A Procedural Analysis of the CCP 35mm Slide Digitization Workflow

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Abstract
The process for digitizing 35mm color transparencies within the Center for Creative Photography's (CCP) Digital Imaging Department has taken a dramatic turn for the better in terms of productivity. With the Digital Transitions (DT) Film Positioning System in conjunction with the DT Advanced 35mm Slide Film Carrier the department has realized a significant increase in productivity in the digitization of 35mm slides or transparencies, with an approximate highest rate of digitization reaching 350 to 400 per hour at the fastest, most uncomfortable pace. Without the Film Positioning System and the Advanced 35mm Slide Film Carrier the process was very time-consuming and tedious in that only one transparency could effectively be digitized at a time, with an approximate rate of about 50 to 60 per hour.

In light of this revelation, it is now possible to begin to think about digitizing some of the CCP's larger 35mm transparency archive collections for some of the most important photographers of the twentieth century, such as Harry Callahan, Garry Winogrand, and Hans Namuth.

The purpose of this procedural analysis is to explain the workflow with respect to the steps and tasks associated with the digitization of large quantities of 35mm slides at the highest quality and at an acceptable rate of throughput (100's per hour), while also taking into consideration preservation and safe handling of the materials as they are photographic originals not unlike a negative.

Hours of research have gone into the development of procedures and techniques working with Capture One software, Phase One digital backs, Schneider Optics & Shutters, and Digital Transitions hardware and systems in order to realize an acceptable throughput. Limitations were realized and overcome in order to assure the finest quality reproduction (digital file). New procedures and techniques were developed and made clear in reference to each consideration throughout the process for digitizing 35mm transparencies at appropriate resolutions. Topics concerning session preparation, object handling, file creation, and image processing have been presented in order to document the subtle sophisticated expertise established through trial and error by Joseph Rheaume & Allie Smith.

Purpose
The purpose of this analysis is to provide digital imaging technicians as well as the outsider with practical step by step procedures for digitizing 35mm slides using CCP's current instant capture equipment.

One of the most difficult and complex tasks today is the delicate and sophisticated process of digitizing photographic film based materials such as 35mm color slides or transparencies. If this procedure is not done correctly and conducted in the proper manner, with the right technology, then the resulting digital files may not be an accurate representation of the original and the photographic original could be damaged. The preparation and handling of the photographic originals requires a delicate balance of care and speed throughout the entire process in order to protect the materials and realize an effective productive workflow and throughput. Due to the age of the photographic materials they may be experiencing color shifting or the mounts could be compromised, therefore it is necessary to make a quick assessment of these materials before digitization in order to determine if any extra considerations should be taken.

Statement of Problem
There are a few areas of concern when dealing with the difficult and complex task of digitizing 35mm slides:

1. The scope of the individual project (quantity and desired resolution).
2. The condition of the photographic original (color shift in image and condition of the mount).
3. Material handling of the photographic original.

The objectives of this analysis are to:

1. Establish guidelines for determining the scope of each 35mm slide digitization project while meeting or exceeding FADGI standards.
2. Establish and/or bring to light procedures for determining the condition of the photographic original and to ensure proper handling and treatment based on those factors.
3. Establish and/or conform to the proper handling guidelines for these kinds of photographic originals.

Background of the Problem
Before digitization of 35mm film based originals was performed using instant capture technology it was accomplished using a scanner. There are two basic types of scanners employed, a flat-bed scanner or a film scanner. Most flat-bed scanners are sold with several different film holder adaptors for the most popular formats. The film holder or adaptor is loaded up with photographic originals and placed onto the glass and a multi capture scan is performed. The most popular film scanners that are employed for digitization of 35mm film based originals is something like the Nikon Super Cool Scan 5000 ED Film Scanner with the Nikon SF-210 Auto Slide Feeder. This device allows the operator to load up to 50 35mm mounted slides at a time and can be very efficient when it works properly.

There are several drawbacks to employing flat-bed technology and film scanners for digitizing 35mm transparencies. Flat-bed scanning technology is great for digitizing reflective materials but can result in softening film based originals because the CCD array utilized by the scanner images through glass, and it can be very time consuming at higher resolutions. Film scanners like the Nikon Cool Scan 5000 (with the auto feeder) can produce nice images but this technology employs a mirror inside the device that the image is reflected off of before it is sampled and this can also result in soft images. The Nikon SF-210 Auto Slide Feeder can increase productivity but is notorious for jamming and damaging slides and or their mounts. The auto feeder takes the control of the materials away from the technician, something we would not want to do with our valuable photographic collection here at the CCP.

Scope of Analysis
This Analysis will provide the imaging technician and others a method for creating digital assets from analog photographic 35mm transparencies or slide originals in the most efficient manner using the current instant capture equipment employed by the CCP. Step by step procedures with detailed descriptions will aid the reader through the complex and sophisticated steps involved in making digital assets from a 35mm color slide transparent originals while complying with FADGI standards.

Research Findings
Variable 1: Technicians can capture 35mm Slides at an extremely high rate (up to 400 frames per hour) but it is not advisable in most instances because it introduces the possibility for errors during capture and it has the possibility of jeopardizing the photographic originals. Additionally, we have found that trying to capture at this extremely high rate is very taxing on

the technicians and the average technician cannot effectively work at this rate for very long in an efficient manner.

Variable 2: The condition of the photographic original will have an impact on the post-processing, especially if the photographic original has started to turn in color as all color photographic materials will tend to do over time. If this is the case then it will require extra attention from the technician performing the post-processing which in turn requires extra time. This also requires the technician to use subjective sensibilities while trying to balance the color, another variable added to the equation.

Variable 3: The handling of these types of photographic originals requires the technician handling the materials to wear gloves in order to protect the originals during digitization. Regular cotton gloves are not recommended because they lack the ability to provide a complete tactile experiences when loading the transparencies into the Advanced 35mm Slide Film Carrier. It is recommended that the technician wear nitrile gloves or lint and dust free, form fitting, photo lab gloves that are more form fitting than regular cotton gloves and allow for more dexterity during handling and manipulation of the slides or transparencies.

Overview of RAW Imaging Workflow for 35mm Slide Digitization

1. An imaging request is made or decided upon.
2. Original photographic materials are brought down to the digital imaging department.
3. The photographs are assessed and the imaging of the photographs are assigned and scheduled.
4. An appropriate resolution is determined based on the physical size of the photographic original.
5. The workstation is set up for imaging at a determined resolution.
6. A RAW capture is made, it includes a quality control device (target) if possible and the Adobe RGB 1998 profile is associated with the capture.
7. The capture is slightly cropped if needed.
8. The capture is processed and made into a master tiff, the file is named with the archive group number or accession number and other data provided by the archivists or registrars.
9. Metadata is added to the master tiff, and it is backed up to storage drive.
10. Post processing of the master tiff is scheduled and assigned, usually to a different technician than the one who made the master tiff file for quality control reasons (see **Quality Control**).
11. Post processing begins, the technician evaluates the image and crops the file appropriately, removes and dust and any imaging artifacts, generates derivatives while the master tiffs remain untouched. The derivatives include a small cropped tiff (cropped out target if used) and a small jpeg. This is accomplished with a Photoshop Action. If it is determined that the file fails the quality control check then it will be re-imaged (see step 6).
12. The derivatives are backed up to storage drive.
13. The requestor is notified that their request is complete.

Session Preparation
When preparing a capture session, the technician will first set up the camera and software to optimize workflow for the particular material being digitized. Capture resolution is determined by the physical size of the photographic original. We have determined that 35mm slides may be imaged sufficiently at 3500 pixels per inch. Using the Capture One capture naming tool, the technician can easily create an automated naming convention that will update during rapid capture, eliminating the need to individually name incoming capture files.

Stage & Advanced 35mm Slide Film Carrier Preparation (positioning)
The DT Film Positioning System includes two components: 1) the stage and 2) the Advanced 35mm Slide Film Carrier. The stage elevates the film being digitized away from the light table so that the film is not exposed to any excess heat. The stage also creates a rock solid platform for the rapid capture of film by precisely controlling its position, so that every frame will be captured at a repeatable location.

The Advanced 35mm Slide Film Carrier enables rapid and precise positioning with conservation grade contact free handling, as the film is only touched outside of the image area. The Advanced 35mm Slide Film Carrier allows the operator to manually apply gentle tensioning to the film to ensure flatness, and include a set of detents that provide an easy mechanical stop to ensure operator speed and accuracy with a consistent registration distance under 1mm. The carrier is easy to load, and provides excellent positional stability.

The DT Advanced Film Positioning System allows one technician to load prepared 35mm slides with ease into a format-specific carrier that safely secures each slide mount without posing threat to the material, while a second technician operates the camera with the Capture One software through tethered capture. While the first technician moves the slide carrier into place, the second technician can make rapid captures and while also making any necessary image adjustments in order to create a digital file faithful to the original material.

Digitization (resolution and throughput)
A technician creates a custom even-fielding for every resolution (camera height) used, and one technician operates the software and camera via the work station computer, a second technician handles and places artwork. Using the Capture One capture naming tool, the technician can easily create an automated naming convention that will update during rapid capture, eliminating the need to individually name incoming capture files. Slide images are cropped to include the full image area, and then output at the captured resolution as master TIFF files in 8 bit Adobe RBG 1998.

Because we utilize technicians to remove imaging artifacts, we do not typically utilize auto cropping nor do we create derivatives directly from the RAW capture files. Instead, another imaging technician will take the master TIFF file, digitally remove any imaging artifacts, and use our custom Photoshop action to create two derivate files. The post-production process is arguably the most time-consuming of the entire imaging workflow.

Handling of Original Photographic Materials (physical and ergonomics)

Here at the CCP we have a workflow that addresses all of the concerns regarding dust on film based photographic originals. We do not employ ICE dust and scratch removal when we make captures because it increases the time for capture and it can blur the image and create digital artifacts. The Digital Imaging Department here at the CCP is charged with capturing photographic originals as they truly are, we would never misrepresent the materials in our collection by creating digital files that have been heavily manipulated; ICE is a heavy manipulation. Before we make a capture of a film based original we clean the object by employing a small burst of air directed across the surface of the material, front and back on the emulsion and non-emulsion sides. Generally, this action removes the majority of the dust on the surface, but if a small burst of air cannot remove what is on the surface and material is

attached to the surface we would bring it to the attention of our conservator. When we send out files to publishers that have requested images for publication through our Rights and Reproduction Department we will perform a manual clean-up of the images. This is accomplished by a digital imaging technician using tools in Adobe Photoshop. We have one flatbed scanner (EPSON 11000XL), however we do not employ it in production for digitizing film based photographic originals, as it does not compare to the quality we can achieve with the Phase One IQ180.

Quality Control (post processing)

It is during the post processing of digital captures that a digital imaging technician will simultaneously process the images and perform a quality check. If it is determined that there is a problem with an image then it will be assessed and rescheduled for capture at this time. One of the most common problems that can occur when capturing 35mm transparencies or slides is that the stage could be bumped or slightly moved. This will result in the capture being out of position and this will have to be addressed immediately. Another common problem that can occur while imaging at a very high rate of throughput is that a capture can be made while moving the next slide into position resulting in a slightly blurred image. Occasionally a slightly blurred image can get through the process that is why it is so important to have the digital imaging technician perform the quality check during the post processing of the digital images

Conclusions & Recommendations

The CCP Digital Imaging Department has determined that the DT Film Positioning System with the DT Advanced 35mm Slide Film Carrier when used with the Phase One IQ180 and Capture One Software is the most efficient and appropriate equipment and software system for digitizing large quantities of 35mm slides. It is recommended that the CCP secure these components to be utilized for digitizing large collections of 35mm transparencies such as Garry Winogrand, Harry Callahan, and Hans Namuth.

Image quality, handling capabilities, and throughput efficiency are all enhanced by the equipment, and the workflow and techniques we have created. While the Digital Imaging Department has realized the capability of creating digital captures at a rate as high as 350 to 400 – 35mm transparencies per hour; this rate is not recommended, as it puts unnecessary strain on technicians and pushes the limitations of the equipment and software. We have found that working at this incredible rate of throughput can also increase the possibility of operator error. An acceptable rate of throughput has been realized to be around 200 to 300 – 35mm transparencies per hour.

This increased accomplishment in productivity and throughput will allow the CCP to begin planning for the digitization of some of the CCP's larger collections of 35mm slides because the Digital Imaging Department has realized an increased ability to produce some of the highest quality digital reproductions in the history of their efforts to digitize film based photographic originals.