4" - 20"	4x	Yes/Yes	Yes/Yes (1.8")	2x AA NiMH batteries	$650.00
Sony Cybershot DSC-S85	2272x1704	Memory Stick	JPEG, TIFF, GIF	34mm - 102mm	2" - Infinity	2x	Yes/ Yes	Yes/ Yes (1.8")	NP-FM50 InfoLithium battery	$429.00
Sony Mavica MVC-CD400	2272x1704	8cm CD-R/RW disc	JPEG, TIFF, GIF	34mm-102mm	1.6" - Infinity	2X	Yes/Yes	No/ Yes (2.5")	NP-FM50 InfoLithium battery	$650.00
Yashica (Kyocera) Finecam S4	2272x1704	Secure Digital (SD) /MultiMedia (MMC)	JPEG, TIFF	35mm - 105mm	2.2" - Infinity /0.5" - 2.2"	2x	Yes/No	Yes/Yes (1.5")	Proprietary Lithium-Ion Battery	$399.95