

# Guide

to compose tendering specifications  
for the outsourced migration of audiovisual content

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*Background*

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**Preservation and Migration Commission**

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## 1 Introduction

This document, the **Background Document**, is the last one of a set of three, which makes a guide, issued by the International Federation of Television Archives FIAT/IFTA, to help everyone who considers writing a tender for the outsourced migration of content from physical audiovisual carriers.

The first document, [Introduction Document](#), provides a general introduction, in the form of a list of questions and answers. The second document, [Overview Document](#), gives detail on the tendering procedure itself, discussing elements that are independent of most legal constraints, specific from country to country.

The [Introduction Document](#) explains the meaning of the term Migration used in this guide, which is the main subject. For clarity,

**Migration** is the transformation of non-file-based information, including both analogue and digital forms (if applicable), into a digital file, as well as the transfer of that file onto a mass storage system.

Also it is important to remind readers at the outset that this guide is not intended to influence or sway an organisation as to whether or not it should call upon the services of an external company. Such decisions are entirely a matter for each organisation having regard to their own particular circumstances.

This **Background Document** is structured as follows.

[Chapter 2](#) is about the vision on the required migration. The tendering organisation needs a clear understanding of their specific situation and requirements, to communicate that information to candidate service providers.

[Chapter 3](#) discusses the need to define the *Scope* of the migration project in its various aspects, namely the formats, the timeline, the budget, and the actors.

[Chapter 4](#) deals with the issue of describing the collections, the physical objects of the migration project. A comprehensive collection description is essential to the success of the tender in terms of prices and results, as it is beneficial to all parties to avoid (as much as possible) nasty surprises. [Chapter 5](#) is dedicated to the Business Case, covering the migration process from start to end presented as an inventory of different steps, the details of which are discussed in the [Chapter 6](#) on technical and project requirements.

The document finishes with a [Bibliography](#). References quoted in the text give further information on specific topics. However the [Bibliography](#) can also be examined by itself, as references are grouped per subject, where [section 7.1](#) provides more general recommendations, while [section 7.2](#) deals with the condition of carriers, [section 7.3](#) lists references on the selection of the master file format, [section 7.4](#) contains links to works [On quality control](#), the statements [On audiovisual carriers after migration](#) can be found in references listed in [section 7.5](#), and finally useful references [On tendering for audiovisual migration](#) are given in [section 7.6](#).

## 2 Vision on migration

As the opening chapter for a Background Document of a tender dossier for the migration of audiovisual media, we recommend that the tendering organisation provide an explanation of its vision on migration. Every migration project for content from audiovisual carriers is embedded in the mission of an audiovisual archive; the vision on migration usually arises from this mission.

Across the very broad world of audiovisual archives, this mission and vision can differ greatly. Setting out the mission of the tendering organisation and its vision on migration again at the beginning of the Background Document allows the candidates to get acquainted with the tendering organisation's goals and how the migration project is supposed to contribute to them.

The migration of content from audiovisual carriers is widely seen as a response to the degradation of the physical medium, the obsolescence of playback equipment and the fading knowledge about it, and the increasing demand for quick and easy reuse of the content. Still, within that broad consensus there is room for nuance, which may be translated into differences in the minimum requirements in the tender documents, or in the appreciation of proposals that will be made by the candidates in their offer.

- Does the vision on migration of the tendering organisation only focus on the content of the carrier, or do these carriers also have a heritage value as physical objects?

### **For example**

in a digitisation project for shellac records, the heritage value can translate into a requirement to digitise the record labels.

- Is the migration seen as the last effort to migrate the content (the file substitutes the original medium forever), or does the tendering organisation believe that a new migration project of the same carriers may be possible at a later stage, with technologies improving faster than the carriers will degrade?

### **For example**

in a film digitisation project, the view on this issue can translate into a requirement to replace rusted film cans as well as digitizing the film. If migration is seen as a substitution, replacing the film cans makes little sense.

- Is the migration aimed at the most authentic representation possible, or is importance attached to the immediate usability of the migrated result in a media context?

### **For example**

in a digitisation project for video cassettes in a broadcaster's archive, the vision can translate into a requirement for editing the content of multi-episode cassettes into one episode per file supplied.

## 3 Project plan

### 3.1 Project scope

Defining the project scope of an audiovisual migration project as one of the first chapters of the Background Document is an essential requirement. The outline of the scope should be as precise as possible, covering goals and non-goals as well. Writing out the scope of a project must follow thorough reflection. It is best to keep in mind that you can't get what you want if you don't know what you want.

This definition part is also quite helpful in deciding whether to try to achieve the general goal via just one big project (handling of large amounts and a larger variety of formats, issues and tasks) or to divide it into smaller projects to address different specialists and get better aligned solutions. The drawbacks of the latter approach are usually a much higher administration effort (and related costs): for tenders, for the actual projects and for the internal planning and preparation.

The scope of the project should at least include precise specifications or further information on:

- formats: the source formats as well as the target formats;
- amounts: per source format (items, content-length in total, range of content length per item, etc.), per condition, per content-type (if there are different digitisation requirements for different types of content e.g. unique, commercially produced, oral history, off-air recordings, production masters), target output (per year, month, day);
- timing: overall project-time, phasing (test phase, consolidation phase, etc.);

- budget: if considered opportune, a price range per quantity (e.g. per minute or per hour) can be given, or even be set as a minimum criterion;
- project team: personnel foreseen for the project by the tendering organisation.

A massive audiovisual migration project is characterised by large amounts of material and lengthy completion times. But in any lengthy time period, things will inevitably change. The tendering organisation should be prepared for these changes, to mitigate their effects. In addition, there are predictable changes that will occur in every project, such as the deterioration of the carriers and changes in personnel. These changes should be addressed with countermeasures such as regular adjustment for target-amounts, staff training and additional technical measurements.

For the tenderer to understand the intentions of the project, the tendering organisation should describe for a generic piece of content what the project goals are. Such a description could focus on what it means for the content to be:

- digitised successfully and entirely;
- at the best possible quality;
- identified correctly;
- respecting the budget constraints, on average;
- ensuring future access and exploitation.

In the context of a large-scale migration, success is a question of metrics and of finding the best compromise between quantity and quality. So, it is important to define how success should be measured and monitored.

Finally: precise information on the foreseen or expected transfer process for the digitised files (technologies and systems involved, etc.) should be given as well. Crucially, within massive migration projects the daily input-rate might affect the systems and networks of the tendering organisation, so additional measurements and regulations (e.g. timeslots, peak-definitions, etc.) should be mandatory.

A final word, addressing ‘non-goals’: not only for the internal decision and definition process of the tendering organisation, but also for the general understanding of the intentions of the project by the tenderers, a statement of on ‘non-goals’ is very helpful and expedient to avoid misunderstandings and long discussions in the first phases of a project<sup>1</sup>.

### 3.1.1 Formats

#### Source formats

The tendering organisation should provide as much information on source formats as possible: the basic technical information is needed, but information on the condition of the audiovisual carriers is especially important. Since the condition might not be consistent throughout our collection, the tendering organisation should divide a format-based collection into ‘condition-batches’, describing each condition category separately. Providing information on common challenges and defects that have been

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<sup>1</sup> This statement might include things such as restoration, segmentation, etc. There are many ways that content can be enhanced during digitisation, but it is important to exclude processing that is specifically not desired, and not in the project budget.

experienced in the past with certain formats and / or ‘condition-batches’ should be considered.

In this context, it is helpful to provide information on the lifecycle of the carriers: when have they been in use; what have they been used for; what were the storage conditions like during the lifecycle of the format; has it been used by professionals only or by amateur users as well; which kind of content has this format been used for, and when; are there re-use (purged) batches included; and what are well-known issues with this format. The more information provided to the tenderers, the better the proposed solutions will fit the exact needs.

More information can be found in [Chapter 4](#).

#### Target formats

During the internal preparation of a migration project by the tendering organisation, the target format should be an important point of discussion. The chosen format should meet internal needs as well as international standards and recommendations. This topic will not be addressed further here, since it would necessitate writing a separate document for this topic alone. The decision on target formats should be influenced by the following:

- the goal and intended purpose of the tendering organisation,
- the quality and restrictions of the source formats,
- the budget for the actual migration project, and
- the future costs for storage of those target formats.

In some special cases it might be practical to choose different target formats for various parts of the collection.

If the decision was not reached internally, the tendering organisation might include this question in the tender directly by

asking for solutions by the tenderers. Nevertheless, it might be hard to do a proper evaluation and ranking of the tenders when provided solutions differ too much.

Therefore, it is better to find a solution prior to the tendering-process and provide the tenderers with precise information on the desired target formats. Each tenderer should provide sample files in the required formats. During the pre-contract phase and the test phase (see clause [below](#)) sample files from the contractor should be inspected and approved by a third party such as international or national testing laboratories. Regular inspections by a third party during the entire project avoids the undetected accumulation of inaccurate files (see also clause on [Quality control](#) in chapter 6).

### 3.2 Project timeline

Once the tendering organisation has defined how much content needs to be migrated from which source formats to which target formats, the next thing to define in the tendering document is the project timeline. Other than the intended project duration and completion date, it is important to define project milestones, dependencies and regular events which will take place during the lifecycle of the migration project. The project timeline can be

visually presented, as shown in [Figure 1](#), by a Gantt-chart or similar. It is recommended to include the following:

- Project phasing - the definition of phases such as the pre-contract phase, installation phase (if applicable), test phase, stabilisation phase, production phase and the evaluation phase.
- Milestones - such as the contract signature, the approval, the start of productive output according to the contract, interim checkpoints, the end of the project etc. Each milestone may be defined based on specific conditions to be met.
- Regular events - such as the periodic meetings of the project board, an advisory board (if applicable) or a steering board. Also training, accounting, statistical alignment etc. can be aligned with a specific moment or they can repeat periodically.

The subclauses here below not only explain which information should be included in the tender regarding each project phase, but they also elaborate on how those phases could be run. The tendering documents should not describe this in full detail, however the information provided here may help tendering organisations to further plan their project.

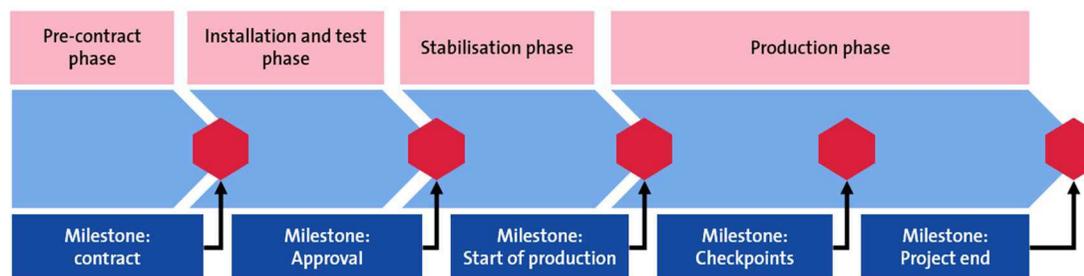


Figure 1 - Schematic representation of a project timeline showing phases and milestones

### 3.2.1 Pre-contract phase

A tender for the outsourced migration of content from audiovisual carriers might establish the pre-contract phase as the most important phase, as it is the right point in time to discuss all steps of the project with the future contractor in detail, pointing out exceptions and peculiarities, preparing for deviations and anomalies, flagging any doubts and open questions.

The tender should include description of this phase to ensure a smooth and proper running of the migration project. Pre-contract phase will outline rules and checkpoints for the migration workflow, to identify and remove anomalies and other potential hindrances.

As set out in the [Overview Document](#) ('Contractual clauses'), in the spirit of fairness and transparency, at this stage the project may be defined in more detail, but not changed in such a way that it affects the nature or the total value of the services.

In principle this phase is completed by a milestone 'contract signature'.

### 3.2.2 Installation phase

Depending on the overall layout of the migration project, a separate installation phase might be a necessary part of the project timeline. The decision on whether this phase is needed and how long it will take is dependent on the contractor as well. It is recommended that the project timeline described in the tender document includes this phase, if required.

Through prior market research, the tendering organisation can learn about the installation times needed, also by comparing its specific project to the ones that the market for outsourced migration is prepared for.

When estimating the duration of the installation phase, the tendering organisation should consider possible need for extra technical equipment (e.g. a robotic tape store) or additional space. This phase, if planned well, will help avoid mixing up problems caused by technical, logistical or process-induced causes. Some testing may already start in this phase. The subsequent test phase can commence in parallel for those parts of the workflow independent of the finalisation of the installation phase. This approach might help to save some time.

During the installation phase, any necessary training should start as well, if possible. Training that depends on fully installed and operational hardware and software will have to start later, in the test phase and during the consolidation phase.

The installation phase ends together with the test phase at the latest and concludes by the milestone 'approval'.

### 3.2.3 Test phase

The test phase is a crucial step in a project timeline for the outsourced migration of content from audiovisual carriers. This phase is not to be mixed up with a potential test done during the tendering process to evaluate the candidates (see the [Overview Document](#)).

When estimating the duration of the test phase, the tendering organisation should keep in mind that all steps of the general and exceptional workflows (including treatments, specialities and aberrations) should be tested in isolation and in combination with single run-throughs and (simulated) mass-workflow. A certain step cannot be approved if it performs nicely alone and with only one cassette or file. Only if it performs smoothly and stably in combination with all pre- and sub-steps under the pressure of larger volumes, a similar performance can be

expected during the (often long-lasting) production phase of a migration project. This means that, depending on the total volume of content from carriers to be migrated and the actual project setup, a thorough testing phase might easily take several months.

There are many aspects of what to test and how to test it. One could argue that in a project for the outsourced migration of audiovisual carriers, the testing of the process is the responsibility of the contractor and that the tendering organisation is only involved to the extent that errors affect the final result. Nevertheless, it is important for the tendering organisation to remain closely involved in the testing. After all, if problems in the workflow or other errors can be prevented, this also increases the chance for the project to be completed without delay. Furthermore, any potential mistakes cannot slip through the quality control based on samples. Some general examples are listed here:

- Test with identical technical set-up mimicking the production phase. Changes as small as a seemingly insignificant software update may induce errors that will only surface much later in the process or even at the very end.
- Test with the same staff as during the production phase. This avoids overlooking or simply ignoring small problems that might have a great impact on the smoothness of a workflow with high volumes of carriers. A staff member who will work on the project for a longer time during the production phase might have a more realistic assessment of what is and is not a problem than a dedicated tester.
- Everything that can go wrong will go wrong. Making deliberate mistakes during the test phase allows evaluation of

their impact on the process. This method will trigger solutions that make human errors (nearly) impossible.

#### **For example**

One cause of errors could be a mix-up of cassettes and their cases. A contractor may use the guideline that cassette boxes must be placed on top of the player during the digitisation. To prevent cassettes from being placed between the players - a possible source of confusion as to which cassette belongs to which player - the space between the players can be blocked.

- The impact of dropouts of all different steps of the workflow might be tested by the contractor. It might be recommendable for the contractor to develop workarounds and to test them too. Also, some combined dropouts might occur so their impact should be tested as well. It is important to expect the unexpected and to be prepared well by testing the impact.

#### **For example**

The worldwide covid-19 crisis had severe impact on several migration projects, but a few projects could cope with it well because aspects like necessary remote work or low staff on premise had been tested and emergency plans had been prepared and applied.

- Don't only simulate - but *do* the actual thing. As soon as all major problems have been detected and resolved, a factor of time pressure could be added, or the tests can be expanded to steps that are sometimes omitted, such as the use of the files in the actual media production and playout.

- Re-test regularly. Whenever a process step has been changed, all steps of a workflow should be thoroughly tested again, also with larger quantities, or with different staff members.
- If possible, test with carriers that have had their content already migrated before. Especially in the early stages of testing, original carriers might be damaged during the test phase, sometimes beyond recovery. Switch to the carriers which have never had their content migrated before only when the playback equipment and the people handling it are proven reliable. This is after the first batches processed came back intact.

The test phase normally ends with the milestone ‘**approval**’, which is often combined with a milestone ‘**start of the production phase**’. It is recommended to include a short stabilisation phase in between to get additional verification of the test phase output and avoid stress induced errors during the first weeks of the production phase.

#### 3.2.4 Stabilisation phase

During the stabilisation phase, the overall goal is aligned with the statement of works in the contract, but both the tendering organisation and the contractor should have the understanding that certain deviations from the expected output numbers are not crucial and will not cause any issues in this phase. Some adaptations and adjustments in the workflow, and connected aspects are normal and should be used to iron out the last bumps and glitches in different steps. Extra staff should be planned for this stage, so higher quality controls and multi-stage monitoring and controlling can be done. Investing time for some extra discussions with all members of all teams should be considered.

It is wise to introduce some material with various known problems within the collection, such as poor source quality. This will help prepare the operational team to deal with such material, rather than doing that later. Also, in terms of the content, the stabilisation phase is the right time to introduce some more important carriers, since a more thorough quality control should avoid problems, and the partner contractor has the chance to prove his skills.

During the stabilisation phase the number of items per unit of time should be constantly raised. By the last third of the phase the output should at least be close to or above the goal.

The overall length of this phase depends upon the overall duration, complexity and size of the project. A rule of thumb might be five to ten percent of the overall length of a migration project, but this will depend on the specific needs of the project. Evidently this decision should be a joint one between the contracting parties.

This phase ends with the milestone ‘**start of the production phase**’.

#### 3.2.5 Production phase

When estimating a realistic duration for the production phase, once again the tendering organisation should use the information obtained from a prior market research. Although the duration of the production phase can only be determined by the specific circumstances of every tendering organisation, it is advisable to set a realistic goal as compared to what the market for outsourced migration of audiovisual carriers can deliver. An unnecessarily short production phase compared to the volume to be migrated forces the contractor to expand its production capacity to volumes that no other customer requires.

Unnecessarily long production phases force the contractor to work below maximum capacity, which may lead to inefficiency or loss of quality. Experience shows that, thanks to their experience and specialisation, the volumes achievable for companies active in the audiovisual media migration sector are often much higher than the archives could handle without the help of others.

As this is the phase in which all the carriers in scope will run through at least a part of the process, in principle the production phase is the longest one. In this phase the foreseen goals (in terms of output, quality, etc.) should be reached with ease and sometimes even excelled. Negative impacts through logistical flaws, problematic material, technical difficulties, necessary adjustments, staff rotation, illness, etc. are rather scarce and can be coped with easily. Deviations from the goals are easily compensated for. The project should meet all expectations.

In this phase for both contracting parties it is wise to start looking for possible threats in the future as soon as possible: deterioration of the carriers due to aging, equipment wear, end-of-service of hardware or software components, staff rotation, etc. Depending on who is responsible for these in the project, this kind of matters should be discussed between the parties, and plans should be prepared together on how to deal with them.

If the overall aspects of the project and the limitations of all involved systems are not reached, it may be advisable to speed up a project so long as it is possible to create a buffer for setbacks. This might be very important when a pay-per-output model is part of the contract, since the contractor might not be able to make enough revenue in a later phase and will have to compensate for it somehow. Whatever those compensations will be, they won't be good for the migration project. So, finding a

solution together with the contractor as soon as possible is important<sup>2</sup>.

Introducing additional milestones ('checkpoints') helps to monitor overall progress on the project, to improve the chance to reach the final project goals on time, in budget and without major problems.

This phase ends with the milestone '**end of the production phase**'.

### 3.2.6 Evaluation phase

Probably the most omitted part of any migration project, the evaluation phase might not be considered a part in which an external contractor is still involved. Nevertheless, it can be a particularly important phase, especially if other migration projects are to follow, for example for other types of audiovisual media. The evaluation phase should not be confused with the quality control phase as it should be an integral part of the production phase. However, the evaluation phase can be used to draw conclusions from statistical documentation, or from logistical or technical processes. These conclusions can then be used in subsequent projects.

In this regard it may be interesting to involve the contractor as well. Due to their business approach, audiovisual migration contractors collect statistics that may also be relevant to the tendering organisation. Since this sometimes concerns strategic

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<sup>2</sup> In this context, it is important for tendering organisations to think on the longer term. Having a good contract with very low prices doesn't help when the contractor goes bankrupt or starts fulfilling the contract by the word.

information which not all contractors like to share publicly, it may be appropriate to make binding agreements about which statistics or reports are expected.

Finally, we would also like to mention the importance of further sharing project results and lessons learned in the international community of audiovisual archives. These lessons learned can be of great service to colleagues. Sharing them is an act of generosity and solidarity in the service of audiovisual heritage.

### 3.2.7 Other events

Depending on the scope of the migration-project, regular (e.g. monthly) project board meetings (see [clause 3.4](#) for information on the different teams involved in a migration project) should be foreseen. During those meetings all daily businesses should be discussed, and the amount of output can be validated.

The Steering Board should meet two or three times per year, with additional meetings as needed. In classical project management approval by the steering board is required whenever the project's scope, timing or budget are being changed.

Advisory board meetings are most valuable and expedient at an early stage of the project (the pre-contract until the stabilisation phase) and at any point where some major threats must be addressed, or adjustments must be prepared.

Training events are also most likely to occur in the early stages of the project. These events should be held as soon as possible in the project and not later than the consolidation phase. Additional training should be foreseen for new team members as well as for changes in the project. Many training courses are available from the international associations active in the audiovisual archiving field.

Other training instruments such as the proper documentation of all stages, underlying workflows and decisions taken throughout the entire migration project, manuals of hardware and software or posters illustrating important and complex areas of decision will help everybody involved to be up to date. Also, the introduction of new staff will be facilitated by these.

Finally, the tendering documents should mention regular moments of statistical alignment and accounting. Continuous reconciliation of the output numbers (for example during the project board meetings) serves this purpose.

## 3.3 Project budget

As stated in the [Overview document](#), beneficial pricing is often considered as one of the most important awarding criteria, based on a simple principle: the lowest price offered gets the highest score. But how to prevent getting an overall price too high, a price that the tendering organisation can't afford, that surmounts the budget for the project?

The overall budget should preferably be known only internally - to prevent the candidates in a tender from inflating their prices to reach the maximum of any provided guideline. It is helpful to get actual cost information from similar projects, as well as doing a pre-tender evaluation on candidates by asking for their indicative pricing.

Another approach is to give a price range directly in the tender (not a total, but per unit or quantity - e.g. per hour). The upper limit of that price range can be a minimal requirement in the tender. When choosing this - rather exceptional - path, the tendering organisation should be very aware of the prices that are common in the market, and of the related risks. Especially

with this approach it is most important to state clearly what must be covered by the unit price, to avoid facing extra charges and opportunity costs later.

As stated in the [Overview Document](#), an interesting and quite helpful approach in the evaluation of the offers is to ask the candidates to provide an overview of their costs in their offer, making a clear distinction between several parts of the service to be delivered.

A clear distinction in the offers between the standard and the optional costs is even mandatory under most tendering legislations. This will help the tendering organisation to keep a good balance between needs and wishes, and it allows for a certain flexibility in setting up the overall budget and evaluating the proposals.

The rules for disclosure and declaration of budget information in a tender are sometimes quite different for public and private organisations. Public bodies may be affected by a wide range of national regulations (and supranational regulations in the case of member nations of the European Union). Asking for legal advice is mandatory in this regard, as stated already in several other chapters in these documents.

## **3.4 Project partners and boards**

### **3.4.1 Project partners**

#### **Tendering organisation**

This is the organisation that issues the tender. It is important - apart from for the sake of completeness - to remind the parties reading this chapter about all the departments and other actors involved in the tender and the subsequent project, active or passive: archival of course, but also technical, legal, commercial etc. If the archive is part of a broadcaster production and sales departments also might be mentioned here, as they are often involved as users. All these will help to set up a proper and on-target tender. Furthermore, involving them might help the archival department in the tendering organisation to get necessary internal support<sup>3</sup>.

#### **Advisory organisations**

Advisory organisations are not mandatory. Especially well networked institutions and audiovisual archive professionals already have their information sources and might not need any special advice. But when tackling the task of migration for the first time, or when audiovisual migration is a side business for the tendering organisation, it might become expedient to involve an advisory organisation. Specific advice on the actual tendering

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<sup>3</sup> Especially the economic pressure might become stringent after some time. Financial departments might argue for cost cuts. However, when for example in a broadcast context the production and sales department are included as stakeholders in the project from the beginning, they could become an ally in this kind of internal battles.

process may be available from national advisory organisations, to achieve a proper and legally watertight tender.

#### **Migration service provider**

The service provider is the most important partner for a migration project - so it is very important to set up a tender that clearly expresses the needs and expectations of the tendering organisation or contains mandatory exclusions to prevent undesirable outcomes of a tender<sup>4</sup>. Since this might be a consortium (which may be desired to get best expertise for every part of a complex migration project), that nature of a consortium should be addressed in the tender to ensure a single prime contractor<sup>5</sup>.

#### **Additional quality control party**

Quality control at the contractor's side should be part of the main contract and therefore the responsibility of the prime contractor, whereas the qualitative acceptance of the result can be done by no one other than the tendering organisation.

However, especially for larger migration projects it could be interesting to engage external quality control services delivered by a third party. This is not meant to replace internal control steps by the tendering organisation but to have another

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<sup>4</sup> Once again, consulting with local or national legal experts on tendering procedures is strongly recommended to prevent legal problems, such as formal objections etc, as they can delay the start of a project for a long time.

<sup>5</sup> See [clause 6.1.2](#) for risks related to subcontracting.

independent partner who will take care of a second quality control<sup>6</sup>.

It is advisable that such a second quality control step is performed promptly and soon after the first quality control step. This helps to recognise errors and non-conformance before they can cause problems. The source of the errors then can easily be eliminated very early in the process, and no large amounts of content will be affected. Finally, an external second quality control step can be very important for the purposes of an official review of the project.

#### **The end users**

Although this group has been already mentioned in the paragraph on the tendering organisation, we want to stress it by repeating it here. Involving the user of the migrated content is mandatory for a successful migration project. If they can be identified, it deserves recommendation to get them on board early, ask for their needs and visions, keep them updated regularly, ask for and listen to their feedback. Any migration project can do with their support.

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<sup>6</sup> It could be interesting to involve a direct competitor of the actual migration service provider to execute this task. It will not only ensure a very critical look on the output files, but also might introduce a second quality control technology as well.

### 3.4.2 Project boards

Setting up project boards is not part of a tender, but the role of the board on the tender might need to be described in the tender.

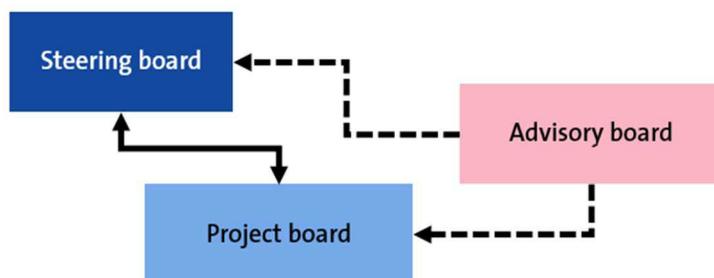


Figure 2- possible relations among project boards

#### Project board

The full group of people involved in a migration project can be quite large. To ensure that any important decisions within this group are discussed and communicated well, it is recommended to establish the project board that should meet regularly to discuss all daily business and validate the amount of output. The members of this board should cover all aspects of migration.

When special challenges need to be addressed, additional experts who can provide answers and facts may be invited. This is the group where practical solutions are born rather than conceptual documents. Still, proper documentation of the practical decisions taken here is needed to avoid misunderstandings with potentially negative consequences.

For further information, please see [Project team and project lead in clause 6.1](#).

#### Advisory board (if applicable)

Especially during the early phases of a large migration project (see [paragraph 3.2](#)) an addendum to the project board might provide additional knowledge and expertise. It depends on the areas of need who should be invited to join such a board. Even representatives of the users might be able to provide valuable advice in certain stages of a project. The Advisory board is mostly an instrument for the project board - but can be used by them to convey certain (inconvenient) information to the steering board as well.

#### Steering board

This board is the stage for all decision makers and heads of departments and the high(er) management, for example the main representative of the contractor, the head (or deputy) of the tendering organisation, the head of archives, etc. Since in this group high level decisions are made (mostly defined as changes touching the overall scope, timing and budget), it should be kept away from all small challenges but informed regularly on the major results of the project. The Steering board should inform the project board on all changes, such as expected changes in the institution that could affect execution of the project, with proper lead time.

## 4 Description of the collection

A good description of the content carriers is an essential part of the tender documents. This description gives the candidates an idea about the characteristics of the carriers to be transferred. The more precise the information about these carriers, the better the timing and costs estimates provided by the candidates, which in practice usually also leads to lower prices being offered. It is therefore indirectly also in the advantage of the tendering organisation to publish as much information as possible about the carriers to be migrated.

A thorough description of the collection includes at least some information about the volume, the typology and technical characteristics of the recordings, their condition (direct and indirect indications), any known deterioration, their age, the relation between the carriers and the intellectual entities stored on them, and their packaging.

In addition to a description of the collection, during the tendering process there are also other ways to provide candidates with more information about the carriers to be migrated.

- Organising an on-site visit, which the candidates can attend and view the entire collection or a representative part of it.
- Adding a photo album to the tender documents, in which the pictures document the characteristics of the carriers and make clear how certain descriptions (e.g. of deterioration phenomena or damage) should be interpreted.

Even if the characteristics listed below are not immediately available, it may still be interesting to make estimations when drawing up the tender specifications, for example via sampling and extrapolation. In doing so, it is advisable to state that it is an

estimation, to give an indication of the degree of uncertainty (for example by providing margins) and, if appropriate, to explain how this estimation was made. It is vital to ensure that estimates are not considered as exact by the candidates, which could become a cause of conflict during the execution of the assignment.

### 4.1 Volume

This aspect has also been briefly touched upon in the chapter on the project scope and this indicates how important it is. Without exception, it is one of the first questions that migration service providers ask when a migration project appears on their radar. However, in this part of the description of the carriers to be migrated, not only is quantity important, but also how much content should be migrated per carrier. Some organisations choose to have the entire carrier digitised from start to (playable) end, while others ask the migration service provider to stop where the meaningful content ends, even if the carrier itself has capacity for more content.

Since the migration of some carrier types (such as film) can require a relatively large overhead processing time (the part of the time invested in the migration process independent of the total duration of the carrier), it is interesting to provide an average duration per carrier, possibly including a maximum deviation from this, especially if the duration of the carrier is a variable of the total migration cost

#### 4.1.1 Volume data estimations

As mentioned in clause 4.3 ([Typology and recording characteristics](#)), for a given carrier format, content duration can vary a lot, depending on for example the recording speed (for

audio tape formats), the number of sides (for many mechanical disc formats) or even the number of layers (for digital optical disc). This means that accurate numbers regarding the volume can only be given when having a good knowledge of the recording characteristics of the carriers.

If such figures are not available, through sampling and extrapolation estimation may nevertheless be given. It is always recommended to include a margin up and down in this respect, and to provide transparency to the candidates about how the figures and the margins were set.

If the actual recorded time (either in total or per carrier) is unknown, it is still useful to mention the maximum recording capacity of the carriers involved in the project (e.g. 60 minutes for a U-Matic cassette).

#### 4.1.2 Volume data structuring

The more the volume data (in number of carriers and duration time) can be itemised and matched with the carrier format and sub format, the applicable recording characteristics, the applicable condition data, packaging etc., the better. Often however, this proves to be impossible or requiring disproportionate effort. Grouping the carriers is in such case the best alternative.

##### For example

- 125 compact audio cassettes, ca. 123 hours in total, each recorded at 4,75 cm/s, with an unknown noise reduction system applied, all Maxell UR60 (Ferric), always preserved at a constant temperature of 20 °C and 40% RH. Delivered in original plastic carrier box, in plastic boxes without lid per 15 cassettes:

- 22 cassettes of in total ca. 20 hours with 2 current affairs programme episodes per cassette, with severe mould on every cassette, most likely produced between 1989 and 1990.
- 103 cassettes of in total ca. 103 hours with 1 folk music programme episode on each, no mould but max. 1% broken tapes.
- 1420 16mm film reels in black and white, 1420 hours in total, each recorded at 25 frames per second, Technicolor film stock, types unknown, preserved at a constant temperature of 8 °C and 40% RH, splices all checked and renewed, glue stains all cleaned, pH value measured last in February 2020 and never lower than 5.2, combined on super reels of 20 television news reports on average (3 minutes on average each), no sound, packed in new plastic film cans.

#### 4.2 Number of carriers versus number of intellectual entities

A migration project is often considered as an opportunity to say goodbye to the limitations imposed by the capacity of older audiovisual carrier formats. This becomes clear in a changing relationship between the number of carriers and the number of intellectual entities (a television or radio programme, a report, an interview, a piece of music, ...) held within them.

In practice, the content of an audiovisual carrier may be segmented into different intellectual entities (for example 10 songs on a CD) or the intellectual entity may span different audiovisual carriers (e.g. a long programme spanned over two video cassettes). One of the objectives of a migration project is often to take the intellectual entity as the new central archival

unit instead of the audiovisual carrier. This translates into post processing operations such as splitting up the content of a carrier or merging the content of multiple carriers.

In the collection description chapter of a tender for the migration of audiovisual media, it is therefore recommended to include information describing how the content is organised on the carriers:

- does one carrier contain less than, exactly as much or more than one intellectual entity?
- which dividers (e.g. black frames, divider tape, auditory or visual test patterns), if any, have been used?

Whether the migration project should adopt the same grouping or recombine it into one intellectual entity per file or per package of files is usually a post-processing action<sup>7</sup>.

### 4.3 Typology and recording characteristics

The migration service provider will need to know which carrier types are present in the collection: audio, video or film? What are the specific formats? Are they, for example, open-reel audio tapes, U-Matic video cassettes, negative 16mm film reels or other formats? Many carrier formats also have sub-formats and standards that differ significantly from one another. These carrier types and subtypes have physical characteristics, but they also have technical characteristics that determine the nature and quality of the signal (sound or image) on the carriers. More details are given in the next subclauses. This part of the description allows candidates to estimate the types of devices

they will need for the migration as well as the actions to be taken before and after the actual migration in order to achieve the requested result.

Audiovisual carriers can be divided into three main families: video, film and sound carriers. The next three subchapters address the specifics of each.

#### 4.3.1 Video carriers

Format, type, subtype, recording standard, dimensions... it takes a lot of data to fully characterise a video recording. This data is essential because the playback and transfer equipment need to support these characteristics. The duration of the recordings is essential information, so candidates can plan the project and carry out a realistic cost determination.

Most video recordings are on magnetic tape, although optical disc recordings also exist. Open-reel formats are generally named after the width of the tape (e.g. two inch - also known as Quadruplex -, one inch, half inch), while cassette formats are often given a commercial name. Examples of these are U-Matic (or three-quarter inch), VHS and Betacam. For optical discs the names were usually determined by the industrial consortia that developed them.

After the family and the format have been identified, it is recommended to include details of the subtypes, recording standards and dimensions in the description of the collection to be migrated. Two inch tape, for instance, comes in different types (low-band, medium-band, high-band) and different recording standards (SECAM, PAL, NTSC and even very local standards such as 405-line in the UK or 819-line in France).

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<sup>7</sup> A couple of non-exhaustive cases are briefly discussed in [clause 0](#)

In a similar manner, U-Matic comes in three generations (low-band, high-band, SP) and three standards (PAL, NTSC, SECAM). In other words, there are some nine different ways of recording a video signal on a U-Matic tape, and the choice of playback deck must be made accordingly, as there is no tape machine that can play back all the different types. To make matters worse, playback devices for certain types have become very rare, hence the importance of comprehensive knowledge of all characteristics of carriers in the collections to be migrated.

Some legacy formats allowed for different recording speeds or were available in different sizes or tape lengths. Both are important parameters in determining the duration of the recording, but also in identifying proper playback equipment. For example, a VHS cassette recorded in the PAL standard may have been recorded in the so-called Long Play mode, which is not compatible with most semi-professional VHS decks. In the same way a collection of DV tapes for example can contain large DVCAM cassettes, small DVCAM cassettes and extra small DV cassettes (so-called mini-DV cassettes). If the audio and video encoding scheme are basically the same on all those formats, the difference in tape dimension may prevent using certain DV playback devices, as well as robotic solutions.

A last important parameter concerns the dimensions of the images, expressed as the number of lines per frame and pixels per line (if applicable), and the ratio between the width and height of the image (aspect ratio). Several standards have existed in this regard and evolution continues until today, with SD and HD as the most common ones for video recording. Some recent carrier formats such as Digital Betacam or DV can contain 16:9 pictures as well as 4:3 pictures. When migrating the video essence into a file, the original display aspect ratio should be

preserved, which is much easier if the information is documented prior to the migration, so the right process can be used<sup>8</sup>.

Sometimes precise recording characteristics are unknown, for example because they are not clearly indicated on the carrier's label nor on its case, or perhaps because the information provided is simply unreliable. In such situations they can only be retrieved by deducing them from the context of the collection or by trial and error when playing them back on different machines, which is costly in terms of time, effort and technical knowledge, plus the risks of damaging the carriers.

As stated above, when a collection cannot be fully assessed in all its technical aspects, it is recommended that estimations are provided including reasonable margins. In any case transparency is a key factor in this regard, to allow the candidates to calculate timing and equipment needs for their proposals.

#### 4.3.2 Film

The general recommendations above for describing a collection apply to film carriers as well, but film does have a few technical aspects that deserve special attention.

First and foremost, there is the film's base layer. The most common base layers on which moving film images have been recorded are nitrate, acetate and polyester. All three have typical deterioration phenomena, storage and playback requirements. Some physical and even aesthetic characteristics are more common with certain base layers than others. It is therefore

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<sup>8</sup> Also, in digital SD the pixel aspect ratio may be different from one, i.e. the pixels-per-line/lines-per-frame is not equal to the display aspect ratio.

advisable to state which base layers are present in the film collection, and in what proportion.

Secondly, the film gauge is important. Film gauges are usually easy to determine and often strongly related to the context in which the film was produced. The most common gauges are 8mm, super 8mm and 9.5mm (the so-called Pathé Baby format) - mostly used in amateur contexts -, 16mm and super 16mm - the most common in broadcast collections -, and 35mm - commonly used for feature films.

A third important aspect of film to be included in the technical description is the film type, related to the stage in the production process that the images occupied. In the simplest scenario a film camera and the subsequent photochemical process generate a negative image, followed by a positive print to be used for projection. However, several in between stages (such as internegatives and interpositives) created to generate all kinds of copies (such as prints, working copies, reversal films) may have ended up in the archive and been submitted for digitisation. Particular film types certainly have an influence on the preparation, scanning processes and on possible post-processing steps take, so this is also important information to be included in the description of the collection to be digitised.

An important factor also to include in the description concerns any sound elements. Is it on a separate reel, or is it attached to the images? Is it recorded magnetically or optically? And in the latter case: is it recorded in using the variable density or variable area technique? As all these parameters require different digitisation equipment and or approaches, they are of utmost importance to the candidates for estimate their costs and efforts.

Information about film colour systems are equally important to include in the description. Before black and white film became popular, *tinted* and *toned* films existed as well. Later, other chemical colour techniques emerged. Evidently these differences translate into other requirements when it comes to the storage environment, but also to the choice of scanning equipment and possible post-processing.

A combination of the frame size of the film (or frames per unit of length), the physical length of the film and the projection speed (in frames per second) determines the total duration of the film. Duration is a key element of the description of items within the collection, simply because the price of film digitisation is often expressed as a function of duration.

The shape, size, frequency, condition and location vis-à-vis the image frame are the most important factors of the film perforation. Perforations provide crucial information for image registration and playback speed. Perforation information is vital for the candidates, as not all film scanners necessarily work on all types of perforation. Also, some scanners use the perforations to move the film from one reel to the other, which requires perforations that are not torn or otherwise damaged.

The base layer, the gauge, the sound system, the colour system, the aspect ratio, the perforation and the film type can often be summarised through reference to the brand and type of individual film stocks. Providing this information to the candidates can be very helpful and often is indicated by a narrow strip printed on the side of the film, between the perforations. A final aspect covered by the brand and type names of the stock is in the chemical materials (the so-called dyes) that make up the photographic layer and determine the photochemical process by which the films were developed. These compositions and

processes can differ greatly from one stock type to another and also have consequences for the deterioration phenomena and the preferred equipment used in the storage, preparation, digitisation and any possible post-processing which may subsequently be required.

### 4.3.3 Sound carriers

To discuss the diversity of sound carrier formats and the characteristics to include in the collection description part of a digitisation tendering specification, we have subdivided them here into several categories according to playback: mechanically (cylinders and discs), magnetically (mostly on tape, sometimes on wires or even discs) and optically (on films or discs).

#### Mechanical recordings

Apart from still pictures, mechanical sound recordings are the oldest audiovisual recordings that exist, beginning in the late 19th century and continuing throughout the 20th. The production of one popular mechanical format, vinyl discs, continues today. Typically, the recording and playback mechanism is based on a groove, read out by some form of stylus. Apart from some very early predecessors and more obscure formats, mechanical sound recordings were made on cylinders or discs. The earliest of these carriers are especially hard to handle, not only due to their fragility, but also because the standardisation in their shape and recording characteristics only started to grow significantly in the 1950s.

Probably the most important technical aspect of mechanical sound recordings is the material the carriers are made from. Cylinder recordings are mostly made of wax or celluloid, whereas phonographic discs up until the fifties were usually made of shellac, aluminium or bakelite. Unfortunately, the exact chemical

composition of cylinders and shellac discs is sometimes hard to determine, as the first cylinders and shellac discs were very fragile, and manufacturers wanted to keep their findings on how to produce fewer breakable carriers secret from their competitors.

A special kind of disc are the so-called lacquer discs, sometimes also called acetates (although they usually do not contain acetate materials) or transcription discs. For these discs it is important to determine which materials have been used for the core and for the lacquer coating: as different materials have different reactions to changes in temperature and relative humidity, information on these materials can provide interesting information regarding their condition, their fragility and appropriate storage conditions. The core material can be determined by looking at the wall of the spindle hole - usually this is aluminium, but especially during wartime also other metals, glass and even cardboard were used.

From the fifties shellac and lacquer discs were gradually replaced by vinyl, a far lighter, more flexible material, whereas the lacquers used in radio studios to record live music and spoken word were largely superseded by magnetic open reel tape.

A second important aspect of mechanical sound recordings is the width and the direction of the groove. Throughout the history of mechanical sound recording the width of the groove has varied, especially because standardisation started to be successful only after several decades. The most important distinction is between the great variation on shellac and lacquer discs and the standardised micro-grooves. Although micro-grooves are strongly associated with vinyl discs, there have been experiments to use a micro-groove on shellacs in the late fifties as well. The width of the groove is important because it affects which styli will be

needed and which equalisation curves to apply in the post-processing.

Next to the width of the groove, also the direction and the vector are important information for the candidates. Grooves cut from the inside to the outside and vice versa require different equalisation curves during the post-processing. Laterally and horizontally cut discs require different styli and different pressure on the turntable arm.

Thirdly, tendering specifications for the digitisation of cylinders or discs should mention the recording speeds. Discs and especially cylinders suffer from lack of standardisation in their first decades. It should be kept in mind that some popular playback speeds as 33  $\frac{1}{3}$  and 78 revolutions per minute are approximate. Nevertheless, any figures that the tendering organisation can provide will help the digitisation candidates compose their offer in terms of planning and equipment needed.

An aspect equally important for cylinders and for discs is their diameter as they translate into requirements for the playback equipment. Cylinder playback requires adjustable spindles that hold carriers regardless of their diameter, whereas the proposed turntables should allow playback of all sizes of discs in the collection. A challenge is the 16-inch disc format, common in radio archives.

Shellac and vinyl discs can also have been recorded in stereo. For vinyl discs this is very often the case, for shellac records it is very rare. Although stereo recordings on shellac records were already patented in 1931, this technology did not break through until the mid-1950s. If stereo recordings occur in the collection to be migrated, it is best to state this clearly in the collection

description, because special playback equipment must be provided.

If the tendering organisation allows certain forms of post-processing in order to make the digitised results audibly attractive, it could require the digitisation service provider to apply an equalisation curve on the digitised sound signal. Originally invented to allow narrower grooves, the system of pre-equalisation and its compensation through an equalisation curve now sometimes poses great challenges in the digitisation process, as the curves applied are not always documented well. Here again, standardisation only became successful after the Second World War. Before that, the curves were mostly determined by the label and the era. Service providers in shellac disc digitisation usually rely upon equalisation curve charts and experienced staff but providing information on these eras and labels by the tendering organisation in the tender documents nevertheless allows for a better calculation of efforts and means by the candidates.

### **Magnetic recordings**

Most magnetic audio recordings exist on open reel or cassette formats. Once again, it is important to include information about the physical and recording characteristics in the tendering documents, because it affects the choice of playback equipment.

For open reel tapes, each tape width and track configuration require a specific tape machine, since the tape transport and the playback heads are different. One common exception is allowing the use of a stereo head to playback full-track mono tapes, as the very slight difference in quality is offset by much greater project efficiency.

The most important physical characteristics of open reel formats are the widths (two inch, one inch, half inch or quarter inch), the size of the tape pack and whether the tapes are on cores or on reels.

Regarding the recording itself, the playback speed, number of tracks and track layout are the most important technical parameters. The following extreme example is to demonstrate the importance of providing as much information as possible in the tendering documents, especially when the migration's estimated cost relies on content duration.

The very common quarter inch tape, used for about 60 years around the world, started with a standardised recording speed of 76 cm/s (or 30 inch/s), meaning a medium spool of tape could contain about 15 minutes of high-quality mono sound. A couple of decades after its introduction, quarter inch tape also became a consumer format, which for economy used much lower speeds, as low as 4,75 cm/s (or 1,875 inch/s). Also, those recordings could be made on two-sided tape (meaning sound was recorded on one track, then at the end of the tape the reels were swapped, and the recording resumed on a second track next to the first one, in the opposite direction). As a result, for the exact same volume of tape (a medium sized spool), the recording time could now reach 480 minutes or 8 hours of low-quality mono sound, instead of 15 minutes at 76 cm/s.

Regarding track layout, for example quarter inch tape can have four tracks, but those four tracks can be laid out in different ways, depending on the recording device. There can be four matching tracks to be played back at the same time (multitrack recording); two sets of stereo tracks, one in each direction; four independent mono tracks follow one after the other to compose the full recording etc.

When dealing with 'sided' recordings (cassette or tape with the sound split between different sides), it is important to indicate how those sides are to be presented as files. Should all the content be edited back together into a single file (i.e. one file per carrier)? Should it be kept separate (i.e. one file per side)?

Next to the recording speed, number of tracks and track layout, it is important to know whether pre-amplification curves (e.g. CCIR, NAB) or noise reduction systems (e.g. Dolby, DBX, Telcom) have been applied during recording as the migration service provider will have to apply the corresponding technology when playing the carriers back to obtain a good digitisation result.

Audio cassette formats offer little variation of recording speed or the number of tracks. For most dictaphone cassette formats and for audio compact cassettes the recording devices allowed for only one recording speed and one configuration of the tracks. However, for audio compact cassettes, the chemical composition of the magnetic layer, indicated by the so-called IEC type (I, II, III or IV) and the noise reduction system are important and any available information should be included in the tender documents.

Magnetic tapes can also host digital recordings. Evidently, a good documentation of these carriers for the migration service candidates starts with the recording format, such as DASH (on quarter or half inch open reel tape, easy to confuse with an analogue audio recording) or Digital Audio Tape (DAT). For these formats the applied sampling frequency (44,1 kHz, 48 kHz ...), bit depth (16 bit, 24 bit ...) and, if applicable, number of tracks (2, 4, 8 ...) are the important characteristics to mention.

For several audiovisual carrier formats based on magnetic tape the thickness of the tape is a very relevant characteristic. This

thickness can have consequences for its proneness to breaking and for the occurrence of the so-called print-through effect in which the audio signal stored in the magnetic particles is passed on from one tight winding to the other. For open reel recordings the thickness is variable. For audio cassettes the thickness is dependent on the tape duration. Longer cassettes use  $\frac{1}{2}\mu\text{m}$  tape, while shorter cassettes use tape up to  $2\mu\text{m}$  thick. Shorter tapes are therefore less prone to the print through effect and which could save time in a migration project as methods to reduce print through (winding, rewinding) take time. For video cassettes the thickness of the tape used does not usually vary with the tape duration.

Finally, it should be noted that some magnetic video cassette formats have also been used to record a digital audio signal, e.g. on U-Matic, Betamax or VHS tape. These tapes are normally labelled as PCM recordings and shouldn't be considered as video carriers. To be migrated, a PCM decoder at the back of a regular videotape player is required. Evidently if these PCM recordings occur in the collection to be migrated their presence is also to be mentioned in the tendering documents.

### Optical recordings

There are many disparate types of optical sound recordings, the main ones being optical sound on film (generally handled along with film migration), and digital optical disc such as Compact Disc or MiniDisc (actually, magneto-optical, but the playback is purely optical).

When it comes to MiniDiscs, the main technical variables to describe are the compression scheme (ATRAC, ATRAC-3, ATRAC-5) and the different bitrates, as these will affect sound quality and recording duration.

Plain optical discs come in different sizes. For the largest ones, the LaserDisc (also known as Laser Videodisc, ca. twelve inch or 30 cm diameter), the main variables to mention in the collection description of a migration tender are whether the disc is recorded in CAV (constant angular velocity), CLV (constant linear velocity) or CAA (constant angular acceleration) formatting, PAL or NTSC as broadcast standard and whether the image contains 525 or 625 lines. These factors all influence choice of equipment and are therefore useful to mention in the tendering specifications.

For the 12 cm diameter optical discs, describing a collection should start with determining the carrier family, as, much more than any other kind of information storage medium up until then, optical discs have been used for the storage of any kind of data: audio, video and other kinds of data, or even a mix of two or more. This job may be cumbersome, as optical discs could be formatted according to several specifications, causing confusion between the name of the carrier format (CD, CD-R, CD-RW, DVD, DVD-R, DVD-RW, ...) and the name of the formatting specification (CD-DA, CD-ROM, DVD-video, DVD-ROM, ...). The discs all have about the same physical appearance, but the recording technology, the dyes and above all the formatting specification used may differ.

Within those formatting specifications CD-DA (also known as audio-CD) is a standard with no variation whatsoever, but DVD-video allows for many more variables, all of which can only be discovered by analysing the files on the disc. The wide variety of technical features of DVD-video has little consequence for migration: most recent DVD players are capable of reading, displaying and transferring all these features as data packages onto mass storage systems.

A description of the typology and technical characteristics of a collection of optical discs in a migration tender specification could therefore read as shown here below.

**For example**

- 2500 CDs, all formatted as CD-DA (Red Book)
- 500 CD-RWs, all formatted as CD-DA (Red Book)
- 1000 DVD-RWs, of which 100 formatted as DVD-video and 900 as DVD-ROM

For all optical discs it is important to mention whether any form of copy protection is present, as that could hamper the migration process and necessitate appropriate decoding and transferring software.

#### **4.4 Condition of the carriers**

A good description of the collection to be migrated should not only mention a typology of the carriers and the technical characteristics of what is recorded on them, but also their physical state. To describe this, direct as well as indirect data can be provided. To further clarify this information and avoid misunderstandings, we once again mention here the possibility of organising an on-site visit allowing inspection of the carriers by the candidates, or a photo book included in the tendering documents.

##### **4.4.1 Physical carrier condition**

Direct data about the condition of the carriers might include statistical information about their material composition, general condition, deterioration and other forms of damage. The details of such descriptions will evidently differ amongst the carrier formats. However, except for a great number of exotic formats

which are very rare in the archival practice, audiovisual carriers can be divided into a limited number of shapes and materials. Below we will discuss the most common phenomena requiring mention in a tendering specification, in relation to their shape and the materials from which they are made.

The oldest **phonographic cylinders** were made out of wax. Their typical deterioration phenomena and other forms of damage are related to this. These wax cylinders are of course very fragile. Broken cylinders can sometimes still be repaired, but it may be interesting to mention the number of pieces and whether there are missing parts, as this might give the candidates an idea of the repair efforts required.

In addition, wax cylinders are very prone to mould and dust accumulation in the grooves, which should be cleaned up before playback as far as possible. Since wax is a relatively soft material, the grooves may be worn out if the cylinder has been played back many times. Sometimes the walls of the grooves are broken, causing the needle to enter a loop during playback. Fixing this is also very labour-intensive.

Wax cylinders that have been stored incorrectly (horizontally) are also prone to deformation: they sag and become oval. A solution to the wobbling effect requires rare playback equipment. Later phonographic cylinders were also made of other, harder materials, such as celluloid. This reduced their fragility, deformation and wear of the grooves, but mould and dust accumulation also frequently occur in celluloid cylinders.

The deterioration phenomena of **phonographic discs** are most often also related to the materials used. Shellac discs generally suffer from the same phenomena as cylinders: they break easily, the grooves wear out and they accumulate dust and dirt. Mould

also occurs occasionally. Repairing broken shellac discs is possible but labour-intensive, so data is also welcome here about the number of pieces and whether any parts are missing.

The same is true for **lacquer discs**, but broken discs occur more rarely here, except for discs with cores made out of glass. Instead, lacquer discs often suffer from delamination: the lacquer coating reacts differently to temperature and humidity changes than does the core. As a result, the lacquer first cracks and then starts to flake off. Sticking back the flakes or filling the gaps with a wax layer to guide the stylus to where the groove starts again is possible, but once again very labour-intensive. Statistics about how often this phenomenon occurs in the collection are therefore again very welcome.

**Vinyl records** are much less prone to breaking and certainly to delaminate. Mould is also rare. In contrast, worn grooves and dust and dirt accumulation are much more common. It is therefore good to provide information about groove condition in the collection description.

**Wire recordings** are made from a very thin, magnetised metal wire. These wires may suffer from rust and rupture, but the most annoying damage phenomenon for this format is undoubtedly the tangling of the wire. As untangling is labour-intensive, a description of a collection of wire recordings should include how often tangling has occurred.

The decay of magnetic tape on an open reel or core depends more on the material used than on its width or whether the tape contains an audio or video signal. Audio as well as video recordings have been made on acetate and later, on polyester. Also, but rather rarely a paper tape was used to record audio. Evidently paper is very vulnerable to breakage and other kinds of

decay. Its occurrence should therefore definitely be mentioned in the description of the collection to be digitised.

Acetate tapes of all widths are vulnerable to the vinegar syndrome, causing a strong smell but also tape warp, shrinkage and other phenomena. Magnetic film sound carriers such as *sepmag* audio tape or *commag* film are particularly prone to developing vinegar syndrome, due to the combination of an acetate base with a metal particle layer in their proximity. Furthermore, all magnetic tapes that have polyurethane as a binder between the base layer and the magnetic particles may be affected by the soft binder syndrome, often causing stickiness of the tape and residue on the reading heads of the playback machines. In some cases, this might be countered by a so-called baking process and frequent cleaning of the heads. Furthermore, as magnetic tapes on open reels do not enjoy the protection of the shell as cassettes do, they are prone to mould, especially if the temperature and relative humidity in the storage spaces were not up to standards. Edited tapes containing splices may suffer from breakage due to dried splicing glue. As all these phenomena affect the preparation of the tapes before they can get digitised, a good description should mention at least an estimation of how often these problems occur.

Whether they contain an audio or video signal, the shell of **cassette formats** protects the tape or the disc inside against many of the deterioration phenomena described above. Nevertheless, this protection is by no means absolute, and parts of this shell can also break or sometimes even cause damage to the information carrier. The soft binder syndrome and mould occur on cassette formats with a magnetic tape. As almost none of these tapes are made of acetate, the vinegar syndrome is hardly ever an issue. The occurrence of broken tapes depends on

the thickness and width of the tape. Tape ruptures frequently happen on the thin and narrow tape of audio cassettes, but almost never with professional video cassettes<sup>9</sup>, also because apart from early two inch quadruplex videotape, the editing of the images did not happen via splicing as with open reel audio tapes or film.

All cassette formats contain moving parts that can break. The most vulnerable part is often the guard panel that protects the tape when it is not in the player. Some types of cassettes have foam-made tape conducting pressure pads. These can dry out, pulverise and leave traces on the tape. Some cassette formats such as VCR contain tape guidance rollers made of metal. If these are rusted, they can literally scratch the recording off the tape as soon as it is played back. Polishing the rollers or transferring the tape to another shell are the only practical solutions.

Plain **optical discs** missing the protection of a shell are very vulnerable for scratches and for the physical degradation of the dyes causing data loss, also known as disc rot. Recordable optical media use dyes, so they are at much greater risk than are commercial CDs which use burned in spots. The dyes used on recordable discs can be damaged by ultraviolet light, even simple sunlight. Optical discs protected by a shell, such as with MiniDiscs or Sony Professional Discs<sup>10</sup> have proven to be quite resistant to physical deterioration and damage. But also, their guard panels may break.

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<sup>9</sup> Except for D3 video cassettes which appeared to be very prone to this problem.

<sup>10</sup> Often also referred to as XDCAM discs.

Condition description is particularly crucial for film materials, because this condition greatly influences all the stages of the digitisation process, from preparation to post-production.

Particular types of film deterioration depend on the film base. Nitrate films are well known for their flammability, but inadequate storage conditions can cause nitrate films to decompose and gradually become sticky.

The best-known threat to acetate films is of course the vinegar syndrome, which leads first to an odour nuisance, followed by deformations such as shrinkage and warp, and eventually the complete destruction of the film: turning it into a congealed mass. The description of the condition of acetate films to be digitised should feature information about the pH values and the frequency and degree of shrinkage and warp.

Independent of the film base, the condition of the perforations and the splices is important. All splice conditions must be good enough to survive the pull force of the scanner. If the archive itself does not check and - if necessary - reinforce the splices, this must be done by the service provider: a labour-intensive and therefore expensive job.

As mentioned earlier, for almost all scanners perforations are crucial to stabilise the image and to apply the correct playback speed (frame rate) of the images. For scanners working with sprockets the transport from one reel to the other also relies on the film perforations. Sprocketless scanners often have a higher tolerance level for torn or otherwise damaged film perforations. This once again clearly illustrates how the condition of the film influences the choice of equipment, and thus the importance of clearly documenting the condition of the media in the collection description which is part of the tender documents.

#### 4.4.2 Ancillary carrier data

When direct data about the condition of the carriers is unavailable, or even in addition to that, other information might help the candidates to estimate their condition, by combining some ancillary data about the carriers with their own experience. Direct data about the condition of the carriers described in the tender is binding in the sense that it can be considered a reason for termination of the contract if the condition of the carriers is presented considerably better than it actually is. This ancillary data is not binding as to the condition of the carriers, as it is the candidates themselves who draw conclusions from them.

As ancillary data about the data the following parameters could be interesting.

##### The age of the carriers

Archival databases rarely provide data about the exact production date of the carriers, and it is not always easy to determine it right away. In general, a good starting point is the era in which the industry produced a particular carrier format, but a candidate service provider often has this information as well. Further narrowing down may be based on the recording date of the content, but that content may also have been copied on the respective carriers later. In some archival contexts such as broadcast archives, the receipts of blank carriers may be traced. For some carrier formats, type or lot numbers can sharpen the time period in which the carriers were produced. In case of film, the stock numbers or stock codes may provide useful information. The boundaries of the era from which the carriers come can be set broadly in the tender documents, based on the youngest and the oldest carrier, but a more precise age distribution offers the candidates even more possibilities to

estimate the condition of the carriers. A graphic representation of this will often take the shape of a bell curve.

##### Brands and types

Depending on the carrier format, the brands and types of carriers can provide very valuable information about the condition. Some brands and types were and are simply more susceptible to some deterioration phenomena than others. Extensive research has been carried out in this domain for certain carrier formats, for example film stocks, quarter inch open reel audio tapes and some types of video cassettes.

##### Origin and preservation history

Also, these can be an important indication for estimating the actual condition of the carriers. Storage temperature and humidity figures can be interesting information here, even if these are usually only available for the most recent parts of the collection's shelf life. Making the distinction between recordings from a professional or an amateur context can be particularly important as well. Recordings made in a professional context such as a broadcaster are generally much more homogeneous, thanks to the recording and storage standards that were more common. Amateur recordings are technically often more diverse and storage conditions were usually more different and worse than in a professional context. Particularly interesting to mention here, if known, is whether the carriers have undergone trauma such as water seepage or temperature shocks.

A special aspect of the origin is the recording device. For some carrier formats, especially magnetic tapes, it is recommended to perform the migration with the same device that the recording was made with, if possible. If the exact device or information about it is no longer available, a device of the same brand and type can be selected, if known.

### Packaging history

A special aspect of the preservation history is the packaging in which the carriers have remained during their shelf life. Depending on the carrier format, inadequate packaging can negatively affect the condition of the carrier and the effort required for migration. In general, good packaging protects the carrier from external influences such as dust, direct sunlight, physical shocks and shocks in temperature and humidity. For certain information carriers, magnetic radiation (e.g. from computers) can be a serious threat. In any case, information on packaging history is a useful indication for candidates in a tender process.

### Winding quality

Finally, for carrier formats based on wound film or tape, it can be interesting to provide information about the winding quality. Since it is usually not a direct deterioration phenomenon, we mention it here as an indirect one, but this does not make it less important. Certain windings sometimes do not overlap nicely with the previous or the next one, exposing these parts to a risk of lateral folding or gathering dust. Sometimes openings (windowing), transversal folds or even so-called spoking occur (the tape becomes angled instead of following a round path), e.g. as a result of warp, in turn caused by the vinegar syndrome. Information about this winding quality can therefore be very useful for the candidates to estimate the condition of the collection via indirect data.

## 4.5 Content and production data

The type of audiovisual material held within the carriers and the context in which it was produced, may influence the migration.

### For example

- A soap opera with many episodes may need to be digitised in sequence for rebroadcast. Special attention to the quality control will be needed so an episode is not missed, or is badly digitised, as this would be particularly annoying if it were to be aired.
- For artist videos, the aesthetics intended by the artist will affect the digitisation. The over-saturation of colours, for example, may have been originally intended by the artist, and these colours should not be flattened.
- For audio content, it can be considered to apply a higher sampling rate for parts of a collection, for example for professionally recorded music concerts (which could be used for a reissue).

Briefly, some parts of the collection could be subject to a separate or different treatment. If this is the case, pointing this out in the tendering documents is necessary, as it may go against the usual industrial approach of many migration service providers.

## 4.6 Packaging

The packaging of the carriers has already been mentioned in the discussion about the ancillary carrier data describing the state of the collection to be migrated. However, the packaging that the carriers have been kept in during their life cycle prior to the migration of their contents is not necessarily the same as the one in which they are delivered for migration.

When describing the collection in a tender for audiovisual migration, it is very important to indicate how the media, i.e. any single carrier, will be packaged.

#### 4.7 Other carrier characteristics determining the migration effort

In addition to those listed above, there are of course other factors related to the carriers and their content that could influence digitisation. In general, it is advisable for the tendering organisation to discuss any special circumstances from which it suspects a positive or negative impact with potential candidates during the market exploration phase prior to the tender.

##### For example

- For various forms of audio and video carriers: were they recorded with a test pattern and a sound test signal, are there major anomalies to that?
- For film recordings, is there a starting cross in the film or some other indication of where the meaningful content begins?
- Are there pre-existing or additional artefacts on the carriers?

## 5 Business case: the migration process from start to finish

The tender documents should describe the entire migration project, including the steps before and after the migration services provided by the tendering organisation. In this way, the candidates can properly assess where they can add value, and why the tendering organisation attaches importance to certain services.

In this chapter we briefly summarize the different steps in a common migration project; in-depth information and additional recommendations for each corresponding step can be found in [Chapter 6](#).

### 5.1 Selection

Although the scope of a project might cover some aspects of this step (source formats, etc.), the proper selection of content in terms of what (different versions, different age of carriers with same content, different level of knowledge about technical status of carriers with same content, etc.) and when (defining the proper time in the project for certain parts of the lots to be digitised in relation to content, re-use and value) is most important for both the maximum performance of a migration project as well as the maximum impact on all services based on the output of that project. This includes quick wins in the fields of return-on-investment and acceptance, as well as the chance to react to actual and emerging needs, either from the migration process itself or other processes downstream.

## 5.2 Registration

Large scale migration projects of audiovisual carriers typically contain many carriers, many process steps and many deviations on the typical workflow. Following up the status and the location of the project as a whole, or of one carrier in particular, becomes cumbersome if not impossible without a proper registration (defined here as a unique identification of every carrier together with all its characteristics necessary either during or after the process, e.g. via a barcoding system) of each individual carrier, and a workflow tool at the service provider, and ideally also at the archive. The best choice is to ensure the use of such a tool by adding it to the minimum criteria in the tender.

## 5.3 Grouping of carriers

In addition to the important information in [paragraph 6.2.1 on Packaging](#), we want to address here the aspect of subdividing the total amount of carriers to be migrated into what could be described *virtual packaging*: the compilation of batches of source material with homogenous features (size, length, content, physical status, etc.), since these are easier to handle and organise in a workflow tailored to efficiency. The size of these batches (based on the amount or the total duration of the carriers for example) must meet the needs of the steps downstream. The ideal size could be determined during the test and stabilisation phases. When introducing the concept of batches, one should consider that these could get broken up as well (e.g. to sort out exceptional cases, which could end up within a dedicated batch).

## 5.4 Transport of the carriers: way up

Often this is the most feared step in migration projects, so a general rule might be to carefully balance the pros and cons of longer transport times and distances. But the risks are not necessarily related to the distance or the duration of the transport: even a very short one (e.g. from one building to an adjacent one) can be harmful for valuable content. Any transportation of valuable audiovisual content should therefore be prepared properly. Other aspects are addressed in [clause 6.2.1](#) and in its subclause on [Transport means](#).

## 5.5 Temporary storage

The important aspects of internal storage for a tender are addressed as well in [paragraph 6.2.2](#). Here we just want to give a rule of thumb: it should meet (at least) all requirements of the standard storage in use by the tendering organisation. And, of course, it should meet the requirements for ad hoc accessibility to all content<sup>11</sup>.

## 5.6 Actual migration

This is addressed in more detail in [paragraph 6.3](#). We just want to point out that playback of (especially analogue) carriers is recommended - and sometimes even easier – using the same equipment as the one that used for making that recording. So, if

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<sup>11</sup> One might think about the eventuality of needing content on a certain carrier in this temporary storage during weekends, holidays, etc. This potential issue is also addressed under [paragraph 6.2.6](#).

there is (still) equipment at the tendering organisation that have been used for recording (parts of) the collection which can be used for the migration project, this should be mentioned in the tender as well<sup>12</sup>.

### 5.7 Transport of the carriers: way back

In most cases the tendering organisations require the carriers to be returned from the place where the images and sounds have been migrated. The same applies here as for the way up<sup>13</sup>. Sometimes a migration project is also a good opportunity to move a collection from one storage location to another, for example when there's a plan for repurposing an old storage room.

### 5.8 Transfer of the files

It is sometimes forgotten that the transfer of the (new, migrated) content is something which also should be planned for and prepared in a proper way. Therefore, this aspect is also elaborated under [paragraph 6.2.5](#). Fortunately, the costs for transferring large amounts of data via secure data connections have reduced during recent years - so this should be the first solution to be considered. But transfer of content through transportation of dedicated off-line carriers (HDDs, etc.) should also be considered, especially when a reliable data connection cannot be guaranteed or if it would prove to be too time consuming. The use of data

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<sup>12</sup> Evidently, if such playback equipment could be used, the cost of the project would be positively affected.

<sup>13</sup> Not considering here the case for the tendering organisation to dispose of the source material immediately after migration.

integrity checks, for example via checksum techniques<sup>14</sup> are mandatory for all steps during data transfer and storage, so these should be used here as well. If the tendering organisation does have a data integrity policy before the start of the migration process, this should be a very good point in time to introduce it.

### 5.9 Quality control and ingest of the files

Quality control is not necessarily a single self-contained operation inside a migration workflow but rather several steps and methods that need to be integrated along the workflow. In this step however, we consider only the control executed as the final step before the ingest of the files on the mass storage infrastructure of the tendering organisation, to check if the files delivered comply with the preconceived file specifications and quality standards. This check is meant to ensure that:

- the carrier was properly prepared for migration;
- the equipment was properly set up and calibrated for playback;
- the conversion and acquisition equipment were working as expected;
- the file contains the whole content of the original carrier, with no missing part;
- the file format matches the requirement;
- there is no naming error that would compromise the link between the file and the original carrier;

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<sup>14</sup> Please see [Note about “checksums”](#) in clause 6.5

- the metadata is correct in its content and formatting;
- the file ingested in the end is exactly the same as the one produced by the service provider.

Evidently the migration service provider should take care of quality control as a part of its own quality assurance policies, but it's advisable to have additional quality control stage(s) after the files are handed over by the service provider, either by a third party company, either by the tenderer itself.

We address this step in more detail in [paragraph 6.5](#).

### 5.10 Cataloguing

Depending on the cataloguing status of the content on the migrated carriers, the safe and sound arrival of the newly migrated files on the file storage of the tendering organisation could be the moment to start with the cataloguing or refine existing metadata. Postponing this step can be tempting, but it may lead to cancellation of this necessary step.

It may reduce the efforts involved to combine this with parts of the quality control that have to be executed anyway to monitor the work of the contractor. Also outsourcing certain metadata alignment (e.g. the updates to the technical metadata) parts to the contractor could be considered but all this would have to be foreseen and planned before setting up the tender.

Since the content is now file based, additional steps like introducing technologies for the automatic creation of descriptive metadata such as speech-to-text, face recognition, text detection, automatic segmentation and other AI-based technologies might be considered as well.

Finally: it is highly recommended to preserve the documentation of the migration process as much as possible. This also includes the information gathered by the quality control process, which might be used later for automatic restoration.

### 5.11 Original carriers

Whether audiovisual carriers should continue to be preserved after their content has been migrated, is a sensitive point of discussion amongst audiovisual archivists worldwide, with answers going from a radical yes to a radical no. This document does not have the ambition to provide an answer to this question. Please see references listed in [7.5](#).

This literature points to factors such as the type of the carriers and their physical status and age, the risk of heritage loss, archival or legal constraints, the risks and costs of the transport of the carriers back from the location where they were migrated to where they would get stored, the costs of an appropriate storage location (short or long term), the costs of a non-polluting way of eliminating the carriers and the potential value of the carriers as museum objects.

Paragraph [6.7](#) provides further detail for specifications on a possible disposal of the carriers to be included inside a tender for the migration of audiovisual materials.

## 6 General technical and project requirements

This chapter is at the heart of the actual tender, as it focuses on how the migration project should be carried out, and it covers both organisational and technical aspects. It is important for the tendering organisation to translate these into clear minimum requirements and questions for the candidates to further explain their proposed solution, so that it can be assessed on its quality.

### 6.1 Overall project management

It is a common misconception to consider audiovisual migration projects as a technical matter only. It is fundamentally a technical matter of course, but it is not less a matter of organisation, proper project and workflow management, communication and so on. A migration project of audiovisual content is as strong as its weakest link. What is gained by a good technical implementation of the migration, may be lost due to a lack of accuracy or quality assurance in another phase of the project. That is why it is important that the tendering organisation and the contractor make good agreements about all aspects other than those about the actual conversion.

As with many other aspects of a tender, when formulating the minimal requirements and clarification requests the tendering organisation should carefully consider what its interests are. It can be tempting to describe all aspects in detail, forcing the contractor to proceed in the exact way as the tendering organisation imagined and prescribed. However, such tight descriptions may prevent candidates from proposing a solution that the tendering organisation may not have thought of itself while holding the potential of better results and lower costs. It is therefore recommended to focus on the intended result and to limit the minimum requirements to those aspects that are

essential to obtain a good result, thereby limiting the risk of an unsatisfactory one.

#### 6.1.1 Project structure, phasing and communication

Migration projects often take many months, sometimes even several years to execute. In practice the collaboration of employees of the tendering organisation and employees of the contractor is temporary, but nonetheless still relatively long-term. Considering the importance of the end result, and the often-lengthy project duration, it is recommended that the tender specifies how the collaboration will be set up, who takes which role, and each of the phases the project will go through.

##### Project team and project lead

It is advisable to ask the candidates in the tender how they want to set up the project team on their side and who assumes which role. Usually on both sides, project leads are appointed, both functioning as so-called single points of contact. Because it is such an important role, the minimum set of requirements could include the following:

- to avoid working with an inexperienced project lead: a minimum of years of experience in carrying out similar projects,
- to avoid unexpected changes of the project lead: a minimum term at which a change of project leader must be announced,
- to avoid communication problems: knowledge of a common language with the project manager of the tendering organisation.

In later stages of the project it might be advisable to detail further who would be responsible, accountable, consulted and

informed for all the sub-tasks in the project, for example via a so-called RACI-matrix.

### Project phasing

In [chapter 3](#) it was already emphasised that it is important to draw up a clear project phasing and to include it in the tender documents. In this chapter such phasing can also be expressed in minimum requirements, by means of a calendar with milestones and associated deadlines. Candidates may also be asked to explain in more detail what they will do to adhere to the set timeline and reduce the risks of delays.

Milestones and deadlines are interesting aspects of project planning as they make the progress of the project measurable. But it is equally important that they are realistic and feasible, and that it is clearly defined what exactly must be completed at what time. At first sight, working with tight deadlines seems to put pressure on the executor of the migration assignment. Inevitably, however, the implementation of a migration project for audiovisual media is a series of activities in which one party sometimes must wait for the other. This means that tight adherence to interim milestones and deadlines can easily become a source of conflict when delays are blamed on the other party. In short, it makes little sense to define interim deadlines that the contractor must meet, if there is not a concrete and clear interest on the part of the tendering organisation.

In concrete terms, digitisation projects work with a pre-contract phase, an installation phase (if applicable), a test phase, a stabilisation phase, a production phase and the evaluation phase. This chapter of the tendering documents should outline these phases, define what is required from the contractor throughout them and define the milestones in between.

### Communication

Communication in the project is extremely important too. A tendering organisation may impose minimum requirements or ask candidates for clarification on aspects such as:

- Which communication activities are provided at a minimum?
- Apart from ad hoc topics, which fixed subjects will have to be discussed?
- What is the trigger or the fixed frequency of the communication?
- Who should be involved?
- Which media will be used or at which location will the communication take place?

### 6.1.2 Subcontracting

As pointed out in the [Overview Document](#), a candidate may want to call upon the help of a subcontractor to carry out one or more parts of the assignment. If subcontracting is allowed, it is of course in the tendering organisation's interest to know which sub-tasks will be subcontracted and to whom. In addition, it is also important to make agreements about who is responsible for communicating with the subcontractor.

Whether subcontracting is permitted within a migration project for audiovisual carriers is of course up to each tendering organisation to decide. Not allowing subcontracting has one clear advantage: all outsourced tasks remain in the hands of one service provider and risks related to task divisions are limited. On the other hand, one should be aware that not every company in the field of audiovisual migration has the capabilities to perform all tasks listed in a tender, and excluding subcontracting might

therefore implicitly lead to the exclusion candidates who would be very well able to execute a (large) part of the contract.

In general, the more diverse the range of tasks that is put out to tender, the more it is advisable to allow subcontracting. For example, some companies only focus on audio, video, film or the most common carrier formats within the categories mentioned. Tenders for the digitisation of several audiovisual carrier formats and where subcontracting is disallowed might unintentionally exclude these companies or lead to suboptimal results.

Some companies are capable of performing certain activities themselves, but not as efficiently as another party could. If subcontracting is not allowed, this may lead to an unnecessary cost increase on behalf of the tendering organisation. Accompanying activities such as the transport or long-term storage of audiovisual media are typically eligible for subcontracting. Here too, a thorough exploration of the market before launching the tender is useful. The conferences of international audiovisual archives organisations are an ideal opportunity to discuss with several audiovisual migration service providers which tasks they would subcontract or do by themselves.

Considering the above, there are good reasons to allow subcontracting, but equally it is important to avoid unpleasant surprises during the project implementation. It is therefore recommended in the tender to require specific information, such as:

- which tasks will be subcontracted?
- which parties will act as subcontractors?

As indicated in the [Overview Document](#), it is best to demand the same technical and financial reliability from these subcontractors as from the actual contractor. It is also advisable to require that the subcontracting does not create any additional complexity on the part of the tendering organisation, for example in communication, logistics, quality control, reporting or other aspects of the project management.

## 6.2 Logistics

In most audiovisual migration projects involving an external party the carriers themselves are transported from their common storage location to the service provider's premises, where the migration is done by their employees using their equipment. However, other ways of working are also possible, commonly with variations applied on these parameters:

- where does the migration happen: in the existing archive location or at the service provider?
- by whom are the migration operations performed: by employees or volunteers of the archive or by employees of the service provider?
- whose devices are used: those of the archive itself or those of the service provider?

Different combinations of the above options are of course possible too, when for example part of the equipment is supplied by the tendering organisation. Evidently, these different ways of working have logistical consequences. In such cases ad hoc agreements should be made and requirements set in the tender. In this document we limit ourselves to the most common case: projects where the carriers are transported to another location,

where they are processed by employees of the service provider and migrated by use of their equipment.

### 6.2.1 External transport of the carriers

The transport of large quantities of audiovisual media with a heritage value is a task on which the tender documents must specify enough requirements to minimize the risk of damage or loss. Additional questions can be asked for clarification, so that the proposals can be judged on their quality. These requirements and requests for explanation may concern, for example, the packaging, the means of transport, the protection against damage, the security, the transport planning and so on.

Special consideration should be given to the place where the content is migrated and the distance to the repository. In some cases, long-distance transport of the carriers, or transferring them abroad, may be prohibited by law. Transporting the carriers over long distances can involve risks, transferring them abroad is sometimes not allowed. In other cases, it may be forbidden to exclude foreign companies unless there is a well-substantiated reason. Whatever the choices, reasons and arguments, it is important to prepare them well, and to realise that if the carriers cannot be transported, moving the equipment into the place where the carriers are stored might be a viable alternative.

#### Packaging

It is important to indicate clearly in the tender to what extent the audiovisual carriers to be transported are already suitably packaged, or to what extent packaging materials and operations are still expected from the service provider. Usually the packaging of the carriers consists of several layers, each of which may have specific requirements.

- Do all carriers have their own packaging (carrier boxes, disc sleeves, film cans, ...)? Does each package contain one carrier, or can it also happen that there are no, or more than one carrier inside, and what should happen in such cases? Is the condition of the packaging good enough to be transported, or do they need to be replaced if necessary? What if this packaging would get damaged? Does this packaging have a heritage value on itself or does it contain essential metadata that must be preserved? Does each carrier have to be returned in its original packaging? And what should happen with possible paper materials inside the packaging?
- Are the carriers collected in larger boxes or crates, to protect them for temperature, humidity or physical shocks? It is advisable, as far as reasonably practicable, not to put carriers of different types or sizes in one larger box. But even then, additional protective materials such as air cushions or foam layers may have to be added. What is ultimately the largest unit to be transported? Who is responsible for the delivery of the packaging materials and the packaging activities? What conditions must these larger packages meet?

#### Transport means

Each means of transport has its specific advantages and disadvantages. It goes without saying that the tendering organisation should be informed about which means of transport will be used. A minimum requirement to clarify this in the offer is therefore appropriate. It is also interesting to emphasize some concerns, rather than explicitly oblige or exclude certain means of transport:

- how are the carriers protected during transport? Will the transport be climatized constantly, even when the driver stops for a break? Some audiovisual media (e.g. film) are very

sensitive to temperature and humidity shocks. Others, such as lacquer and shellac plates, are sensitive to physical shocks [3]. How long will the transport take? Which guarantees are given regarding security?

- the flexibility of planning: the choice of certain means of transport can also have an impact on the flexibility of the planning of the transport. An airplane cannot be rescheduled as easily as a small truck, but a flight often takes less time than a truck's journey of equal distance.
- other technical points of attention, such as regard loading and unloading docks: are these protected against wind and weather, are they permanently accessible, to all types of trucks? Is the driver supposed to assist with loading and unloading, etc.

#### Security measures

Of course, protection against theft is equally important. How do the carriers remain protected during transport? Are alarm systems installed and permanently active? Is the means of transport sometimes left unattended? Can the means of transport be permanently tracked, for example via GPS? All these aspects can be translated into minimal requirements or judged upon if the tender asks for further specification.

#### Transport planning

Planning for transport is of course related to the quantities to be transported, the capacity of the means of transport, the amount of journeys, and so on. Here, it is important that the tendering organisation carefully considers what its interests are. Are all carriers ready to be transported at the same time? For how long are the carriers allowed to leave their normal storage location? Working with multiple transportation can increase the price, but

it also spreads the risk of loss and damage. How to prevent that the carriers are on the road longer than necessary? Do the carriers have to be returned to the same place where they will be collected? How will the scheduling of the exact pick-up and return time work? If the tendering organisation has special interests in this regard, specifications can be laid down in minimum requirements. Otherwise, the candidates may also be asked to propose a solution, which can then be assessed on its quality.

In some projects, it is requested that the original carriers should not return to the archive, but destroyed by the service provider or a subcontractor, either immediately after the migration or following a certain delay.

This document does not take a view as to whether this is appropriate. However the question is further discussed in [clause 6.7](#) and useful references are listed in [section 7.5](#) at the end of this document.

At the time of writing the tender the tendering organisation may have already reached a stable position regarding the future of the original carriers, or not. Depending on such a decision, various implications for the logistic and asset management aspects arise, without mentioning the related cost issues. The alternatives are, in principle:

- to keep the carriers for the longer term;
- to keep the carriers for a shorter term;
- not to keep the carriers;
- the decision is not taken yet.

The worst case is the latter, as it implies uncertainties in running the project. In the first two cases we refer to the transport and storage planning above. In the third one the tender should contain provisions about:

- the delay and the intermediate storage between the moment of delivery of the files and the destruction of the carriers;
- the actual destruction (where, how, by whom?), the proof thereof, the environmentally friendly processing of the residues.

#### Permissions and other shipping documents

In some cases, especially when the carriers are protected by heritage legislation or when the carriers must be transported across national borders, special permits for the transport of the carriers, such as waybills, may be necessary for the customs services. It is advisable to obtain enough information about the required documents from the competent authorities before the tender is published. If the need for any necessary permits is not certain, this condition must also be clearly stated in the tender itself, in order to allow the candidates to make a risk assessment. It is also best to state who will be responsible for obtaining the necessary authorisations, along with any accompanying terms and conditions.

In order to avoid misunderstandings about which carriers are being transported, and to prevent possible conflicts in the event of loss, it is interesting to put the details about the transport on paper before it is executed. This is often done by means of consignment notes or shipping lists, that clearly state which carriers are involved, where they will be picked up from and taken to, who transports the carriers, and by which means of transport. The list of carriers should be checked in the presence of both the

carrier and the archive staff. In this way it is clearly determined when the responsibility of each party takes effect and to which carriers exactly it relates. Minimum requirements for this can also be stated in the tender, otherwise it can be asked what guarantees the service provider provides.

#### 6.2.2 Internal storage and transport of the carriers

Once the carriers have arrived at the service provider, they must remain protected against damage or loss. As with previous aspects, one can easily solve this matter in the tender documents by stating that the carriers must not be damaged or lost. However, given that it often concerns particularly valuable material, it is always better to also act preventively and provide the necessary specific conditions in the tender, or to request additional clarification on how the candidates aim to approach aspects as:

- vaulting conditions:
  - will they remain in their original packaging until digitisation? How are the storage and the digitisation rooms climatized? Some carrier formats such as acetate films or lacquer plates are especially sensitive to sudden temperature and humidity changes. Is an acclimatisation space provided for these types of carriers between the storage space and the place where digitisation takes place? And how long do the carriers have to stay there?
- internal transport:
  - how is the internal transport of the carriers at the service provider carried out? How far apart are the warehouse and the digitisation space? Are there any special risks associated with this?

- security:  
how are the carriers secured during their stay with the service provider? How is access to the rooms controlled?

### 6.2.3 Insurance of the carriers during the storage and the transport

It can be useful to have the carriers and any other materials insured during their transport and their stay with the digitisation company. Most digitisation companies and their possible subcontractors have an insurance covering third party goods. It is advisable to request additional information about these insurance policies. Is it a standard insurance against professional risks, as it is mandatory in many countries, or is it a special insurance for the transport and storage of valuable heritage? What exactly is covered by the insurance and for what amount?

When determining minimum insurance requirements, the tendering organisation might be tempted to set a high minimum amount per carrier, the reason often being that not only the value of the carrier, but also the value of the content must be insured. It should be noted, however, that the price of the insurance will also be included in the total project cost by the digitisation company and that, as heritage often involves unique material, no insurance compensation will ever bring the original carrier and its contents back.

### 6.2.4 Identifying, tracking and arranging the carriers

From the transport of the carriers to their return and even afterwards, it must remain possible for the tendering organisation to follow the carriers on an individual level. It is advisable that the tendering organisation knows exactly where the carriers are at all time. Each carrier - and preferably also the

individual carrier box - must be identifiable and traceable throughout the entire process. The tender should therefore also contain a clear division of roles and set minimum conditions concerning:

- unique identification:  
since it must be ensured that all carriers leaving their normal storage place also return, and since at the end of the migration project it has to be clear which files originate from which carriers, it is necessary prior to any migration project to give each carrier a unique identification. This is common practice in most archives, but it may be interesting to provide a procedure in the event such a unique identification is missing.
- automated recognition:  
often scannable barcodes, RFIDs or similar are used for an immediate, automated and less error prone recognition of the carriers. These barcodes are already present in many archives. If they are not, it must be clearly stated in the tender who is expected to deliver them, which barcode standard will be used, who will apply them and where exactly on the carrier and on the carrier box they will be applied. It is evident that the usual conservation guidelines must be observed when applying these barcodes, also when the service provider wishes to apply extra labels of their own. For example, barcodes should never be stuck on optical discs. Certain parts of cassettes may not be covered or affixed to. It is also advisable to stick the barcodes consistently in the same place and in the same direction on the carrier and to include a human-readable code on the barcode sticker.

- follow-up system:
 

it is recommended that the carriers remain traceable throughout the entire process, not only for the service provider but also for the tendering organisation (e.g. box number, pallet number, storage room number, ...). The unique identification and the automated recognition should be backed by a database indicating the location of every carrier and the phases it has been through. Such a database can also support the documentation of each process step (who carries out the step, with which device, at what time, with what result?). Does the tendering organisation only require access to this information when the carriers return? Or does it want to be able to continuously monitor each carrier via live access to the information from the tracking system? It is best to determine the details of this in the tender. Although most migration service providers today use software dedicated to this task, fulfilling this requirement with a simple spreadsheet is still tempting for some migration service providers, too. It is worth considering a potentially high error-proneness in case of the use of spreadsheets for this task.
- order of the carriers:
 

in some projects it may be important that the order in which the carriers are delivered to the digitisation company is also adhered to when they return to the storage space of the archive. Since this order might get lost or disturbed during digitisation (carriers are often grouped by their technical characteristics), it is important that the tendering organisation clearly indicates in the tender documents whether it wishes to receive the carriers in a certain order.

## 6.2.5 Delivery of the files

The delivery of the files after the migration of the images or audio material is of course an important step in the migration process. It is often the first time that the tendering organisation is confronted with the result of the migration process. Naturally, the tender documents should also provide details about the delivery process, such as:

- delivery unit:
 

which files are delivered exactly? Is it only about video or audio material, or also about related files, such as report files, metadata files, checksums and so on? How is the relationship between these files and between the files and the original carriers indicated? Should a certain naming convention, folder structure or sequence be used?
- delivery frequency:
 

do the files have to be delivered individually, per batch or all at once after the migration of all carriers? In some projects, certainly for the digitisation of film material, quality control files are first supplied to assess the quality of the digitisation. Only when those have been approved, the final files may be delivered, followed by the original carriers.
- delivery deadlines:
 

can the files be delivered immediately after the migration? Does the delivery take place at the same time as the original carriers, or can there be a difference?
- delivery medium:
 

different delivery media can be considered, often depending on the volume of files or their size, the processing capacity of

the contractor, the tendering organisation and so on. For smaller quantities or lighter files (such as audio files) a delivery over a network can be considered: (S)FTP, Media Shuttle, Aspera etc. In that case the delivery unit becomes important again to facilitate verification, for example with a view to the invoicing process. For greater quantities or larger files, hard drives or other forms of external storage units such as LTO tapes are often used.

- submission procedure:

whatever the delivery medium, the tender documents must clearly state how the procedure will be structured. Some examples: whose network connection will be used and who will be able to access it? Who is responsible for the delivery of blank LTO tapes? Can these be reused and who determines their naming? How should these LTO tapes be formatted? How are the external storage units shipped, to where exactly and who bears the costs?

### 6.2.6 Urgent request procedure

An urgent request procedure - sometimes also called emergency procedure - is an optional part of a migration project that is set up to meet an urgent need for certain sound or image material that sits at some stage in the migration process, by giving priority to the migration of this content and thus delivering the migrated material much faster than foreseen in the normal process. Such a scenario is common in the broadcasting world and less likely, but not completely non-existent, in other types of audiovisual archives.

It may be useful to specify minimal requirements about an urgent request procedure if experience or statistics from the archive show that this scenario also occurs in more common

archival circumstances - but evidently, the tendering organisation should research and specify its own needs properly. It is recommendable to provide details in the tender documents about aspects such as:

- availability:

should the service be available during working hours, extended working hours or even 24/7? Are the working hours of the archive taken as a basis for this, or those of the service provider?

- communication and response time:

how is communication about an urgent request conducted? How quickly should the request be followed up?

- frequency and effort:

on average, how often is an urgent request expected to occur, considering the entire duration of the project? What efforts are required exactly? It is advisable to ask the candidates to include the price for these exceptional requests in their overall pricing, but this also requires that the number of occurrences and the efforts required should not exceed certain limits clearly mentioned in the tender, thus allowing the service provider to properly estimate a maximum impact on its own costs. If the average number of urgent requests for the entire project duration is difficult to estimate, it may be interesting to agree on a supplementary fee per case, in the event the estimated actions or efforts are exceeded.

- deadline:

how long is the maximum delivery time? Often a term is agreed for this aspect in addition to the actual duration of the

image or sound material itself, since with many carrier formats content cannot be read out faster than real time.

- delivery format and delivery channel:

how is the image or sound material delivered? In which file format and via which channel?

Evidently, the ability for a migration service provider to respond to such urgent requests heavily depends also on the smoothness of the migration process and the solidity of the tracking and tracing infrastructure and routines, making it an even more important aspect of the whole process.

### 6.2.7 Temporary safety copy

Of course, even after the actual migration of the image and sound material, something might still go wrong with the files. For example, during transport, ingest into the digital storage infrastructure of the archive, or even afterwards. It is therefore advisable to ask the contractor to keep a temporary backup copy of the material for a certain period. This time frame should provide the tendering organisation enough time to perform all necessary checks, but equally should not burden the contractor with an unreasonably large temporary storage capacity. Typically, the required time frame for the safety copy to be kept by the service provider varies between 30 to 90 days, after which the contractor can delete it. With regards to this safety copy, the tender documents should outline minimum requirements, or ask for further details about aspects such as:

- what storage medium is this safety copy securely held on?
- how can the back-up copy be requested if necessary, when can it be delivered and via what medium?

- how long should the backup be kept?
- is the expiry of the safety period enough to proceed with the erasure of the safety copy, or is an additional authorisation from the tendering organisation required?

## 6.3 Transfer of content from the carriers

Apart from the importance of all surrounding aspects of project management as explained previously, the actual migration of the content from the carriers remains central, as this is the very purpose of the project.

As mentioned earlier, this document does not have an ambition to explain how the migration of audiovisual content should actually take place.

The intention of this chapter is to refer to how a tender for the outsourced migration of audiovisual carriers can translate these recommended practices into minimum requirements (which allow to set a guaranteed minimum level) and requests for clarification (which allow for a further qualitative difference between the offers).

We focus on provisions related to following different aspects:

- the equipment used;
- the proposed overall workflow;
- the examination and preparation of the carriers;
- the actual playback;
- the output specifications.

### 6.3.1 Equipment

The tender documents may state in general terms that the contractor should use equipment that is the best suited for optimal performance when playing back and transferring audiovisual carriers. Particular attention must be given to the pieces of equipment chosen for the playback, the analogue to digital conversion (where applicable), the digital acquisition and the connections made between machines. The following aspects may act as parameters in order to establish the quality of the proposed solution:

#### Choice of devices and connectors for normal cases

To what extent is the proposed fleet of devices and connections specifically tailored to the characteristics of the most common carriers in the collection to be migrated, and to reach the predefined output specifications and quality? Are they capable of dealing with the numbers, their technical features, their condition? Below we provide examples from the video, the audio and the film world.

#### For example

##### Video

When migrating Betacam SP tapes using a composite video cable somewhere in the transfer chain means that the video quality of the produced files will be degraded from the quality of the source. This is therefore not acceptable.

##### Film

There are quite a few different film scanners on the market, at different price ranges, whose output quality can differ notably. Depending on the type and condition of the film carriers to migrate, it should be assessed whether the proposed equipment is adapted to their handling: tolerance to warped

or shrunk film, degraded perforations, fragile splices and so on. Further interesting features may relate to the focus (manual or automatic), the bit depth and colour range, the capacity to scan in HDR, etc.

#### Audio

An audio tape playback deck equipped with a 2-track head is not suited to play back 4-track tapes. The tapes will play, sound will be produced but different signals will be mixed down together in the resulting files with no possibility to separate them back to normal.

#### Choice of devices and connectors for exceptional cases

To what extent is the proposed fleet of devices and connections able to handle carriers that are exceptional, either for their technical recording characteristics or for their exceptional condition? Can the predefined output specifications and quality be reached for them as well?

In some situations, the tendering organisation may be in possession of rare playback equipment that could be lent to the service provider, specifically for the migration project. In that event, the conditions of the loan should be detailed in the tender.

Below are some examples from the video, the audio and the film world.

#### For example

##### Video

For many open reel videotape and video cassette formats, PAL and NTSC tapes cannot be played back with the same machines. Most tapes are recorded in one of the two of these broadcast standards, but it is recommendable that the other

standard is also covered.

### **Film**

The gates (the opening through which the film passes just before it passes along the camera) of some film scanners are very low. This has the great advantage that the film is placed exactly in place for scanning and it greatly reduces the risk of focusing problems. But for warped and brittle films such a low gate is unsuitable: it risks breaking or blocking the film when it passes through the scanner. Therefore, if warped, brittle film is included in the collection description chapter, the proposed scanning equipment should also take it into account by providing for a higher scanning gate.

### **Audio**

For the oldest mechanical sound recording technologies (cylinders and phonograph discs), transfer technologies have been developed that differ considerably from their original playback technology. The traditional method is of course purely mechanical, by using a steel needle (stylus), but in recent years optical reading devices, making use of cameras, have made appearance. While they don't necessarily provide a better sound quality compared to the traditional method, they allow processing carriers that are in such a bad shape (broken in pieces, delaminated, warped, or featuring large scratches) that they couldn't be played back in any other way. Therefore, when owning such carriers in very bad condition, it is preferable to look for a service provider which can accommodate optical playback.

### **Preventive and reactive maintenance of the setup**

The contractor should justify its ability to maintain its equipment in pristine working condition. This implies owning a number of

spare machines for each piece of equipment, as well as spares for the most critical parts of each machine (for example the playback heads). In addition to the equipment, the contractor should have an expert maintenance engineer available, either working full time for the company, or hired specially as required to carry out maintenance jobs.

The contractor must also present its maintenance plan, which should consist in regular cleaning, tests and calibrations with reference carriers (test patterns, etc).

### **6.3.2 The proposed overall workflow**

In addition to detailing the equipment, the contractor should describe its migration workflow which needs to demonstrate the ability to deal safely with all the carriers concerned by the tender. This workflow should include the steps described in the following subchapters.

Can the predetermined throughput be achieved using the proposed workflow? Does the proposed workflow guarantee the quality as laid out in the tender? Are there enough control steps built in? How error-prone are the monitoring and documentation systems? Does the proposed workflow describe all process steps foreseen by the tendering organisation? Are there no superfluous steps? Is there a risk of unwanted digital processing of the files that could obstruct the transparency of the migration - as mentioned under [clause 6.3.4](#)?

### **6.3.3 Assessment and preparation of the carriers**

Assessment of the carriers ensures each carrier is given the best treatment to match its nature and condition. Most of this assessment is facilitated by the collection inventory provided by the tendering organisation, though in the end, for example if the

inventory provided is not very detailed, it is the operators at the contractor who will have to decide, using their experience of the different formats, brands, models, eras, conditions, what is best for each carrier.

In order to increase the chance of a successful migration, the tender documents should firstly state how the assessment must be carried out: which aspects must all be checked in advance? For which aspects does the candidate propose additional checks? Are these relevant aspects in light of the collection to be migrated?

Furthermore, it must be determined how the carriers should be prepared, again to increase the chance of a successful migration. Naturally, the necessary preparatory actions differ per carrier type. The tender documents can however provide details for several key preparatory steps, and state to what percentage they should be applied.

Depending on the type and condition of the carriers, some special operations may be necessary before doing a transfer, like cleaning, spooling, baking, splicing. It should be specified in the tender whether those operations are systematic or optional. If optional, the said operations can be either included in the standard migration price or billed as an extra procedure.

#### **For example**

- The collection to migrate comprises of 1980's Betacam tapes. To prevent playback head clogging, preventive cleaning of each tape is demanded before migration. The cost of the cleaning can therefore be included in the migration cost.
- The collection comprises of audio tapes which contain physical splices. Some of those splices have dried up and need to be redone. Every tape will need to be spooled to

another reel then spooled back to check the condition of the splices and any bad ones fixed. Fixing the splices can be included in the global migration cost, so long as a maximum number of splices to repair per tape is defined (for instance, maximum 5 splices per tape). Alternatively, every splice repair can be billed separately as a fixed price item.

- The collection comprises of 1970's U-Matic tapes. It is not known whether those tapes are prone to stickiness, or how many of them are concerned. Consequently, a separate price item is created for the operations dedicated to those tapes of unknown quantity, typically involving baking and cleaning in several passes.

#### **6.3.4 Playback and transfer**

Just as the actual migration process is central to these types of tendering documents, the actual playback or transfer is central to the migration steps themselves. Within these playback or transfer steps, there must be provisions in the tender documents regarding some specific aspects.

##### **Setting up the playback equipment**

Previously it was recommended to ask which equipment the candidate will deploy, and minimum requirements have already been stated for this. Now, here are the provisions regarding the actual setup of the playback equipment.

Some recordings have colour bars, test patterns or audio frequencies allowing the operator to calibrate the equipment according to the original recording. If not present, the actual recorded signal can be used to adjust the playback equipment. That's especially true for film and analogue audio tapes which can have high amplitude variations from one carrier to another:

the source analogue signal should be aligned with the digital recipient, to avoid under-modulation as well as clipping. This optimisation of the transfer will preserve more data in the digital domain and will allow for higher quality subsequent post-processing, for instance when restoring content for re-use.

In general, the tendering procedure may require the contractor to set their selected playback device in this step in such a way that all meaningful characteristics of the content are reproduced as correctly as possible. More specifically, the offers can then be assessed on how they determine what the correct settings are and which settings the proposed playback equipment makes possible.

### Monitoring

In this part of the tender, minimum requirements can be set about the monitoring of the playback and transfer process. For example, a maximum can be set on the number of machines that one operator can monitor at the same time.

Some fragile formats like phonograph records, two inch video tapes or worn films require very close surveillance throughout the transfer, and, to reduce the risk of them getting damaged in the process, cannot be left unattended.

Other formats like Betacam, VHS or audio cassettes, are generally more robust and can be transferred in parallel with little live monitoring. However, when possible, automatic surveillance of the transfer must be used, such as logging channel condition warnings and timecode breaks on Betacam tapes. This may point to playback issues that could be resolved by cleaning or repairing the tape, cleaning the player or by using a different playback machine altogether.

The technical setup should permit monitoring audio and video signals right at the output of the playback device, as well as at the end of the transfer chain (digitised signal), so it's possible to easily detect any fault in the chain.

### Number of passes

Several passes may be necessary to properly transfer a carrier when:

- the carrier is clogging the playback heads, which need to be cleaned up several times during the transfer;
- several recordings of different technical nature are found on the same carrier, requiring a change of setup or equipment in the course of the transfer;
- splices or weak points of the tape are gradually breaking up and need to be fixed.

Running several passes means transferring a part of the carrier until a problem occurs, then stopping the transfer, and removing the carrier from the playback device, performing the repairs or cleaning the carrier, the device or both, returning the carrier to the replay device, rewinding a bit and then resuming the playback and transfer. At the very end, all parts transferred must then be edited back together seamlessly.

Those situations could be anticipated in the tender, by setting up a maximum number of passes to process each carrier. It is also possible to define in advance processing categories, allowing the service provider to adapt the pricing to the actual difficulty of the job.

### For example

- Category 1: good condition carrier; 1 to 2 passes is enough; price X
- Category 2: average condition carrier; 3 to 5 passes are necessary; price Y
- Category 3: bad condition carrier; more than 5 passes are necessary; carrier is rejected from migration or a special quotation is submitted for approval

Of course, when working with such categories, a good knowledge of the carriers' condition helps the tendering organisation to make sure legitimate categorising is done by the service provider.

All this information should help the service provider to offer realistic prices. Any out of scope operation may lead to a separate quotation, if indeed the service provider has the technical ability to deliver.

### Transparent migration

When preserving archives, one cardinal rule is to avoid any unnecessary transformations. In many migration projects the files generated will become the digital master that will eventually replace the original carrier, which won't last eternally. That is why they should represent as closely as possible the source they originate from.

Examples of transformations that one could be tempted to make:

- the normalisation of broadcast standards (PAL and NTSC, using different frame rates);
- the current broadcast standard is HD, then every source should be formatted to an HD master file;

- all interlaced video material should be deinterlaced to progressive scan, to make it more adapted to computer and internet use.

While all these transformations make sense from a re-use perspective, it is advisable to exclude them in the tender documents, as they'll produce irreversibly altered digital master files. Instead, such operations can be performed on demand when accessing the correctly preserved content, using the latest technology available.

### Digitisation of accompanying documents

While migrating the content from its audiovisual carriers, the tendering organisation might also wish to preserve a digital copy of all the documents that are enclosed with the carrier. That includes:

- technical data sheet (such as recording characteristics or duration);
- technical inspection sheet (reports of previous quality checks);
- re-use history (list of all the times the carrier was taken out for broadcast or copy);
- documentation (such as list of programs or summary of the content);
- labels of all kinds for example if they hold a documentary or aesthetic value;
- music sheet.

In the same way, the carriers themselves or their case may present unique and useful visual information that could be worth preserving.

The service provider can then be tasked to digitise those documents, for example as tiff image files, using scanners or cameras. In that event, as for the audiovisual content, the

characteristics of the output format (picture resolution, compression, etc) as well as the naming scheme must be described in the tender. It is also important to mention how many documents are expected to be found with each carrier, so the service provider can better estimate the time and cost linked to this operation.

### 6.3.5 Output specifications

Ahead of the tendering phase, a digital master format must be chosen for long-term preservation. Several different formats can be chosen, depending on the variety of the audiovisual collection to migrate.

The choice of the file formats is crucial and must not only allow retention of the full quality of the original recordings, but also make sense in terms of compatibility, sustainability and accessibility of the coding algorithm. While it should offer the best quality possible for each given source, to avoid wasting storage space, a digital master format should be chosen to which it does not exceed it too much.

#### **For example**

It is absolutely not good practice to transfer a 16 bit / 44.1 kHz DAT into a 24 bit / 96 kHz file: it takes up about 4 times the space, while degrading the original quality during the resampling operation and falsely suggesting the quality is better than it really is.

As much as possible, it's better to retain digital recordings' characteristics into the file domain. Therefore, the preservation format, for the migration of digital carriers, is often precisely dictated by the characteristics of the source medium. This equivalence between the source and the target is less obvious

when dealing with analogue carriers converted to the digital domain, that is why thorough technical recommendation documents cover these aspects.

A strong indicator of success for an audiovisual migration plan is when the original carriers no longer need to be accessed. The digital master file is aimed at replacing the original carrier as the new preferred source for the programme it contains. Hence the importance of choosing a format that ideally removes the need to go back to the source carrier, ever again.

The required output specification is probably one of the hardest and most objective aspects that a tender for outsourced migration of audiovisual carriers should set. Therefore, the file container or wrapper, the codec and the specifications must be described by the tendering organisation in the finest detail. Because of its sheer size, this output file format specification is often in the form of an annex or an appendix to the tender.

But next to the compliance with this output format, the tender should also specify that the service provider must demonstrate there is no single weak link in its processing chains, whereby the digital media would be degraded before being converted to the desired output specification. So even if the files delivered are perfectly within the specifications, the actual quality of the content is inferior to what should be expected.

#### **For example**

- The service provider is digitising quarter inch audio tapes using a 24 bit / 48kHz analogue-to-digital converter. The delivery master format is 24 bit / 96 kHz. The files resulting from the digitisation are converted from 48 kHz to 96kHz before delivery. It is of no use as it doesn't meet the quality level permitted by the format.

- The service provider is migrating Digital Betacam video tapes to digital master files which are in FFV1 encoding with a 10-bit; 4:2:2 format. The acquisition of the video signal is done through a video editing software, with a project configured in 8-bit ; 4:2:2. After the acquisition, the digital video is exported as FFV1 10-bit 4:2:2. Again, some data will be lost in the process and as such the quality requirement is not met.

#### Note on additional copies in alternative formats

In addition to the master file format, the tendering organisation may expect to use other formats, in lower quality than the master, but derived from it, usually for addressing the following needs:

- a low-resolution access file format, often also called proxy or browse copy format, enables quick access to all the migrated documents, through a network, without the need to stress the high-volume storage used for the master files;
- a mezzanine (or production) format<sup>15</sup>, with the purpose to offer a high quality, enough for most applications, while being more compressed and therefore more easily accessible than the master file.

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<sup>15</sup> A content-similar file to the archive master, produced during digitisation or afterwards - while in production may be used to normalise input from different sources - with a specific codec. The mezzanine/production format is visually lossless but lighter than the archive master and is used for production purposes.

File format sustainability is less of an issue for these, because this aspect is guaranteed through the new digital master format.

Those alternative formats can be produced either by the service provider, in which case the formats must be specified in the tender document, or by the tendering organisation, upon receipt of the master files. It's often considered more sensible to produce those files only after the final quality check is passed, immediately before digital archiving.

#### Note on storage needs for long-term preservation

All the files produced must be stored on adapted equipment for long-term preservation and/or fast access.

Master files, the largest ones, are often stored "offline" to save cost. It does however mean those files are not accessible at all times, because daily access of the archive is provided by the access (or mezzanine/production) copy of the files. The most frequently used technology for storing such large amount of data that does not require instant access is data tape, for example LTO (Linear Tape Open). The more data involved, the more tape storage saves cost compared to hard discs and servers. In addition to that, tape storage uses far less energy than constantly running servers. Data tapes can be used as traditional storage "on shelves", where all the handling is manual, or they can be loaded in automated libraries which don't require any manual handling for writing to or reading from tape (in that case the storage is considered as "near-online").

Whatever the storage technology, it is very important to have at least two copies of each of those master files, preferably held in different locations.

Access files, on the other hand, need to be accessible at all times, that's why they must be stored on fast "online" servers. They take up much less storage space than the master files.

Mezzanine/production files, whose size is in between Access and Master, can be stored either online, either "near-online" on a tape library, meaning they can be retrieved within a few minutes for quick re-use.

#### 6.4 Reporting

Thorough and precise reporting is not only mandatory to achieve good project management, but also to document the migration process itself, for preservation reasons. As such, it will be considered as metadata and an integral part of the new digital master. The data reported must be sufficiently detailed to cover all the important aspects of the operations, but at the same time shouldn't be too verbose to avoid the data becoming unusable.

For each carrier, this documentation can start with the inventory number of the original carrier, the name of the file generated, the batch number if applicable, and the duration of the file. To document the migration process steps the PREMIS standard [9] can be particularly useful, as it allows to document the date and time, operators, equipment, outcome and notes for each of the actions applied in a structured way.

These fields are very important because they give the contractor the opportunity to pass on information about defects that were already present on the original carrier and were therefore not caused by the migration. In this way, the Quality Control operator at the tendering organization is also assisted in making their judgment.

Some aspects that can be documented using the PREMIS standard [9]:

- the recording standard, if not known before;
- the brand, model and serial number of the playback device used; this can help identify a faulty batch if at some point playback defects are noticed on several files;
- details of the physical repairs performed on the carrier (splices repairs, perforation repairs, cleaning, baking, ...);
- original start timecode;
- characterisation of the output file format, if different formats are possible;
- any description field read from a carrier's label, provided it was explicitly asked for in the tender (for example 'title', 'version').

As far as reporting is concerned, it is important that the tender not only states provisions on the *what* and on the *how*, but also on the frequency of the reports and the means of communication. Both are often related.

Provisions regarding frequency and means of communication largely depend on the wishes of the tendering organisation. Sometimes static reports are considered enough, but ever more live dashboards are becoming available on which the progress of the work can be followed.

The report files often take a machine-readable form, like XML, or XLS with one line per carrier processed into the batch and one column per data field transmitted. This format offers a quick and simple view of what was done over the previous time period,

what went wrong, how much content (duration) was processed, etc.

More and more service providers offer dedicated online platforms where the client can access a dashboard with real-time figures related to the progress, as well as individual data about each carrier. This service comes as a complement to the report files which we still recommend be obtained. These periodical reports also remain useful because they often align with billing. They are one way of checking the validity of the invoices. Of course, it's preferable to also check the actual number of files received, and whether the durations of the files match the reports.

Finally, it is also important to record in the tendering specification at which level the reporting must be done. Carrier level, content level and batch level reporting are the most common.

#### **6.4.1 Reporting on carrier level**

All the data gathered during the project can be exported as individual metadata files which accompany the media files. The tender documents should specify all the fields that the migration service provider is supposed to fill in, either automatically or manually, throughout the process.

Furthermore, the file format and the metadata schema should be indicated, through which this documentation should be delivered. It is strongly recommended to use machine readable file formats and standardised specifications such as PREMIS for these reporting files, as these usually allow a very easy ingest and more powerful use in archival databases such as media asset management systems.

#### **6.4.2 Reporting on content level**

If the number of carriers and the number of output essence files do not correspond - for example because several video files had to be merged - specialised reporting on this aspect might be requested. It can take a similar form to that used for the reporting on carrier level.

#### **6.4.3 Reporting on batch level**

Traditionally an audiovisual content migration project is organised in batches, submitted at a regular time interval, for example monthly. Batch reporting thus follows this arrangement, and report files are provided when the work on a batch is completed, at the end of the time interval.

### **6.5 Quality control**

An efficient quality control is a combination of various checks which should take place at every stage of the process, within both the contractor's and the tendering organisation's responsibilities, culminating with a final dedicated quality control stage which checks the compliance of all files (essence and metadata) with the file format specifications and the quality standards as defined in the tender documents.

The obvious long-term goal of the whole quality control process is to make sure that the new preservation master to be archived digitally is of the best possible quality, given the sources available. A more short-term objective is assessing, carrier-by-carrier, the quality of the migration service provided and, in the event it is not considered satisfactory, ask for a rectification (often, a new transfer of the same carrier), while it is still covered by the ongoing migration contract.

In the tendering documents several requirements and requests for clarifications regarding the quality control could be included. Primarily, it could ask for a full overview of all their quality assurance measures, to ensure that:

- the carrier was properly prepared for migration;
- the equipment was properly set up and calibrated for playback;
- the conversion and acquisition equipment were working as expected;
- the file contains the whole content of the original carrier, with no missing part;
- the file format matches the requirement;
- there is no naming error that would compromise the link between the file and the original carrier;
- the metadata is correct in its format and content;
- the file ingested for preservation is exactly the same as the one produced by the service provider.

In a way, quality control is the proof of the pudding. A tender for audiovisual migration should be written in such a way that if all the requirements and specifications mentioned in the earlier stages are followed, the quality of the obtained result would be guaranteed.

Three distinct aspects of quality control are described in the following subchapters: the quality of the process itself, the file format compliance and the quality of audio and video.

### 6.5.1 Process quality and assessment procedures

This is to ensure that verification of all the main requirements specified by the tendering organisation is achieved during the production phase. For avoidance of doubt, the issue here is not about compliance against possible contractual obligations on throughput or delivery deadlines. The question is about checking that all steps are performed as required.

#### **For example**

if it is required that tapes are cleaned before playback, this fact must be verifiable. Another constraint could be on maintenance and working conditions of playback equipment.

For each relevant requirement, the tendering organisation will have to identify a verification method or to request the implementation of one among a choice of alternatives.

In its offer, the service provider should describe thoroughly the measures that are taken to attain the quality control objectives. In particular, the following procedures are to be expected.

For a precise follow-up of all operations, dedicated project management software with a database is preferred. It allows the service provider to track each carrier and know exactly what was accomplished. It can also make sure the audiovisual files are fabricated with the proper name. All this gathered data will be the source for the reporting documents delivered to the tenderer.

A stage of assessment for each carrier is necessary, even if an account of the carrier's condition was given by the tenderer. The goal is to avoid handling fragile carriers in an inappropriate way, which could result in low quality transfers or even damage to the carriers. The workflow must be organised so that any carrier can be redirected to the most appropriate step for optimal handling:

cleaning; rethreading; baking; splicing; playback on a specific machine; or in the worst scenario cancellation of the migration altogether.

All along the workflow, reliable identification of the carriers is of great importance, which forbids any manual input of a carrier's ID number. Instead, a system such as barcode, QR code or RFID tag must be used. File names should be constructed automatically either from the ID number or from a database.

The control of the transfer itself can be performed in different ways, depending on the source formats and the number of carriers processed in parallel. During the transfer, a minimum of manual audio/visual check is expected, at the very least at the beginning of the operation. Various automatic controls can also be added. In some cases, it's possible to log status messages sent by the VTR (Video Tape Recorder, used to play the tape back), which can help with detecting dropouts (typically with the Betacam family). Video and audio signals can also be monitored live by devices or software and report defects such as clipped signals, frozen frames, absence of signal, bad azimuth setting, etc.

Once a file has been created, it's then necessary to perform a final check on it. It can be automatic, manual, or ideally a combination of both.

### 6.5.2 File format compliance

An automatic file quality control must assess the file format: container, codecs, parameters, etc, and validate its conformity against the template defined in the tender.

The failure of such a test, when executed in the production phase, will result in raising work-flow exceptions on the affected

files, and to specify how to handle such exceptions is going to be another task for the tendering organisation. If detected by the service provider, it's its responsibility to resolve the issue before delivering the file. If detected after delivery to the tendering organisation, it generally leads to a notice to the service provider to issue a new version of the defective file.

It is recommended to define the test as a logical combination (with 'AND' and 'OR' operators) of subtests, to be run on each relevant property, with a Boolean output, i.e. "Success" or "Failure", together with a detailed report - especially for the latter case.

It is important to consider all the acceptable alternatives, to prevent "false" failures due to mismatch with properties that may indeed change for acceptable reasons.

#### **For example**

if not all sources have the same number of audio tracks, and a fixed number of audio tracks is requested in the file compliance test, this will turn out in exceptions, unless either a number of alternative property sets are specified or all files are obligated to contain the same number of audio tracks, even if some will be empty (which may also be a problem).

The tendering organisation may opt to require the use of a specific tool, if they know that it fits their requirements or simply because they are familiar with it. However, the possibilities for flexible configuration (as described above), the format of output (e.g. XML, JSON), the possibility of integration with other tools should all be considered.

It is recommended to consider the use of more than one tool, for allowing cross-checks and also because some properties may be

more accurately detected by ones instead of others. An approach might be to combine both commercial and open source tools.

In addition to checking file properties, the quality control of files will have to include assessing against problems which may affect the files resulting from malfunction of some component within the process. This verification must be run on all the files. It includes:

- playability;
- consistency of duration - when the duration is stated in the header, it is better to check that it matches with real duration of essence;
- end of file - if the format specification includes explicit end of file marks;
- end to end file integrity - can be verified through checksums and will ensure both integrity after transfer over networks or devices and detection of erroneous file replacements.

#### **Note about “checksums”**

The best way to avoid unnoticed data corruption when transferring files is to protect them with a checksum. MD5 is commonly used, though it's not the only algorithm out there. A checksum (or “hash”) should be produced as soon as a file is in its final state, even before quality control. The checksum produced is conveyed alongside the audiovisual file it relates to, generally as a companion text file, all the along the path to the long-term archiving solution. This checksum can be checked against immediately before the archiving takes place. If the check fails, then the service provider is asked to deliver a new copy, for no additional charge. That's why it is an important requirement that the service provider keeps a copy of all files delivered for a pre-

defined period (typically ranging from 30 to 90 days). A checksum file in no way can help fix a corrupted media file, its role is only to make aware of such corruption.

### **6.5.3 Audio and video quality assessment**

Once the file format has been validated, further checks can be done on the audiovisual content. For instance: detection of dropouts, pixel blocks, colour bar patterns, black borders, out of range signals, etc.

The main goal of this step is to assess the transfer from each carrier and decide if that operation must be repeated or not. In other words, it deals with detection of defects and determines if such defects have been created by the transfer or were present on the original carrier.

Again, automatic tools can help with the process, using specific detection templates. The template used for the detection of defects may vary as the audiovisual characteristics are different from one source format to another. A unique generic check might prove inefficient.

A service provider could be tempted to simply forward the reports from an automatic file quality control to the tenderer and consider the work done. One true challenge of quality control lies in the capacity to deal with those automatic reports, which can be quite extensive, and make something useful out of them. Therefore, it should be the responsibility of the service provider to draw conclusions from those automatic reports and act if needed (e.g. repeat transfer of the carrier).

That is why a manual check is preferable to complement the process, though it may not be applicable to every single item, being a time and cost consuming process. On some projects,

manual check is only performed when the automatic controls are pointing to major issues; or when source material is in a format known as problematic or marked as particularly fragile.

A manual check can assess the validity of the automatically generated quality control report and make additional observations, such as audiovisual artefacts that cannot easily be detected by automatic means (light playback head clog for instance). Again, criteria of acceptability may vary from one source format to another, so the quality control operators should be trained to identify the source of the various audiovisual defects.

The final approval is usually given by the quality control operator. Ultimately, it is about understanding if any defect revealed by the control has been created by the transfer or was present on the original carrier.

Quality control reporting should not only include the validation seal from the service provider (or the tendering organisation, or a third party in charge of QC), but also the listing of any persistent anomaly (or what can be interpreted as an anomaly) in the audiovisual content which the contractor has acknowledged as either part of the original recording, or as a consequence of the degradation of the source carrier that cannot be avoided. It is very important to preserve this quality control statement even after the file is ingested into the tenderer's system, as it will provide insight on the document's quality for all its life and avoid questioning about this quality in the future.

Additional automatic and / or human quality control can take place at the tendering organisation as well, or be managed by a third party, before paying the contractor's bills and archiving the files. It makes sense to separate the final quality control from the

service provider's operation, although it requires specific human and material internal resources or another contract specifically for quality control. Extensive internal quality control should be considered especially when it is decided to discard the source carriers subsequent to migration.

Quality control is not only about audiovisual quality and media file validity – it is also about metadata integrity. Like for audiovisual checks, a combination of automatic and manual controls can help with vetting the metadata. File structure (like XML scheme), presence of mandatory data, field format can all be validated automatically. Manual inspection is necessary to detect improper technical metadata (ex: audio tape running at “18 cm/s”) or misspelled comments about the transfer.

## 6.6 Post processing

A characteristic of massive migration is that, acting on the whole collection within a limited time scale, it does not necessarily to serve immediate repurpose needs. Thus, most organisations would not incorporate postproduction activities, normally intended for ready-to-exploit material. The reason is that, only a likely subset of the collection is going to be re-used (not knowing in advance exactly which part), so the post-production costs will be limited to the required content and postponed to the date of any emerging exploitation.

Nevertheless, there can also be reasons in favour of some post-processing being done as part of the migration process.

### 6.6.1 Recovering a complete copy from damaged materials

When source materials are seriously damaged and/or the equipment needed/used for the content playback are often in trouble, then it may be difficult to obtain a digital continuous instance from the transfer operation.

The preliminary result may be a set of sub-items with distinct or overlapping temporal portions and/or the video component distinct from the audio.

It is also possible that such a set of sub-items has actually to be obtained from distinct source copies. As part of check for completion, setting up the assembly of a complete copy is clearly a consideration.

This can be postponed, however the quality of information related to various parts is likely at its strongest now, as competencies and skills of specialists approaching the tasks are still available.

### 6.6.2 Basic post processing on exploitation copies

If the work is organised to also produce mezzanine or other copies for short term exploitation, then it should not necessarily be excluded to perform some (basic) post processing.

Within a massive process such post processing is likely going to be configured in a general way, for example by adjusting some characteristics to the target exploitation formats.

## 6.7 Original carriers after the migration

Disposal of the original carriers is a very controversial issue and is often not recommended by authorities dealing with audiovisual archives. However, if the decision of the disposal is taken, it must be done in a very open process, considering that there is no turning back after, and it should keep records of the criteria or protocol leading to it.

For a more in-depth elaboration of this issue, we refer to the bibliography of this document, but we point out the following three publications in particular:

- IASA TC 03 [3] in its chapter 9 points out the possibilities for future technical improvements in retrieving information from the physical audiovisual carriers. Thus, this document recommends the preservation of the carriers and the suitable reproduction equipment, whenever possible.
- Nijsmans and Declercq [24] propose an example of a decision-making framework taking a realistic approach, in which, without disagreeing with the principle that the audiovisual carriers should be preserved, it is acknowledged that there are cases in which this principle has to be left behind.

- The position paper of Memoriav [25], eventually enumerates a set of strict conditions which are required for disposing original carriers before they become unreadable.

Without claiming to be exhaustive, the reasons for keeping the carriers in the long term include the perspective of a new migration in the future by other means, or because of errors during the first one, provided that suitable playback technologies will be available and that the physical condition of the carriers will allow this; potential legal constraint or uncertainty about the ownership of the carriers; to ensure testimony of the past, for museal purposes.

Admittedly, the most concrete reason for disposal is to avoid the costs of keeping both the carriers and the playback equipment in good condition. The strength of this argument is proportional to the number of carriers. It can be understood that, for some formats, the aim to keep enough playback devices in the long term is considered practically impossible. Thus, even supporting the principle of the indefinite preservation of the carriers, the awareness is starting to catch on that this is realistic only for a limited time, which could be many years but not unbounded.

A tender for outsourced migration of audiovisual carriers should mirror the plans of the tendering organisation. If there are plans to keep the carriers for a shorter or longer period after digitisation, then the provisions for storage and transport must be adapted accordingly.

If the service provider is assigned a role in destroying the carriers, then there are also necessary provisions as well:

- a clear identification of the concerned carriers;

- a check of the completion of the workflow including a quality control report and authorisations;
- respect for waste disposal regulations and environment friendly treatment;
- a verification of actual erasure and disposal, for avoiding illegal trafficking.

Eventually it must be acknowledged that a decision by the tender organisation for disposal of original carriers immediately after the transfer raises a great deal of potential risks, if for no other reason than the possibility of mistakes.

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