Film Digitisation in Practice

Why are you digitising the film?

It is essential that the purpose of the digitisation is carefully defined before a project is planned and put into action. Preservation, access, and restoration will all have different requirements which cannot be satisfied by a single workflow because film digitisation is imperfect at its present stage of development: a film scanner will not capture all the information contained in the film, and different film elements (negatives, prints, etc) all have different purposes, so "one size does not fit all".

In very simple terms, digitising films for **access** purposes means creating an end result fit for whatever access purpose is intended: the cinema screen, distribution on DVD/Blu-Ray, web-streaming, or merely low-resolution reference. This often means that the end-result has to be 'screen-ready' (that is, colour-corrected, properly framed, in synch with the soundtrack, at the most suitable resolution and in the appropriate file format). But it may also mean that the scanning can be done rapidly from release prints rather than from original masters.

Preservation	Access
Slow careful scan	Fast scan
Original masters	Release print
4K – 8K	2K – 4K
Overscan	Cropped to image
No post-scan work	Colour correction, etc

Typical requirements for digitising for preservation and for access

On the other hand, digitisation for **preservation** is a matter of capturing as much information from the originals as possible: this generally means careful scanning of the original masters on the highest quality scanner available, at the highest resolution possible, with the image 'overscanned' to capture beyond the image frame to include at least part of the perforations. For preservation, the original raw scan should ideally be kept as the digital master: this will generally not be screen-ready without further work such as colour-correction, cropping, synchronisation, and possibly some digital cleaning.

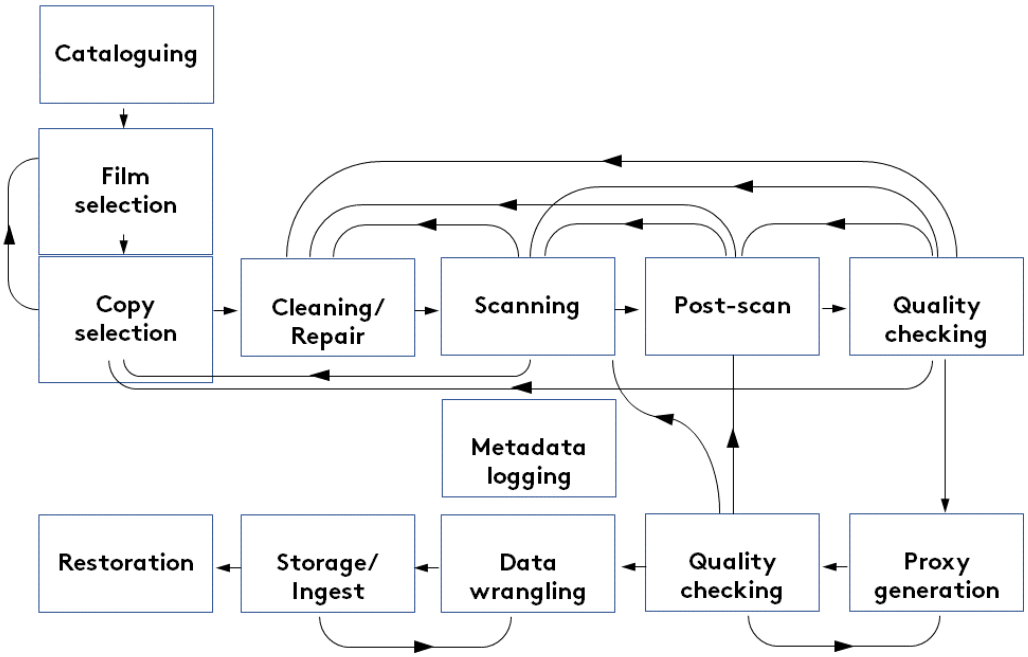
Of course, it is possible then to create versions from a preservation master which are suitable for access, but this is a separate operation which is unlikely to be suitable for

automation. It is also important to understand that with today's digital technology, creating a screen-ready version from a digital master is a one-way journey in which some of the data in the master is lost, so the screen-ready version should not be considered acceptable as a preservation master.

It may be possible (and in extreme circumstances, necessary) to devise a single output to satisfy all requirements, but the results are sure to be a compromise, either digital copies whose value as preservation masters is limited by the information lost in the process of their creation (such as a high contrast masking information in the shadows and highlights), or digital copies which fail to show the film in the way originally intended (typically with flat contrast and muted colours).

Digitisation workflows

The film scanner is only one small part of the process of film digitisation. Digitisation workflows can be immensely complex in large digitisation projects, but even for a single



An example of the various elements in a digitisation project

film there will be many elements and potential complications.

Selection

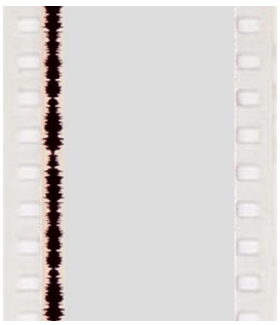
Before you even start, you must decide what films you are going to scan. This may be easy if you intend to digitise a complete set of films of limited size (such as a collection of newsreels), but for many archives the option of digitising everything in one project is not remotely feasible. It may be necessary therefore to take a step back and include cataloguing as the first step in the project so that curators have the necessary information to select and prioritise the films. If some of the collection is in a state of degradation, it may be necessary to carry out condition-checking on all the films at the start of the project: this is because the condition of each film will influence how it is to be

digitised and prioritised. The decision over which films to prioritise may be a matter of balancing significance of each film against its state of degradation.

Having selected the film, you have to select which copies are to be scanned. If there is only one copy, then there is no choice, but where there are masters and prints the decision about which elements to scan is highly dependent on the purpose of the digitisation. Taking the right decision can be extremely difficult if there are multiple copies, especially if copies are damaged or incomplete, or if there are different versions, or where the original film technology was complicated (such as A and B roll masters, separate title elements, separate overlays, etc).

A combined graded print can usually be scanned at one light setting, and sound synchronisation should not be a problem. The resulting scan may only require a small amount of post-scan work to generate a version suitable for users. However the quality will be lower than a scan from the original masters – though in theory not worse than the original print as shown to original audiences.

An original negative with separate track will almost certainly need scene to scene grading, and will need to have the sound synchronisation checked. Digitising a negative containing numerous splices requires care (see below), and digitising an optical negative track presents its own challenges (also see below). However, this option will, with care, capture the original film in the best possible quality. However, the resulting digital master will require further post-scan processing and manipulation to create a version suitable for an audience.



Digitisation from the film master elements becomes more complex where there are A and B rolls, or where there are additional elements such as separate title rolls (commonly used where different language versions were produced). Often it is far from easy to determine what place a particular roll of film has in the original production chain (for example, is a title roll a separate section on the front, or an overlay?). The print, of course, incorporates every element in one neat package, but at reduced quality.

Film preparation

If you have scanned an old film without any cleaning, then all the dirt and scratches become part of the digital image, and improving the result then depends on the ability of any digital restoration software to distinguish between defects and the actual image. This means lengthy effort on a workstation, and potentially damaging processes carried out on the digital image. Therefore, the condition of the copies should be part of the decision about which one to scan, and the chosen copy should be cleaned before scanning.

Damage of this sort may not need repair, depending on the ability of the scanner to deal with damaged film.

Does the film need repairing before scanning? You need to be familiar with the scanner that will be used, and understand what kind of damage it will tolerate, because ideally you would not stick any repair tape on to a film in case it compromises the film's future stability, and in any case repair work is slow and time-consuming, requiring great skill. However, despite many modern scanners being able to tolerate films with considerable damage (such as broken perforations), there may be occasions where some repair work is necessary.

Does the film need some kind of special treatment? If films are brittle and buckled to the point where they cannot be scanned properly, it may be possible to temporarily rejuvenate them by re-moisturising in an atmosphere of water, or if necessary, water and glycerol, or even water, glycerol and acetone. Such techniques should be carried out only by those who have been trained in their use.

Scanning

There are all sorts of film scanners on the market, with a large price difference between the cheapest and the most expensive. However, even the most expensive machine may not be ideal for some types of digitisation, and in certain circumstances the cheapest

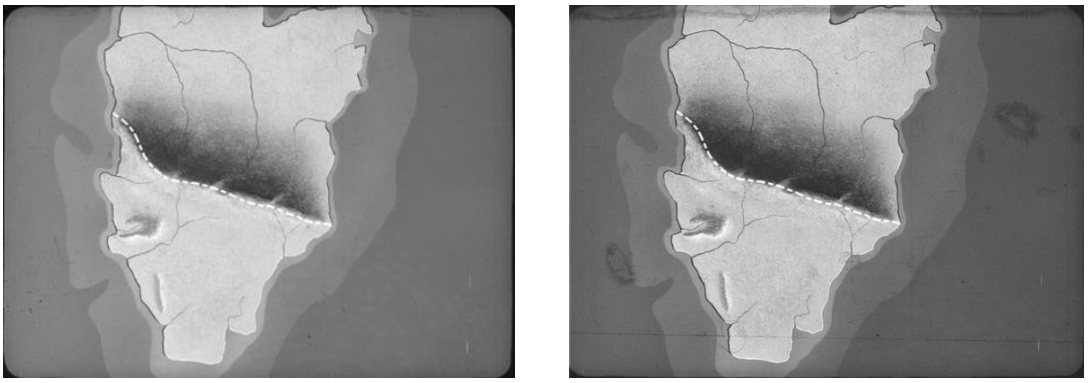
One scanner may cost ten times as much as the other, but the cheaper scanner can produce good results in the right circumstances.

scanner may be the most suitable for the intended purpose. For instance, a scanner that captures the film frame by frame with multiple exposures will probably give the best results when digitising for preservation or restoration, but a cheaper, faster scanner may be better for a mass-digitisation project for access purposes.

The state of the film

Ideally, the choice of scanner should be dictated by the type and condition of the film to be scanned, and by the purpose of the digitisation, although of course this is not always feasible. Particular factors you should consider are:

- Colour fading: cheaper scanners which use a single Bayer-pattern sensor chip are likely to struggle to correct badly-faded colour film because the colour filters will not be optimised to capture the faded colour dyes in the film.
- Instability at splices: it is common for splices in the film to cause a degree of instability when a physical splice passes through the gate: this shows as a jump in the frame position or as a distortion in the image. In some cases the effect can be quite severe. If the intention is to scan original negatives containing many splices, then a scanner which can handle the splices with the minimum amount of disruption to the image is preferable.
- Shrinkage, buckling, brittleness: if a lot of the film is degrading in this way (such as collections suffering badly from 'vinegar syndrome'), then the scanner must be able to handle the film without further damage and without losing focus when buckled frames pass through the gate. Most scanners have some kind of adjustment or gate adaptors intended to improve the handling of shrunk or buckled film, but some are more effective than others. Avoid any scanner based on a traditional editing table design: these generally have many sprocket drives with a large 'wrap-around' and are likely to cause serious damage to shrunken film.
- Scratches, blemishes, dirt, tape splices and repairs (especially on the 'cell' side of the film): because of the different optical arrangements used in scanners, there is a surprisingly large variation in the ability of scanners to disguise these. If much of the film is in poor condition, then using a scanner which reduces the visibility of such blemishes will save a huge amount of post-scan restoration work.



Raw scans of the same frame made on two different scanners. Note the high visibility of the blemishes and the tape splice on the right-hand example.

Resolution and bit depth

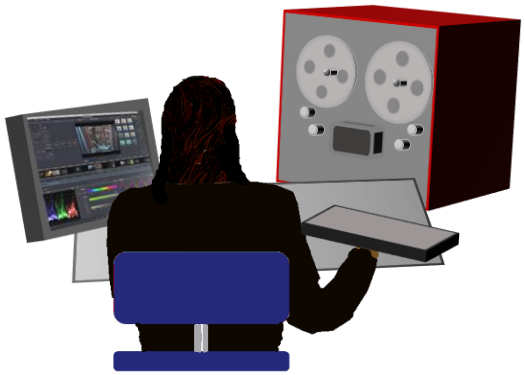
Higher resolution and dynamic range does not necessarily mean better digitisation. For example, an excellent result might be obtained from old nitrate print scanned on a high-quality 2K scanner creating 10-bit files; a poor result might be produced from a faded negative scanned on a cheaper 4K scanner creating 16-bit files. Think carefully about the inherent quality of the film, the purpose of the digitisation, and your budget and resources. Is the project about saving a collection before it degrades beyond rescue, or is it about creating high-quality material for dissemination? Have you got the time and resources to manage high resolution scans? Does the quality of the original film justify high resolution? Do you have original negatives which will benefit most from high dynamic range scanning? Do you have the expertise in-house to run the often complex operation of a high-quality scanner, or do you need a scanner which is simple to operate?

Think especially about the capacity of the digital systems to manage the data: 4K scanning produces four-times the amount of data as 2K, and 8K produces sixteen-times this amount. Never underestimate the impact of large quantities of data on all the processes downstream from the scanner. Excessive time spent moving and processing data will have a serious negative impact on the project, and inadequate storage at any stage will cause the workflow to breakdown. The capacity of your digital systems will need to be many times greater than the theoretical minimum to allow for unexpected hold-ups anywhere in the workflow.

Remember also that a scanner with a 4K Bayer-pattern sensor does not create true 4K resolution in all three colour channels, but instead builds the 4K resolution through mathematical interpolation. (There is a way of getting *true* colour from all three colour channels, but only by halving the resolution.)

Carrying out the scan

Scanning film is a skilled operation. An inexperienced operator will create poor results even on the highest-quality scanner. Do not think that you can spend a lot of money on a scanner and then allow just anybody to run it – the operators must be trained, must gain experience, and must have an innate understanding of image technology.



You must give the scanner operator clear guidelines about what is expected from the scanning output. Many projects have run into difficulties because of muddled thinking about this. If the main aim of the digitisation is to create digital preservation masters, do not expect the scanner operator to produce graded, colour-corrected, synchronised material as well as producing un-modified preservation versions. If the intention is to speed through the scanning of as many prints as possible, do not expect the results to be

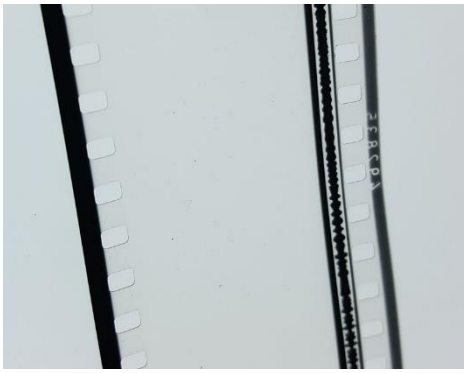
up to preservation standard. Be clear about what dynamic range is to be aimed for, what level of colour-correction is expected, what faults can be tolerated, and so on.

Soundtracks

The creation of soundtracks for films has always been a highly skilled process, involving specialist technology and dedicated professionals in the pursuit of the highest possible quality within the constraints of the technology of the time. Digitising a soundtrack in a manner that respects the original work requires skill and understanding, as well as specialised equipment.

Many film scanners include the means to capture soundtracks, either by reading them directly through an optical sound head, or by capturing an image of the track and generating a sound file by digital processing. The optical soundtrack on a film print is a 'positive' track designed to be read by an optical sound head in the film projector; a negative optical soundtrack is designed to be printed onto a projection print in a film laboratory, and is not intended for reading directly in a sound head.

A negative optical soundtrack



A positive optical soundtrack (in this case without any matching picture)

Negative soundtracks played through a conventional sound head will have increased background noise, and will be distorted (especially noticeable with sibilants).

Most film scanners are now sold with some method of capturing the soundtrack, and it is essential to understand what types of track you might need to capture, whether the scanner under consideration is capable of doing justice to the original sound, and whether you have the skills and resources in-house to manage soundtrack capture.

Certainly, if you have negative soundtracks to scan, you should not be planning to capture them using a conventional optical sound head. There are a number of systems now available which generate the sound from a digital image of the original track. Most of these are expensive and some require dedicated hardware; others are included with the scanner. Some of these systems work by stitching together a complete track from individual images of each frame, so that the sound can be retrieved from the digital images of all the film frames (provided that each frame is overscanned to include the soundtrack and a degree of overlap with adjacent frames). These specialised systems and software are the only way of retrieving good sound from a negative track, and the results of best of these systems are very good in the hands of a skilled operator.

If your collection includes magnetic soundtracks, these again require the right equipment to read the tracks. Be aware that although some scanners do include magnetic sound heads, these often will only read one type of track (edge tracks) as found on combined

magnetic prints, and may not be able to read ‘centre’ tracks as used in the production process.

Post-scan work

The output from the scanner is likely to require some work on the raw files before logging and storing. Common operations include soundtrack synchronisation, cropping the image,

Over-scanned original

Image cropped for presentation purposes

stitching together reels and part-reels, topping and tailing, adding identifiers, generating proxies, file-renaming. If any of these tasks can be carried out automatically as part of the logging process and scanner setup, then it is well-worth spending the effort to ensure

Uncorrected scan from slightly faded original

Small degree of colour-correction applied

that the systems are configured to do so.

If access copies are to be generated, the work may include colour-correction and dust-removal.

Do not underestimate the resources needed for this step in the workflow, and do ensure that those on the digital workstations are completely clear about what they are expected to do.

Do also make sure that the expectations for post-scanning operations is compatible with the scanner’s capabilities. For example, it is unlikely that perfect colour balance can be recovered from a badly faded print if it has been scanned on one of the lower-range scanners, so setting this as a goal for the workstation operator will only lead to frustration.

On the other hand, with a high-quality scan it is possible (and may be tempting) for the operator to spend an almost unlimited time working on a film to colour-correct every shot,

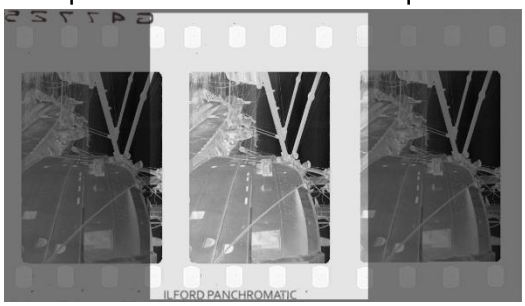
and to remove every scratch and blemish: this type of high-level restoration work will not fit into a project for digitising a large number of films, and should be reserved for films of special importance only.

Preservation scanning

A digital preservation master is the analogue of the original film negative: it contains the greatest amount of information at the highest quality, but is not intended for presentation to an audience. A digital preservation master should strive to capture all the information in the original film, ensuring that future access versions generated and disseminated by any means and any technology available are not limited by decisions made at the time of its creation.

In principle, a digital preservation master should **not** be subjected to post-scanning processing work, but should be retained in its original state: this is because image processing is always subject to improvement and also because views on the acceptable degree of intervention are also subject to change. An 'ideal' digital preservation master would conform to the following:

- As much of the film outside the image should be captured. Ideally, this would mean the entire width of the film including the soundtrack, the perforations, the manufacturer's marks, signs of damage, and so on. However, scanning such a large area means that the resolution available for the image itself is significantly reduced, and a higher resolution scan is therefore required. In practice, few scanners offer the option of scanning the film from edge to edge, but at the very least, some part of the perforations should be captured to provide information about the stability of the image.



Over-scanning to the edges of the film

- The image should not subsequently be cropped to the frame of the image.
- Any adjustment to the dynamic range of the image (that is, the degree of difference between the darkest and lightest parts of the image) should not result in any loss of information in the shadows or highlights. This may mean that the image appears flat and lifeless when viewed.
- Similarly any adjustment to the colour balance should be fully reversible.
- Digital restoration (dust-busting, scratch removal, etc) and any other image processing such as resizing, stabilisation, should not be carried out.

Quality control

Be sure to build quality-checking into your workflow in such a way that there is no lengthy delay between creation and checking: this is to ensure that systematic faults do not affect too many films before they are detected. Those carrying out the quality-checking must be familiar with the characteristics of both film and digital technology, and ideally have a good knowledge of the type and condition of the films being digitised – what might

appear to be a serious fault when digitising a collection in good shape might be considered a significant success if the originals are in a very poor state.

Documentation and workflow

One of the most important aspects of digitising film is documentation, that is, recording metadata about each step in the workflow. Every step from selection to dissemination must be recorded; if this is not done, then it will be difficult, if not impossible, to keep track of the work and to determine the full history of any digital file. These are some of the most important pieces information that must be recorded:

- Which originals were used
- Whether they were cleaned, and how
- What repair work was carried out
- Which scanner was used and who operated it
- What scanner settings were used
- What post-scan processing was carried out
- What software and which version was used
- When each stage was carried out
- Details of the digital file formats used

This information, which comes under the general heading of Preservation Metadata, will be needed to answer almost any query about the digital versions, and will be needed to guide future decisions about the digitisation process. For instance, it will be essential to know who created each digital version, on which scanner, and whether this or that copy was used. Also, when considering any upgrades to hardware or software, it will be important to know how many and which digital copies were produced using the previous generation in order to inform future decisions.

It is worth taking some trouble to ensure that your data conforms to a metadata standard, such as PREMIS: even if this is felt to be too difficult to grasp fully, it may at least help you ensure that all the necessary data is captured.

Do not underestimate how much care and effort is needed to record this data accurately. Although much of it can be generated automatically, it may take careful planning and systems development to reliably capture it, and some degree of manual input will always be needed. Even in the simplest project, the design of the workflow and all the systems that underpin this will be complex; a large project is likely to need a staff member whose main role is the design and implementation of the workflow systems.

Restoration

Few large-scale digitisation projects will have the resources to carry out significant digital restoration on every film, and you should be realistic about what can be achieved with the available time, staff and funds. The degree of effort expended on a major film destined for a film festival screening will be considerably more than that needed for a collection streamed online, and will be the exception rather than the norm.

Remember also that digital restoration techniques are developing constantly, and what it will be possible to do to a raw scan in the future will surpass what can be done now. A restoration should always be thought of as today's version of the film, and there will always be the potential to create tomorrow's version with greater sophistication as technology improves. It is therefore worth retaining the unprocessed digital master for future use.

Appendix: Digitising projects, good and bad

The following three examples are not real cases, but have been put together from typical situations in order to illustrate what can go wrong and what can go well. Do not take the successful examples as project templates: the situation in each archive is unique, and any digitisation project must be carefully designed to fit your own circumstances.

An unsuccessful project.

- *The project:* to digitise a collection of 3000 reels from a mixed collection of masters and prints, in conditions ranging from good to badly-affected by vinegar syndrome.
- *The equipment:* a mid-range scanner using a single sensor (Bayer pattern) and continuous film transport, optionally 2K or 4K. One high-specification workstation.
- *The digital infrastructure:* Local fast storage 50 TB. One LTO7 tape deck.
- *The staff:* film technicians, scanner operator, workstation operator.
- *Timescale:* 3 years.
- *The purpose of the digitisation:* not fully defined - understood to be different things by different people.

At first sight this project seems reasonable: 1000 reels per year should be achievable as it means only about 4 reels per working day; 50 TB of local storage should be fine as this will hold around 50 hours of film at 2K, which would be perhaps 150 reels, depending on their length, which is 7 weeks work; the write-speed of the LTO7 deck when copying the files to tape should easily keep up with the flow of work, and there is no limit to how many tapes can be purchased; the film technicians have worked with the collection for years, the scanner operator will learn quickly on the job, and the workstation operator is rapidly learning how to use the post-scan processing application that has been chosen.

However the project gets off to a slow start because the technicians find that the collection is more complicated than anticipated: not all the labels are completely correct, and there are problems with incomplete reels, damaged reels, decomposing reels, etc, and it will take longer to select and prepare the reels for scanning. Because they understand about picture and sound quality, they select the copies which will potentially give the best results, namely the negatives and separate sound elements. Unfortunately this means preparing twice as many elements for digitisation.

The scanner operator gets started and finds that it takes a long time to scan the negatives because it takes time to set up the scene to scene exposures and colour balance.

The workstation operator finds that the picture and sound take time to synchronise (and sometimes the sound goes out of synch halfway through the reel), and the sound is poor quality anyway (because they don't have the right equipment to capture optical sound negatives). Also, finalising the colour and exposure from scene to scene takes a long time, and there are a lot of white specks and dustmarks on the image (because the films weren't cleaned before scanning).

So the decision is taken to use the prints instead. Unfortunately most of these are faded and neither the scanner, nor the post-scan workstation can rebalance the colour very effectively (because of the limitations of the imaging system). But at least the project has speeded up now!

Then the first request to use one of the new digitised films arrives: this is for an event to publicise the project. The project has no proper quality control and sadly the digital version of the chosen film is poor: the colour is bad, and the film looks very scratchy, even though there has been some attempt at colour correction and a bit of automatic dust-busting. Also the film has been over-scanned so the track is visible in the picture, and it is in separate reels with the leaders at the head and end of each reel included. This is because it was thought that these scans were intended for preservation, not access, so no work was carried out to crop the image, and tidy up the head and ends of the reels. The quality of the soundtrack is also poor. In any case, because nobody was responsible for setting up the workflow system, there are no proper records of what was done and nobody can be sure which film copy was scanned, so it is not clear how much things could be improved by doing it again.

These digital versions aren't really suitable as preservation masters either: in most cases the master negatives weren't used (and for preservation purposes, they should have been), and some processing has been done to the files using fairly basic software and an inexperienced operator (and for preservation purposes, irreversible processing should be avoided).

In other words, the digital versions aren't particularly good for preservation or for access.

Meanwhile, the digitisation project has come to a stop because there are some inevitable issues with the digital infrastructure with the result that the files cannot be transferred to LTO tape fast enough, and now there is no more digital storage space for the output from the scanner and workstation.

There is now an argument going on between the director and the project head: the director wants the digitisation to solve *all* the needs of preservation and access, but still wants the project finished in three years because there's no more funding available, and the project head says that it's not possible without more staff, more equipment, more time and most importantly, more clarity about exactly what the intended outcomes of the project are.

After three years the project comes to an end, having digitised half the intended number of films, most of which are only available as reference copies because the quality is not very good. (However, the project is deemed to have achieved its aims, after the aims were re-written to fit what actually happened.)

A successful (but expensive) project.

- *The project:* to digitise a collection of 3000 reels from a mixed collection of masters and prints, in conditions ranging from good to badly affected by vinegar syndrome.
- *The equipment:*
    - a film cleaning machine
    - a mid-range scanner using a single sensor (Bayer pattern) and continuous film transport, optionally 2K or 4K.
    - a contract with an external contractor to use a high-specification scanner at 4K or more.
    - a dedicated soundtrack facility
    - high performance workstations (various).
- *The digital infrastructure:* Local fast storage 50 TB. A RAID store (hundreds of TB). A number of LTO8 tape decks. All linked through a fast fibre-channel infrastructure.

- *The staff:* film technicians, sound technician, scanner operators, workstation operators, workflow manager, digital infrastructure manager, quality control technicians, metadata and documentation manager, cataloguer, restoration workstation operator (etc.).
- *Timescale:* 3 years.
- *The purpose of the digitisation:* to create good-quality access versions suitable for online and broadcast; to generate 4K (or better) digital preservation masters from films which are degrading; to restore a selected set of key works for screenings and special events.

The scope of the project has been carefully defined and planned: all staff are clear about what they are expected to do and to what extent; all systems feed information into a central metadata logging system using unique identifiers so that a minimum amount of data has to be input manually; quality control has the capacity to keep up with the workflow and there are set procedures and routes for quality control failures; the digital infrastructure is designed with a large excess capacity to cope with interruptions to the flow of work; the budget for the external contractor has been calculated based on a statistical survey of the condition of the collection and the number of films considered to be at risk and are therefore to be digitised for preservation; the key films for restoration have been selected by curators and by external cultural experts; publicity for the project has already raised interest about the archive and in the forthcoming screenings and events.

Inevitably there are problems: the film collection holds some unexpected surprises (as all film collections do) which impact on the progress; some films are more challenging to digitise than expected; maximising the quality of digitised soundtracks keeps the sound technician working late at night; even with carefully defined guidelines, there is still some disagreement between the quality control staff and the digitisation staff about what level of defect is acceptable. However the project stays on track and achieves its aims within the budget, and the perception of the archive by the public and the politicians is greatly enhanced by the restorations and by the huge range of films now available for viewing – so much so that funding for a new archive store is approved, thereby securing the future of the master films.

An emergency project.

- *The project:* to digitise a collection of 3000 reels from a mixed collection of masters and prints, most of which are badly affected by vinegar syndrome and held in poor storage.
- *The equipment:*
    - a film cleaning machine
    - a mid-range scanner using a single sensor (Bayer pattern) and continuous film transport, optionally 2K or 4K.
    - a digital workstation.
- *The digital infrastructure:* Local fast storage 50 TB. A couple of LTO7 tape decks. A very small but very fast fibre-channel infrastructure.
- *The staff:* film technicians, scanner operators, workstation operators, a small number of multi-skilled staff who understand digital technology, workflows and documentation.
- *Timescale:* 3 years.

- *The purpose of the digitisation:* to generate digital preservation masters from films which are degrading before it's too late; to restore a selected set of key works for screenings and special events.

The archive has one scanner and very little money. The promised new film store which will give the archive time to preserve the films properly has been delayed again in the government's latest spending review. The entire collection is at severe risk of loss unless something is done to save the content.

However, the staff are skilled at using available hardware and equipment, and they are clever at using open-source software to manage the digital processing (with a little help from the university). As a small team they are familiar with the collection and the likely problems they will encounter with the films. They have set up a largely manual workflow which ensures the smoothest possible progress and ensures that all the necessary data is recorded. They are all clear that there is no time to do anything more than make the best, cleanest possible scan of everything (and this might mean scanning both prints and masters of the same film where these exist), capturing the full dynamic range of the films, as far as the scanner allows. They understand that time spent cleaning the films before scanning will be well spent. They plan to have two operators in working in two shifts on the scanner to maximise throughput. Where there is sound, the scanner will 'over-scan' to capture image and soundtrack (with a small overlap between frames), so that in the future it may be possible with software processing to recover improved sound.

There will be a minimal amount post-scan processing (perhaps synchronising the sound and generating lower resolution proxy copies using standard settings to create versions that are acceptable for streaming and reference).

They are in discussion with potential funders to help restore fully three or four iconic films so that these can be used to publicise and raise awareness of the importance of their mission.

With careful control and a bit of luck, they might be able to save the content of much of the film collection as reasonable-quality digital masters. However, they will now face the unending task of digital preservation in order to ensure that those masters are not themselves lost in the future.

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