Metadata

in the audiovisual production environment

An Introduction

by Annemieke de Jong

First edition in Dutch, Hilversum, the Netherlands 2000
First edition in English, Vienna, Austria 2000
First edition in Spanish, Mexico D.F. 2001
Second edition in Spanish, Mexico D.F. 2003

'Metadata in the audiovisual production environment' is a fully updated and revised version of former editions.Text by Annemieke de Jong, head of the Dptmnt of Information Policy, sector ICT, Nederlands Instituut voor Beeld en Geluid; member of the Media Management Commission of the International Federation of Television Archives (FIAT/IFTA). Illustrations by Miranda Thurlings, Dptmnt of Information Policy, Nederlands Instituut voor Beeld en Geluid.

Definitio sit de uno et omnia

St. Thomas Aquinas (1225-1274)

Contents

1 Management of digital media

1.1 Introduction

In the near future virtually all major broadcasting organisations and producers throughout the world will be making digital productions. The tremendous development of network technology allows for the creation of an environment in which many - if not all - production routines will be performed digitally. Servers, databases and storage devices with digital media may be easily connected with all technical and (post) production services. For the audiovisual production environment, paper and tapes may well become rare objects. All this is still in a continuous flux, which makes it difficult to forecast just what the digital production process will really look like. One thing is quite certain: the rapid increase of digital materials in the organisation will lead to a major management issue. All documents and all processes that are related to their production and distribution will consist of indifferent zeros and ones. If there is no adequate data management system available, the authenticity and integrity of the information proper - and thus the quality of the final products – will be in grave danger.

Audiovisual archives have had many years of extensive experience in managing, cataloguing and making available ‘multimedia’ items. So far, the archives have mainly dealt with analogue collections, but the essence of rules and regulations for professional cataloguing should be relatively easy to transfer to digital collection management. It is in the archive that we find the required expertise on data structuring, identification methods and accessibility and the organisation may well wish to consult archives to help solving the information problem. Many principles and techniques that are applied in traditional archival management may easily be applied in the new digital environment. More than ever before, the experience and the expertise of the archivist will be called upon in future - it is safe to say that each and every person working in digital production may have to acquire some of the archivist's skills, if he is to find his materials and if he really intends to get working, after all: digital production will automatically imply a form of archiving.

1.2 New issues

Yet there are more issues than these that can be addressed by the existing professional knowledge. These new issues are a consequence of the particular features of digital media that will be distributed on a large scale, such as migration of collections and processes; interoperability standards for the network; compatibility of media systems; (semi-)automatic indexing; digital storage issues; new customer services, and so on. These matters demand new expertise and the need for a ‘digital’ translation of existing skills.

A subject like metadata may illustrate this. The concept of metadata demonstrates how classical, established rules and principles are adapted to the management and the distribution of digital files, and may take on an entirely new significance. It is essential for audiovisual archivists and librarians to keep abreast of these effects, for in the end it is to them that users and organisations will often turn, expecting them as information managers and professional end-users to know their way in the world of structuring and retrieving digital multimedia.

In the digital production environment the automated systems will hold a key position. All company procedures will be executed from one platform of connected media and information systems. Each and every element of the process – be it sound records, moving or still images, scripts, translations, financial information or progress records - will in the end be part and parcel of the huge virtual system, that is the basis for information and documentation, production and broadcasting, archiving and access. In this network the work processes of technicians, IT specialists, programme makers and archivists will converge, and consequently the old and well established borderline between ‘technics’, ‘technology’ and ‘content’ will blurr. These professional groups will have to collectively formulate the specifications for the future systems. This being the case, it is necessary to decide on one single communication language that is universally understood and may be interpreted only in one way.

The need for such a language is illustrated by the various interpretations that are given to the concept of metadata. The entire broadcasting staff- be it producers, journalistst, technicians or archivists, seem to regard ‘metadata’ as a vital part of the future work.

But the numerous analogue and digital processes they take part in, obviously are still a hazard for communication. It will be essential to jointly analyse the various uses and meanings of metadata, so as to contribute to a more precise definition.

1.3 Tapeless production

We may expect that production, distribution, broadcasting and archiving of radio- and television programmes within one digital network - what is called 'tapeless production' - will rapidly increase both in size and in complexity. The digital production of news bulletins, current affair programmes and other items in the daily schedule are coming first, followed closely by other programmes. This will create a situation in which an infinite variety and considerable quantity of digital information will in a sense be permanently circulating on the network. Obviously, strict control measures are called to keep the information flowing and to identify each and every element wherever and whenever necessary.

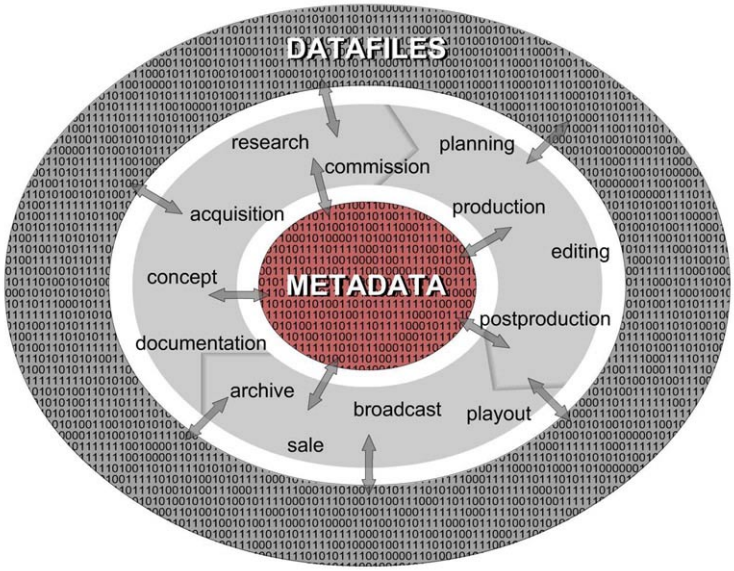


Fig.1 *Dataflow through the various stages of the production process.*

Such control consists of a detailed information structure that directs storage, distribution, production and archiving of the digital data, and at the same time defines form and content of such items through protocols, standards and regulations. This structure has to be maintained so as to safeguard accessibility and availibility of documents at all times. At the same time the information structure may improve the efficiency and access conditions, in regard to the internal digital work processes and thus increase commercial exploitation of the materials. An adequate information management system will have to be geared to the specific requirements of the broadcast organisation it is used for. Secondly, the necessary protocols and standards should be moulded as closely as possible on international protocols and standards.

1.4 The digital production cycle

The infrastructure allows in the near future the creation of a digital workflow, which may be defined as the connection of individual units in the production chain. By linking systems and subsystems, the main phases of the broadcasting process -being pre-production, production and acquisition, postproduction, distribution and storage, emission and archiving- will form the component parts of a virtual integrated system. In each of these phases items such as video, audio, graphs, stills, texts or any combination of those will be produced. This is the logical consequence of the programme creation process, that covers the gradual materialising of a programme concept coming from producers or programme makers through to planning and pre-production, technical departments, editing and mixing systems - to final play-out and archiving.

Stages, processes and sub processes in the production environment, that will be linked and integrated :

1. Pre-production	2. Production & Acquisition	3. Post production
Scripting **Music composing** **News assigment (event)** **Planning and design** Storyboarding Location research Budgetting – Contracting Sets, props, costumes Modelling	**Live news/ sports** **Live production** **Video/audio recording** **Film shooting** **Graphics** **Animation** **Motion capture**	**Editing** Offline- field- and filmediting Sceening and workprint **Composition and manipulation** Keying, paint, rotoscoping, colourising Realtime graphics Multiple linear M/E online editing **Sound** Dialogue editing Mixing and effects editing Mixing, audio sweetening and recording **Multimedia authoring** Premastering, assembling, linking, encoding, bit-budget allocation **Film negative cutting** **Foreign language dubbing, titling, subtitling, captioning**
4. Distribution & Storage	**5. Emission**	**6. Archiving**
Routing, client/server access **Receiving feeds**, Internet download Archive retrieval, interfacility-transfer, relay, backhaul **Standards conversion** **Quality control** **Asset management** **Uplinking**	**Playlist preparation and log- creation** **Wholesale delivery** Uplinking Cable headends Satellite headends **Broadcast** **Commercials insertion**	**Nearline storage** **Long term storage** **Deep archiving** **Asset management**

With each step in the production cycle new information will be generated. The video and audio materials themselves, will continuously undergo major and minor changes and adaptations, and various supporting documents will be created along the way, both on paper and in electronic formats. This information will all be (temporarily) stored in distributed databases. The end product - the edited programme and the documents pertaining to it - will end up in the archive, where yet again information elements will be added: the catalogue description. This process is not linear; indeed, routines will often be carried out simultaneously and overlap. The process may also have a circular shape, e.g. when the draft programme results from archive research and when archival data is recycled into the production chain, as is the case when footage is re-used in new productions.

A digital network offers the possibility to link all programme related information and enter the data into the system *just once*. Ideally, this digital workflow contains a constant flow of bits and bytes, that defines clusters of media-objects irrespective of the original framework. Each data cluster becomes a separately stored ‘object’ that will be detached from its origin and may be retrieved and (re)used in different, flexible configurations time and again. Semi-products, complete programmes, stock footage, unstructured and edited texts and many other ‘objects’ will be available at any time and place through the network, in a continuous flow of retrieval, editing, transmission, cataloguing, storage and again retrieval.

The tapeless production environment interrelates the formerly separate processes and smoothly integrates software, working procedures and production tools. In the ideal setting, the entire digital content can be accessed from any PC-station with the appropriate client-server software. A uniform, transparent storage construction provides optimal access. Because the content can be relocated by way of its intrinsic characteristics, the user does not need to be aware of the divergent conventions to approach the various files and directories. Large scale re-use is facilitated by storing the content in various flexible formats, that may be easily converted to production or distribution standards.

Wherever applicable, the status of copyrights related to the material can be clearly indicated, and unauthorised use of the materials may be prevented by firewalls and other protective protocols.

1.5 Media asset management

If the new developments offer many advantages, they do require strict management to become operationally effective. Media management provides the framework for both the information and the technical architecture of a network. Media management, also called 'media asset management', controls

- Storage of all digital content (individual or clustered media objects, also called media assets).
- Applications for processing and cataloguing the content.
- Applications for searching and retrieving the content.

The media management system controls the servers, the databases and the network itself. It also controls the actual processing of the information, including the many automated, standard procedures such as conversion, indexing and selection routines. It finally controls the digital information itself and manages the media content that is stored in the databases. The system arranges the information in such a way that all is grouped in data files and may be retrieved easily. With the help of various document management techniques all media objects may be identified and traced through their entire lifecycle, from their creation through to their storage or removal. In short, media management aims at establishing and maintaining a logical internal information structure, that is foolproof in safeguarding the authenticity and the integrity of data itself, as well as of data *concerning* those data.

A media management system may be used in three ways:
1) for *input and storage* of the content in the (central) storage facility
2) for *relocating* the content by way of a browser on the PC-network
3) for *usage* of the content during editing, routing in the production process, electronic distribution and cataloguing.

In some cases materials to be input in the system are only available on a physical carrier. If so, they will be converted into a digital format, e.g. by scanning or encoding. During the process of digitisation and compression, elements for identification and other characteristics may be added either manually or automatically. The media management system will store this information and the content itself in a such manner they stay virtually connected. To retrieve media objects the user consults the database, specifying what he needs. The query results in a number of content summaries with (in the instance of moving images material) a selection of keyframes at browse quality level. From this information the user may make his final choice and download the selected shots or sequences in the desired resolution. The object may then be processed: edited, transmitted, catalogued, send on to another user in the production chain or plugged into a different electronic distribution channel.

In the following five stages of media asset management development, identified by Cap Gemini, the commercial benefits of media asset management are emphazised, regarding the use and re-use of archive materials:
1. *Media assets stored* in a warehouse called archive. Finding anything depends upon the knowledge the archive staff. There is little re-use of the material and no scope for revenu generation.
2. *Media assets organised*: A manual catalogue or index opens the archive up to internal re-use and even some limited external sales.
3. *Media assets utilised:* A simple computerized catalogue or index (probably separate systems fo video, audio, stills and texts) enables reactive sales and brings inevitable pressure for company accountants to incerase revenu.
4. *Media assets managed:* An integrated catalogue and enhanced functionality on the search workstations enables pro-active sales and genuine revenu growth.
5. *Media assets fully epxloited:* Multi-user access to an integrated catalogue and digital storage systems allows for the opening of new markets for selling the material.

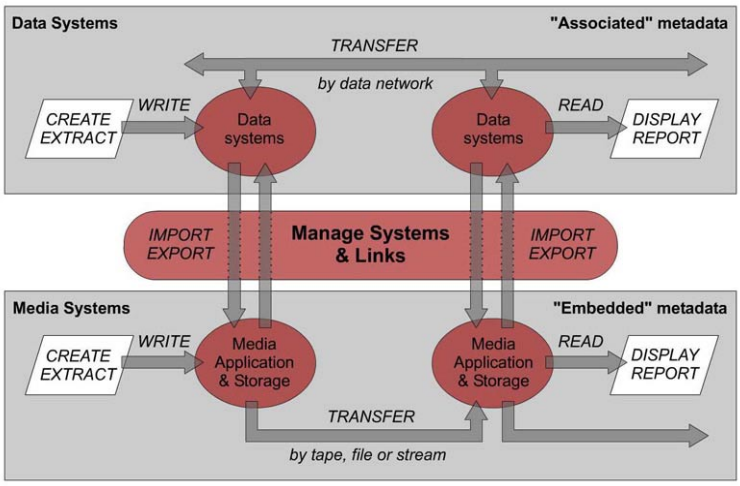


Fig.2 Media management as the heart of the production process.

1.6 Functional requirements

Effective management of complex media within a professional environment requires specific functionalities of the system, and is based on a thorough rethinking of traditional file management principles and routines. Bulldogs' technology specialists have formulated a number of functional requirements for media management systems, that may illustrate this point:

- The system has to be able to register each media object (the *internal assets)*. It will respond to all types of media and must be designed in such a way that it will support future types also.
- The system must deal with digital materials as well as with non digital materials (this is particularly important for media archives or libraries that also hold analogue materials, the so-called *external assets*. These materials have to be managed, identified, catalogued and stored in a such way, they can be an integral part of the digital environment).
- The system is to support the indexing of all characteristics and features of the media objects, some of which (like file format, colour and number of frames in video) may be extracted from the materials themselves.
- The system must be able to use the content of the media objects itself, for querying the database: it should facilitate *content-based* searching.
- The system has to be able to automaticaly generate indentification elements for every media object, in addition to the identification elements that the organisation may wish to add manually.
- For very large media objects, the system will produce browsing copies (in the case of limited bandwidth, high resolution versions of the media object may be stored near online or offline, while the low resolution copy is kept available online).
- The system shall be able to transfer media types from one type to another, depending on user requirements and PC facilities (MPEG-2 to MPEG1, JPEG to GIF etc.).
- The system shall register information regarding copyrights, re-use conditions and user authorisation for each media object.
- The system must be able to regroup any composition of media objects into given hierarchical classifications, without duplicating the data (as is the case in 'traditional' file management) .
- As media objects evolve throughout the course of their existence, the system must be able to generate tree structures to arrange and classify the differing versions.
- The system will register and support every stage of processing of the media objects throughout the production workflow. (http://www.bulldog.com)

1.7 Significance of metadata

These functional requirements can help to make a choice of the 'hard' components of the system: the hardware, some of the software and the infrastructure for the network. At the same time an organisation will need to arrange all digital production and archiving processes according to one and the same information model. Overall, transparent rules and protocols should be set to enable the interoperability and compatibility of all distributed files and databases in the organisation. This is indeed a *conditio sine qua non* for digital production.

Formulating data definitions, data formats, indexing and cataloguing rules therefore, are an integral part of media management system building. All structures and guidelines for input, mutation and accessibility of digital files, including their relevant information, have to be defined formally. Compliance with the conventions will be a matter of permanent attention and control. Special efforts should be made to make such rules cover as much (local, national and international) production areas as possible so as to enlarge the scale of information exchange. The system will have to consider connecting with other, different environments by using open standards.

The road to well-organised production, storage and exchange of digital media content is paved with *metadata.* Metadata are the single most important instrument to realise an effective and consistent audiovisual production environment. Their significance in this particular domain can hardly be overestimated. It highly exceeds their role in the world of 'traditional' data indexing and retrieval techniques for written texts. This is due to the vast number of different business processes, media types and search criteria related to the many applications in the broadcasting organisation. It is also connected to the divergent query paradigms in this domain: 'exact match' queries for instance, are consequently of no use when searching collections of many different digital media types. Finally, audiovisual materials at large are much easier to analyse and enter by way of the related metadata, than from the content itself. Audiovisual collections tend to be voluminous and retrieval techniques based solely on the content do not work properly. They need the addition of generic, abstracted characteristics that can be quickly retrieved.

As has been observed earlier, there are many different systems that have to communicate with one another in a tapeless production situation; they relate to programme and planning information and archival catalogues, as well as to digital newsrooms, editing systems, servers, play out devices, to name but a few. For communication between these existing and future systems in the audiovisual field, metadata function as the key tool. Without metadata no exchange of digital information whatsoever will be possible.

2 Aspects of metadata

2.1 Definitions

In Chapter 1 metadata as a collective concept was used to indicate the guidelines for structuring information. Metadata are also often described as ‘characteristics of information sources’. The most concise definition of metadata is: ‘data about data’. One could be tempted to think that the concept has come to replace the traditional title description or catalogue entry. If so, are ‘metadata’ not just about identifying and structuring information so as to make it available, an area all too familiar to librarians and documentalists? This is only part of the truth. Metadata in fact form the attributes that identify and structure elements of information sources, but these elements explicitely refer to *electronic sources that are available within a network*. Like the more traditional instruments, metadata presuppose transparent and consequent guidelines, standards and specifications. Due to the scale by which the information is distributed, overall standardisation of the metadata is essential. Metadata in a digital environment imply general agreements on many issues and practices.

Metadata and standards formulation depend largely on the area or discipline that they are used in. Many such areas can be found in the Internet, - medical data; library information; games; e-shopping and audiovisual catalogues. Per domain the metadata may serve various and different purposes: they may help to determine the relevance of information related to a particular query; they may analyse the characteristics of a set of information, or they may transfer information from one system to another

Within the audiovisual area, the concept of metadata is subject to different interpretations. On the one hand, IT would consider metadata as pertaining to information systems, including data models and technical architecture. In this sense metadata are really information types, their form, characteristics, classification, storage and structure. Version management, integrity and performance are also parts of this concept. IT within the broadcasting environment interprets metadata primarily within the framework of media management, i.e. as information that focuses on media content identification and analysis. In audiovisual production, metadata are then logical data items and the manner of their classification, as related to programme materials and the way they are processed. Broadcast engineers have cast this appropriate definition: *content* = *essence* + *metadata* (where essence is the audiovisual item itself).

Information analysts will often think of an additional layer - 'metadata' for them, refers to information regarding the structure of metadata proper, that again refer to the digital content. Perhaps the multiple interpretations of the concept of metadata in the audiovisual world are caused by the technical specialists who ask *what* can be found in the fields of a metadata list, as opposed to the information specialists who ask *how* metadata fields are defined and structured. If we were to be strict we ought really to coin the term 'metametadata' for the latter, if such a new term would help clear up the confusion.

Because conception, need and usage of metadata differ so widely, general definitions of metadata may fail. It is therefore essential that each organization defines precisely what constitutes its own metadata. Within a given context, a clear distinction must be made between data and metadata and the full extent of metadata -i.e. all the metadata necessary to describe the data fully - must be determined.

2.2 Purpose and categorization of metadata

It is not sufficient for users to have access to data, without the information needed to understand or interpret the data. All organisations that produce information, have an obligation to produce the metadata necessary to make this data accessible, both for their internal and external users. Metadata is the information which makes the data understandable, managable, and shareable over time. Through networks, information objects and their metadata can be made available together. As long as the metadata remain accessible, the information objects can be used and re-used.

Metadata are *always additional* to the document content. They form the characteristics of that content, describe its processing and are therefore closely related to it, albeit without being part of it.

Information regarding the content may by subject to continuous change without the content itself changing. In the main, metadata are used *to find* materials that correspond to the users search criteria*; to identify* an information object; *to select* an information object and *to obtain access* to an information object. Organizations produce different kinds of information, and therefore have different requirements for metadata, but a general classification has much in common:

- **Descriptive metadata**: metadata used to describe or identify information resources; information needed to understand or use the data.
  Examples: catalogue information, annotations by users, authority files, thesauri and other specialized indexes.

- **Technical metadata** : metadata to how a system functions or metadata behave; the characteristics needed for computer programming and database management.
  Examples: file locations, storage media, database schemas, data dictionaries, digitization formats, compression rates, authentication and security information, tracking of system responses.

- **Administrative metadata**: metadata used in managing and administering information resources.
  Examples: acquisition information, copyrights, location information, selection criteria, version control, preservation information, use and user tracking.

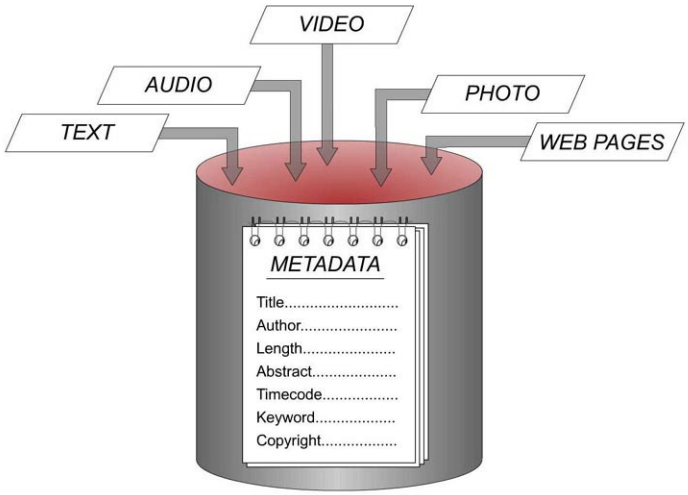


Fig. 3 *Descriptive metadata and the data they describe.*

2.3 The organisation of metadata

Metadata not only identify and describe an information object, they also document how that object behaves, its function and use, its relationships to other objects and how it should be managed. Defining, structuring and organizing the metadata is indeed necessary, in order to ensure that different kinds of descriptive metadata are able to operate with metadata from technical systems, from administrative and management systems and from production- and copyright systems. For efficient and effective use of information objects, metadata should be organized formally. A metadata specification consists of two fundamental components:

- a flat list of metadata elements: the metadata dictionary.

- the arranged order of the metadata elements: the metadata structure.

2.3.1 Metadata dictionaries

Metadata about information objects, recorded in different systems within different environments, will need to be capable of being communicated in many different ways. Metadata must be shareable, so there should be a general understanding of its meaning, usage and representation. For a query to be effective, those who create metadata and those who use them for searching or adding to, will have to speak the same 'metadata language'. This presupposes the common use of definitions. Definitions of metadata elements must be documented and made available in a metadata dictionary: a central and controlled information resource, that lists and defines all metadata elements, including their naming, definitions, identifiers, values, where and how they are used and their relationship to other metadata.

Metadata elements serve as attributes or properties of defined *entities* within an information domain. An entity (in WWW terms often called 'resource') can be seen as an information object, i.e something that can be identified, described and processed. In a dictionary, the metadata elements are structured in categories, types and fields. Categories may be 'descriptive', 'technical', 'administrative' etc. Each field belongs to a certain type (text, numerical, alphanumerical) and contains an attribute of the information object itself, or of its content, for instance 'length', 'title' or 'keyword'. The fields all have at least one value. A value can be characterized as the instance of a field. Some fields may have multiple values, e.g. a description field that is available in different languages. Each metadata element can have different roles, according to its context. Metadata elements can function as attributes, types or values or as entities, which in turn have their own attributes and types. For example the element 'name' may be an attribute of an entity 'person' or it may be an entity in its own right, with attributes such as 'type' or 'language'. A metadata dictionary will have to be commonly and effectively used in conjunction with description rules, thesauri and controlled vocabularies, that specify the values of the fields.

2.3.2 Metadata structures

The more highly structured metadata are, the more that structure can be exploited for searching, manipulation and interrelating with other information objects. Effective organizing of metadata requires an underlying structure: a metadata model or schema. A metadata model is a (graphical) representation of the arranged order of the metadata-elements, that are compiled in the metadata dictionary.The metadata model defines the hierarchical and associative relationships between different components of an information object and their attached metadata, according to the internal structure of the objects themselves and the way end-users wish to approach the information.

Metadata structures shape the basic elements of informational design, and may cover many different aspects of content creation and management, storage and delivery processes. The development of a metadata model may depend on the kind of information object that is being represented: diverging structures may apply to for example books, stills, video, film and recorded sound documents. Using the same definitions from a common metadata dictionary, different schemas may be developed for different purposes: to support the *processing* of information objects and metadata (the creation, capturing, editing and versioning), to facilitate the *exchange* of this content (between users, departments or organisations) or to actually *store* the information (in archives or repositories, temporarily of permanently). For each of these approaches specific modelling techniques may be used, like SQL (for the storage of metadata), object-orientation (for the processing of content), XML (for the exchange of metadata) or a combination of these. To support the various business processes within organizations, methods will have to be designed to effectively map and combine the various approaches and techniques.

<Indecs> the European community of metadata copyrights owners (www. indecs.org), has formulated a few fundamental principles that underlie the development of well structured metadata.

- *Application independence*: *metadata structures should be independent of any application or technical platform.*
  In general, metadata structures that are shaped by technical rather than semantic contraints, will be less than optimal. It should be noted however, that in the end technological differences must be resolved at the point of interoperability, since they cannot be wholly anticipated at the source.

- *Modular dependence*: *the metadata of any user are dependent on the metadata of another user.*
  Metadata are made up of connecting pieces, created by different users, during different stages of the production, distribution and archiving process. A metadata structure can be viewed as a combined set of metadata modules, produced in different places and for different purposes.
- *Unique identification*: *all elements must be identified within an identified namespace.*
  The basis of shareable metadata are recognisable, unique identifiers. Numbers form the basis of highly effective distribution systems and apply at all levels. The use of controlled vocabularies for values and properties is essential. In well formed metadata the only free text properties of an entity are found in its names, titles and textual descriptions.
- *Functional granularity: materials should be identified only if there is a reason for doing so*.
  It should be possible to identify an information object, its identyfing parts and its versions whenever these need to be distinguished. The implication is, that a resource may have different identifiers for different levels of information. Application of functional granularity may depend on the type of resource, its location, its composition, its usage conditions etc.
- *Designated authority : the author of an item of metadata should be securely identified*.
  Well formed metadata must provide mechanisms for declaring the authorship and for authentication claims of veracity in any item of metadata.
- *Appropriate access* : *users will need acces to the metadata on which they depend*
  Everyone requires access to the metadata on which they depend, and privacy and confidentiality for their own metadata from those who are not dependent on it. In a distributed environment, metadata has to be accessible where it is needed, but in order to secure control of rights it is necessary to disclose and distribute information about the relevant copyright issues.

2.4 Interoperability

Undefined and unstructured metadata will be found deficient when it comes to the point of *interoperability.* Interoperability means enabling information that originates in one context (i.e system, department, process, organization) to be used in another, in ways that are as automated as possible. This implies combining and accessing information that arrives in a variety of forms, coming from many sources. Accuracy and effectiveness of the metadata created, must be able to survive intact, as it is exchanged across systems and networks. Different metadata fields and different metadata structures will have to be integrated across media types (books, audio, video), across functions (edit, catalogue, distribute, workflow) across levels of metadata (simple to complex), across linguistic and semantic barriers and across technology platforms.

2.4.1 Semiotics

The interoperability between systems is constituted by protocols and interfaces and is determined by semiotics, where four different and interrelated aspects are distinguished:

Semantics

Each element and each field may only have one single meaning, and all signs in a given field are to have only one interpretation.

Syntax

Syntax determines the rules for the digital coding of metadata elements, so as to produce overall consistency in the field names and values. A well known example is that dates are to be recorded solely as ‘yymmdd’. Formulating the syntax requires a high level of standardisation and consensus, as protocols are defined per element: systems either communicate or do not communicate.

Structure

The structure, model or schema establishes the details of the metadata elements and their organisation: definitions, values, positioning, relations and constraints. Though structures may resemble the syntax, they also include the framework for the support of heterogeneous metadata so as to synchronise and map syntax and semantical elements in other structures (*what* is the name of *which* element in *what other structure*?). A structure may also handle different languages.

Practice

This aspect covers the practical impact of the metadata specifications on the user, taking into consideration the effect of the information and the way it is organised.

How does a user react to a certain rule, sign or guideline? If semantics have been properly fastened down, they will help establish a ‘best practice’ in defining syntax and structure.

In order to be interoperable, the metadata structure or schema must be interpreted by the systems themselves and consequently has to be machine readable. This concerns above all the elements within the schema, that define the metadata and their value contraints. When this information is available in a machine readable format, metadata schemas may include subelements or *qualifiers* that indicate what external schemas may be accepted, and what values are to be given to which metadata elements in them. In this way different metadata schemas can communicate. Systems that have not 'encountered' a specific schema before, may still identify its various metadata elements, and thus enable a succesfull interchange between different databases.

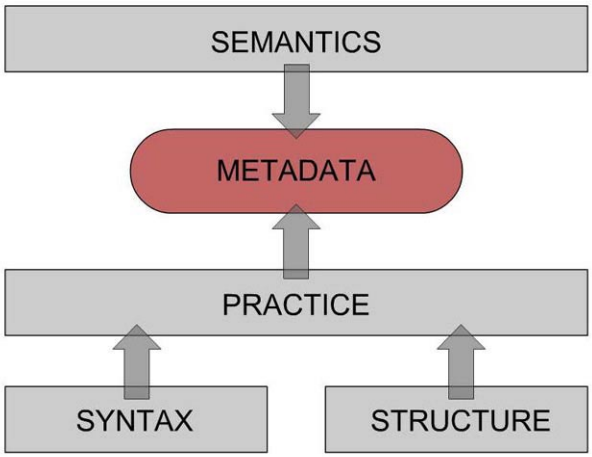


Fig. 4 *Metadata and the four aspects of semiotics*

A major problem in developing metadata schemas is the absence of supportive mechanisms that allow extension while maintaining the integrity of the original semantics. To be able to exchange metadata schemas on a large scale, it is necessary to centralise the registration and produce a common source for machine readable schema details. This requires an international registration of metadata structures, supervised and controlled by authorised groups or institutions.

The actual implementation and subsequent exploitation of central metadata registries has still to be worked out, the more so as general agreement regarding metadata standards has still to be reached. It is not likely that there will ever come one single, centrally registered metadata schema that may satisfy the demands of all users of the many different digital collections. As a consequence the (international) efforts are mainly concentrating on the enhancement of interoperability between environments, that work with different semantics, syntaxes and schemas.

2.4.2 Data interchange standards

Data interchange standards may help to define the interfaces onto which different metadata schemas can be transported across a wide variety of systems. Whatever technology is used, it must allow the information exchange to keep the original semantics and structure of the metadata. These standards offer a 'neutral' representation of the metadata elements and their arranged order. They are not concerned with the underlying semantics, only with providing a common, purely machine-readable way of carrying the defined elements across networks, systems and platforms. Data interchange standards thus establish the mapping interfaces between the definition layer and the technology layer of information systems.

XML
A well known example of a data interchange standard is the Extensible Mark-up Language (XML). XML is a metalanguage that may translate any kind of local and standard metadata schemas into a a common representation format, to be transported between systems and over the web. Opposite of HTML, another well known meta language, XML distuinghes form from content.

XML uses plain text to format the metadata and is platform independent. XML DTD's (Document Type Definitions) and XML. Schemas may convert local or standard metadata models into XML-structures, that can be be read by and exchanged (imported and exported) between various systems and databases. An XML document thus allows the user to retreive the structured metadata without the programme that has produced it.

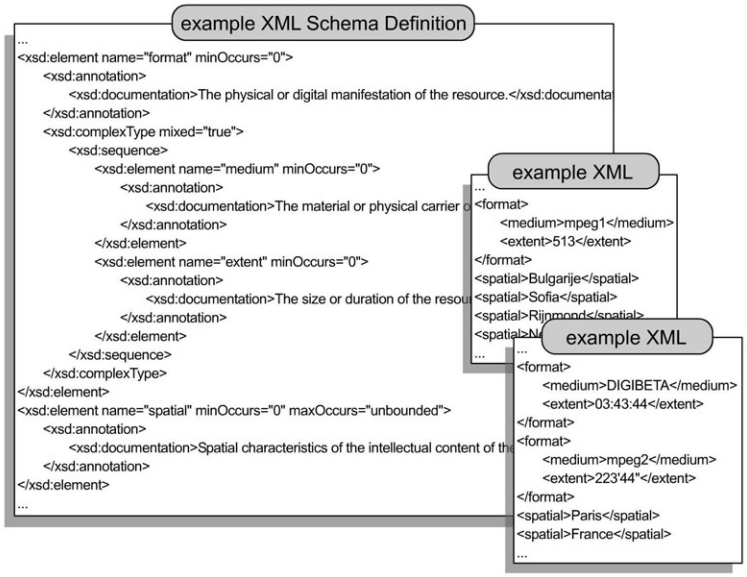


Fig.5 *Examples of an XML Schema and XML tags.*

RDF

The Resource Description Framework (RDF) functions as a global framework for interchanging metadata, and provides the groundwork for other standards. RDF has defined a high level metadata model and a syntax, that is expressed in XML. The RDF concept is based on three premises: independence (every community may use its own dedicated metadata vocabulary); interchange (RDF documents can be easily exchanged because they are based on XML) and scalability (RDF documents have a simple three-part structure and are easy to handle, even in large numbers). The RDF model is described by three object types:

-A Resource: anything that can have a URL.

-A Property: a Resource with a name that can be used as a Property (e.g. author, title).

-A Statement: consisting of the combination of a Resource, a Property and a Value.

RDF properties are attributes of information resources, that also can represent relations between these resources. They may come in sets or packages of metadata attributes that 'belong' together (for example a basic set of bibliographic properties). In the RDF terminology these sets are called Vocabularies. Specific property vocabularies may describe the characteristics of specific information objects e.g. books, video, multimedia, webpages etc. RDF doesn't define the properties themselves, only the mechanisms to define the elements of the Vocabulary, to name the classes of information objects they may be used with, and to restrict possible combinations of classes and relationships. Vocabularies based on the RDF Schema share a common structure. This allows the distributed creation and use of metadata by independent organizations.

KLV

An example dedicated to data exchange in the audiovisual environment, is the Key Length Value (KLV) protocol, that specifically facilitates the encoding of metadata and digital materials between production systems. The protocol defines a structure for representing data items and data groups. KLV is a special application layer within media systems, and supports a regulated encoding of any local or standard metadata schema and of audio, video and multimedia materials, to various compression standards like MPEG1, MPEG2, AES or other.

'Key' is a unique registrered sequence that defines the type of content that is to be encoded, 'Lenght' is the numeric length of the field (defined in a relevant metadata dictionary or in application and essence standards) and 'Value' is the data value. The KLV protocol is based on metadata definitions developed by **SMPTE** and **ISO** (see Ch. 4), but may also support proprietary metadata definitions.

2.5 Metadata and the audiovisual media

The metadata in professional production, distribution, broadcasting and archiving, are rather more complex than the metadata related to digitised textual information. Though some principles may be identical, image and sound materials, more than text, contain much implied, instrinsic information that again constitutes a separate group of metadata. This information is itself integral part of the video and audio and it can –as structured metadata- be derived and be used to support *content-based retrieval*. A digital production process also generates several quantities of technical and process-related metadata, used to facilitate transfer, internal and external distribution and storage.

The temporal nature of video and audio causes one of the most signicant differences between indexing text and indexing audiovisual documents. The abstracted, derived metadata which are added to the dataflow will always be variable, depending on the sequence or shot in the programme they refer to. Contrary to the 'stationary' information gained when consulting an automated text catalogue, searching a video database leads to query results, each of which is related to a different point in time. Metadata as related to the audiovisual production environment can be defined from various different angles.

2.6 The media processing perspective

2.6.1 Generation

In the production process, the first appearance of metadata is when they are created. This may happen at the level of the complete programme, frames, sequences or clips. Metadata may be generated in three ways:

- by automatic indexing of elements of the content (e.g. by extracting image elements in video, keywords in the spoken word and automated detection of programme genres).
- by implicit generation of elements during the creation and encoding of the shots (hour and date as registered by the camera, time codes and frame numbers when material is being digitised).
- by manual or semi-automatic addition of external information, such as catalogue descriptions, keywords etc.

2.6.2 Usage

The second part of the process is the actual usage. Metadata mainly serve as *indexing tools* to navigate, browse and retrieve. All television- and radio productions are documented throughout their life, and this documentation is stored in part or in whole for immediate and later referral. Metadata allow an efficient search of the dispersed information, to retrieve the actual items whatever may be their nature and shape.

Consequently, contentbased metadata can be used for queries by image and queries by sound (i.e. for items that 'look like' or 'sound like'). Catalogue entries and keywords may help in finding descriptive information on the programme content. Other categories of metadata may be used to answer to queries that are not based on the materials themselves, like its location, status of the data, copyright details etc.

Any production division as well as any other part of the organisation may choose to add its own dedicated metadata, such as proprietary codes or internal production and financial information. By travelling with the programme itself and its parts - while being used, added to or adapted whenever appropriate - metadata connect the various organisation units with one another. From this it follows that metadata can also be used to *manage* the distributed storage, distribution and archiving processes of materials at macro level and at micro level.

2.6.3 Storage and maintenance

Metadata, whether manually added or automatically extracted, have to be stored. They may be stored separately from the content they belong with, for instance a catalogue text in its own database. Embedded metadata – i.e. metadata that are an integral part of the media object itself, such as its *header* - are stored together with and indeed within that object. An important aspect of storage is *location*. All metadata in the production and archiving domain may be stored at one huge, central database, but to avoid continuous and laborious maintenance, it would make sense to store them locally.

Fig.6 *Identifying images with the help of automatically extracted metadata, in this case form attributes*.

The various departments in the organisation will then be responsible for their 'own' part of the metadata. The corresponding digital materials would be stored in central video and audioservers. However, in order to maintain the integrity and consistency of the information within the network, all rules and regulations for generating, adding and controlling metadata, would have to be authorised and supervised centrally at all times.

Audiovisual materials are bound to be changed and adapted in the course of their life, which means that the metadata dictionaries and schemas must be able to absorb changes as well: metadata shall be maintained. This implies not only flexible metadata structures, but also explicit knowledge of the schema and semantics of the metadata, and is consequently extremely labour intensive. Obviously, the embedded metadata and some of the technical metadata, will automatically be stored together with the digital files, as they are an integral part of it. Within the broadcast environment, the digital materials are dynamic and subject to frequent adaptations. Because it is not realistic to assume that embedded metadata will be adequately maintained, separate storage is prefered. This is also argued because of the practical impossibility in providing permanent *online* access to all audiovisual files and their embedded meta-information.

2.7 The metadata characteristics perspective

2.7.1 Media type-specific metadata

Metadata may depend on the type of media they relate to or are derived from, such as 'sample frequency' in audio, 'texture' in stills, 'movement' in video or 'type' in written texts. The more specific the media type, the more dedicated will be the corresponding metadata. Obviously, audio and video may generate specific metadata that do not work for text or stills, like musical sequences, that are automatically recognized in radio, and camera movements that are detected in moving images.

2.7.2 Media processing-specific metadata

Another type of metadata does not concern the content or type of media, but describes the functionalities needed to process media objects. This particular category relates directly to the media management system itself and is needed to direct, locate and link elements of the content. Content consists of the digital materials themselves (the essence), and of their corresponding metadata, both of which may be either in the same data flow and storage device or in separate ones. In the production environment the content has to be send through the network and for this purpose specific metadata is attached, that direct the way of transferring the media. Media processing metadata are part of the mechanisms that link the audiovisual files to the relating metadata, in order to effectively direct and exchange this content between the various system components. Special 'composition' metadata that are generated during the creating of materials, such as Edit Decision Lists and timecodes, are also part of this category.

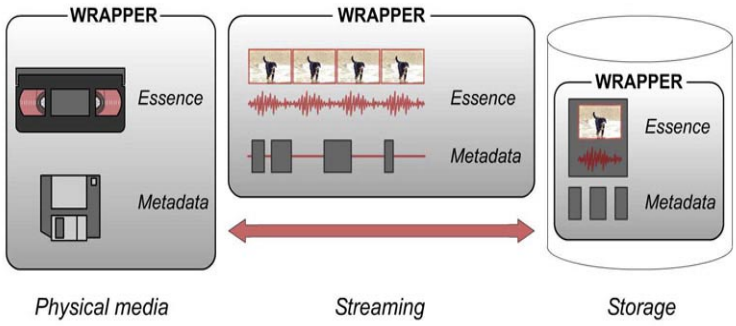


Fig. 7 *Wrappers provide the link between essence and metadata and hold them together.*

Metadata that are transported with the essence (like in a videostream) are 'wrapped'. The wrapping takes place at any moment in the production process the data has to be distributed, edited or stored as a - temporarily - integrated whole. 'Unwrapped' metadata are metadata stored in separate, distributed databases but referring to certain essence, stored somewhere else in the production chain. With the help of the wrappers, physical and digital media may be joined, programme materials may be streamed over networks and materials may be stored on servers. There are special metadata defining the 'wrappers' and structuring the bitstream. These derived metadata basically function as a kind of 'rubber bands' to keep document and related information together. Finally, the class of media processing metadata also comprises information related to media processing performance which may be used to measure and consequently achieve desirable system performance. Similarly, meta-information about the interoperability of system components is essential to deliver the proper application functionality

2.7.3 Content-specific metadata

Another, more 'classical' category contains content-specific metadata, that are then exclusively derived from the content of a document, independently from media types, functionalities, systems or process. Content-specific metadata can be subdivided in *direct content-based* metadata (e.g. full text indices) and *content- descriptive* metadata. In this category one may distinguish:

- *Objective descriptive metadata*
  e.g. author, title, duration of programme, dates of production and cataloguing.

- *Topical metadata*
  Description of (parts of) the content, the subject and the significance.
- *Additional metadata*
  subjective appreciation of the content.

Keywords are another type of content-specific metadata, and are mainly used as indexing tools. In a networked production environment keywords have to originate in an authorised thesaurus that is mandatory. Though content-specific metadata are on the whole generated manually and intellectually, this does not apply to the entire class. It is possible to use software that extracts certain metadata from the content directly, indexes them and transfers them to the descriptive metadata fields. A separate category of content-specific metadata is reserved for information that refers to the history, age or quality of the metadata. These metadata may be generated as a result of conversion or migration, when the original carrier is copied onto another format, and new metadata is being created in the process. To guard the authenticity of both carrier and information, the content of its differing versions and the history of their related metadata will have to be documented.

Fig. 8 *Many catalogue systems can automatically segment and index shots from digitized programma materials. Analyzing the semantic content stil demands human intervention*.

3 Modelling the digital content

3.1 Write once, read many

Throughout the entire production process the digital programme materials and the related metadata will have to be used and re-used, while at the same time it is necessary to maintain the principle of the digital workflow: *write once, read/edit many.* This may be realised once there is an information architecture that covers the entire organisation and is joined with a media management system that identifies, stores and presents digital data in one uniform manner.

A metadata dictionary and a metadata model are fundamental components of the logical datastructure, that underpin a media management system. In order to define these components two interrelated aspects have to be considered. In the first place the system has to be geared to the specific requirements of the audiovisual organisation it is used for, secondly, the specifications should be closely moulded to standards, as to enhance interoperability between organisations and to facilitate the exchange of audiovisual content on a larger scale.

3.2 Problematic issues

Presently, within the various audiovisual practices, numerous proprietary dictionaries and models are being designed.
1. Public and commercial broadcasters and independent audiovisual producers develop their in-house metadata specifications for setting up their digital production systems.
2. Project based specifications are being defined for several local pilots of broadcast organizations; for national projects, aiming at developing digital infrastructures and for international media-management projects within e.g EU funded IST programmes.
3. Vendours and manufacturers of media management systems implement their own metadata definitions, sometimes including (parts) of existing standards, added to with requirements from their customers.

Acknowledged by all organisations involved in the setting up of media-management system requirements, is the complex and time-consuming labour of structuring their metadata into a logical framework. Consequently, companies tend to preferably want to share work and base their designs on existing standards. It has become clear that the more authoritive standard metadata models do not meet every requirement in the field. Standards must be tailored for many sorts of content providers, technology providers, functionality providers and many types of end-users. On the one hand these models tend to cover only one specific aspect of the audiovisual domain, and have no provisions for applicabillity to one another. On the other hand, organizations have themselves too many differents requirements as to their data structures and formats, workflows and user demands.

Company-specific metadata models could encourage the media industry to adopt similar thinking and support solutions which are driven by user needs. Obviously, in terms of contributing to standards, interoperability and creation of common products, media organizations could more collaborate, to formulate user-defined specifications and develop advice for manifacturers. An obstacle for the development of common metadata models may be, that such models often reflect the businessmodel of the organizations. A metadata model must be seen as a high level strategic tool, and may hold detailed information on business protocols and working procedures. In view of copyright and commercial exploitation, the exchange of this information will be restricted. Consequently, the level of standardization will be limited and media organisations may only join forces to a certain extent.

Even within one company, or within the scope of one project, the variation in objectives, requirements and procedures may, may lead to obstacles in establishing a common metadata model. The obstacles could be identified as follows:

- Harmonizing the various user requirements within and between the production, archiving and distribution departments.

- Understanding and integrating the various catagories and types of metadata in the audiovisual environment, including media-processing metadata, technical metadata, production related metadata and descriptive metadata.
- Determination of the *universe of discours*: to what level should metadata and essence be processed and exchanged: on programme, clip and/or shot level? (the so-called 'granularity')
- Standardizing of the working processes (input procedures) within and between production, distribution and archiving departments.
- Standardization of metadata definitions, type fields and type values.
- The development of unique identifiers, to link the essence with the metadata throughout the production chain.
- The integrating of legacy archives and legacy catalogues into the digital environment.
- Identifying and structuring new and complex copyrights and protection issues.
- Integration of new ways of creation, (re) use, distribution and delivery of new media types (web materials) many of which cannot be envisaged.

3.3 An approach to metadata management

As part of the overall information architecture the metadata schema will serve as the central reference model for production, distribution and archiving processes, for core user requirements, and as a model to integrate media technology, analogue and digital collections and business systems. The primary need is for broadcasters to *understand* the issues. In a way metadata modelling is a technical discipline, connected to network infrastructures, applications and system interfaces. It requires a strong centralized vision and extensive knowledge of its formal processes and methodologies. Companies should undertake analysis of their in-house metadata requirements, and review candidate solutions among emerging standards. Often the company business processes will be so complex, that no standard can match it, in which case an internal model will be have to be build. Examples of relevant metadata frameworks already in use in other organisations, may provide a usefull starting point.

Having understood what is involved, broadcasters will then need to decide to what level they will define and implement internal metadata specifications, and to what extent they may adopt external standards. When full in-house system development is planned, internal standards may be applied, but chosing 'off the shelve' vendour products will imply a compromise between local system requirements and the manufacturers standard offer.

Broadcasters should expect to direct dedicated resources at the task of establishing a company-specific metadata implementation. It is advised that this work is anchored at the top strategic level of the company, drawing upon personnel possesing detailed knowledge of the production, distribution and archiving needs. A clear understanding of the business objectives of the work should be shared by all parties. Metadata modelling and metadata management will not be a stand alone project, but is an ongoing business activity, with a high impact on all work procedures. Organizations considering building in-house metadata schemas should carefully consider coststs and benefits. In many cases it may well be more expedient to supply high volume simple metadata rather than constructing highly expressive but expensive metadata models. This decision should be based on careful analysis of desired business objectives, datatypes, functionalities and economic realities. The following outline, set up by experts of BBC's Media Data Group, offers a possible approach to metadata development and metadata management.

3.3.1 Designing a logical data structure

1. Define the scope of the business requirements in terms of processses and systems to be connected. Identify and describe the datatypes to be processed, archived and exchanged.
2. Agree the standardization whether modelling logical data structures, or interface specifications for the exchange between systems and with other organisations and (outside) users.
3. Identify which metadata schema(s) should be applied in order to meet the needs of the content creator, the archive and the end-user and ensure that the metadataschemas applied will be the most current versions.

4. Set up an information infrastructure, comprising
a) Process analysis: identify, define, classify and structure all functions and data-input and output, required to respond to business transactions and
b) Metadata specifications: identify, define, classify and structure metadata, such as is used in all stages of the production processes .
5. Document the metadata to be exchanged, to provide compatibility between the local metadata, and metadata recorded as part of a standards; document the organizations' chosen approach in terms of the internal metadata standard or declared adoptation of (an) external standard(s).

3.3.2 Building a technical architecture

With the logical data structure and the metadata specifications in place, the next step is to take on the systems themselves. The organisation may wish to define a complementary technical architecture, that describes the strategy and the infrastructure for connecting and integrating new systems, legacy systems and the systems of outside organisations and users.

The overall technical architecture will allow interfaces to link all essence and metadata in the process of digital production, distribution and archiving. Existing and newly required technical interfaces and protocols for transport and transmission have to be identified and adapted to the logical data specifications. System solutions should be implemented in line with the logical data architecture and any divergence should be recorded and managed as part of the implementation process. While designing this technical infastructure it must be clear that both system- and software vendors and the broadcasters' own application developers, should be required to comply to the organisation's declared position in regard to the internal specifications and the use of external standards.

3.4 Formulating metadata specifications

3.4.1 The role of the audiovisual archive

Analyzing the metadata requirements and designing process models are a joint enterprise, involving content creators, administrative personnel, information managers, broadcast engineers, system analists and executives. A special role in the developments should be reserved for the audiovisual archive. Audiovisual archives that function in a professional environment render many services from their collections of analogue and digital materials. They are, additionally, important application domains for the development and implementation of metadata specifications. Archives have a vast expertise in classifying and storing important quantities of multimedia materials and in making them available. Data storage, data integration and making data accessible are indeed their core business. For the archive, metadata traditionally belong to the most critical and essential ingredients for cataloguing and accessing materials. Archives therefore, may be the prime sources of expertise and experience regarding role and effect of metadata.

Due to their strategic location in the organisation, archives overlook the production process from beginning to end. Archives have important knowledge of the various stages of the authoring process of audiovisual productions. The collections of metadata held in their catalogues and information systems for registration, inventorising and management may illustrate this. These metadata already cover an important part of the metadata used in, and required for production itself, including identification data, (copy)right status and content information. In other words, archives should be seen as important elements for realising an effective interoperable structure covering the entire process. In fact, the metadata from the archives, complemented with technical and media-processing metadata and other specific information regarding production and transmission, form an important basis for company metadata specifications.

3.4.2 Compiling the dictionary

Formulating metadata specifications will start from a broad inventory of all required in-house metadata. A dictionary must be compiled, documenting the name of each metadata element, its definition (size and type) and where and how it is used in the process. All metadata in the end-to-end production chain without a single exception have to be identified. Names and values of fields have to be collated, standardised, rubricised and classified to join the description rules in a metadata dictionary.

Because it should reflect the needs and profiles of *all* usergroups and types of usage, the complete set of all programme related information may well consist of a huge amount of data. In the end the metadata inventory will have to cover literally everything that happens with a media item, at any time during its life-cycle.

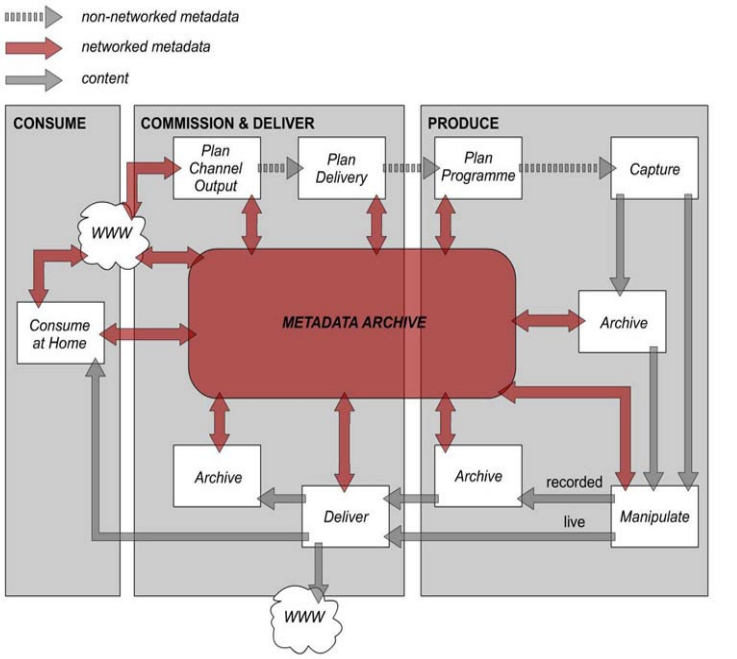


Fig. 9 *The life-cycle of all metadata and essence in the production process, must be identified, defined and described.*

Starting with the fields and the information contained in the various archive catalogues, other systems (such as new or existing information systems, production systems, editing and play out systems, newsrooms and copyright databases) need to be analysed and checked for their metadata. The information may be gathered through a network of key users, whose input is expected to add to the metadata standard list. The collected metadata will have to be analysed in regard to purpose and dynamics of the actual use in the digital environment. The most important metadata lists will be:

1. the basic list containing archive metadata (the micro level, within a department).
2. the joint list, being list 1 plus the metadata from the production stages (the meso- or organisational level).
3. the exchange list, being the minimum set of metadata required for information exchange (the national/international, macro level).

The joint list is in fact a series of subsets, each of which is specific for a certain type of use. While editing, a video editor will need different data, compared to what a programme maker wants to know when browsing through the archive catalogue, or the programme information the company's legal advisor requires when he is checking a claim. Obviously there will be many more different types of use that the digital infrastructure has to cater for. All of them need to be mapped in diagrams to define *what* is used *when, by whom*, as to identify everything content creators, distributors, system builders, archivists and end-users ever need to know about a media item, and to understand how that information is passed between process stages and departments.

This overall analysis allows the generation of a series of user templates, that are intended to enable in turn a dedicated use and exchange of production information. A template may be considered as an extract of the joint list mentioned earlier: for each group of users a specified metadata format may be derived from the common dictionary, to allow each authorised individual user to add, mutate or retrieve their own specific information throughout the production process.

3.4.3 Structuring metadata and essence

Many in-house metadata initiatives proceed with insufficient attention to underlying modelling principles. Failure to use formal principles may lead to attempts to express complex information, without a clear exposition of the information objects and relationships necessary for their description. Such informality may be appropriate for simple metadata, but lacks precision for detailed retrieval. One essential test of a metadata model should be the specificity of queries that it supports. The level of 'granularity' should be tailored to the level of detailling, in which users want to access the information. If the intent is to support simple general usage, then it is reasonable to build metadata formats as lists of fields and their appropriate values. Many users in the audiovisual production environment however, will need more advanced query semantics, which include fine-grained, dynamic combinations of metadata and essence. In order to support such usage, a metadata model must provide a logical foundation for *temporal* semantics and consistent links to all the persons, transactions and states involved in these semantics.

An audiovisual metadata model is a formal structure to describe and uniquely identify the logical relations between (groups) of metadata and the media files they refer to. This structure functions as a conceptual model of information objects and their relations, on which technical structures can be built. Interfaces may be derived from these models, for systems to be able to communicatie with other systems, processing and exchanging metadata and essence. A metadata model also serves as the foundation to the technical datamodel, that organises the storage of the information in databases.

The first step in the modelling is to define the key objects or *entities*, that are of interest to users in the audiovisual production domain. The analysis should focus attention not on individual metadata, but on the 'things' the metadata describe. Any entity in the domain, that is of significance to users, will have to be defined as part of the model. An entity diagram for a media management system would, for instance, likely identify 'programme' and 'broadcast event' as meaningful entities. An entity diagram also depicts the relationships *between* entities: a 'programme' will be associated to one or more 'broadcast events'.

Once the high-level structure for the entities and their relations has been defined, the next step in the methodology is to group the relevant metadata fields into the various entities. Every individual entity serves as a cluster of metadata, being the attributes or properties of that entity. For example, in the context of a media management system, the metadata associated with the entity 'programme' might include title, description, keywords, contributors etc. For the entity 'broadcast event' these may be channel, transmission date, broadcast format etc. As an extension, the modelling can also be applied at a more detailed level, to define the specific relationships that operate between instances of entities.

The metadata model has to logically connect the entities, relationships and metadata attributes to the actual (digital) essence. The model will arrange for its information elements to be linked to all corresponding media, whether it be digital audio en video files, or ' traditional' analogue materials. The first action is decide at what level the essence is to be accessed. Broadcasting materials allow different levels where essence and metadata may be linked, like series, programme, episode, item, sequence, clip, shot and keyframe. This again follows a decision regarding the desired level of granularity, given the different types of usage that are expected.The model will have to be able to consider a programme as part of a series, as one integral entity, and as a collection of items, shots and keyframes, which refer to media files or analogue tapes. All information has to be arranged in such a way, that the metadata and the connected essence may be retrieved at each and every appropriate level and that unique identifiers may refer back and forth in the proper hierarchical order.

3.5 Metadata frameworks for reference

For the audiovisual domain there exist various generic reference models for the logical structuring of metadata, i.e their grouping and their hierarchical and associative relations. These reference models cannot always be identified as standardization activities as such, rather they describe -on a conceptual level- possible solutions for the arranged ordering of metadata. The objective of these models may vary, as may the domain that is modelled, but they are all meant to function in the context of production, archiving, exploitation and exchange of digital content and to support the interoperability of metadata. In this capacity they may serve as important references in the process of developing in-house metadata specifications.

Below a short description of four different metadata frameworks, developed for library and archive catalogues (the IFLA-FRBR model), the production environment (the Standard Media Exchange Framework), digital rights management (<indecs>) and archive, library and museum collections (the ABC model).

3.5.1 The IFLA-FRBR model: multimedia catalogues

The International Federation of Library Associations and Institutions has in 1998 defined the IFLA-FRBR model (Functional Requirements for Bibliographical Records), that includes a bibliographical record as an aggregation of data, that are associated with the entities, described in library and archive catalogues. These data pertain to textual, music, cartographes, audio visual, graphic and three-dimensional materials. The model has a multilayered and hierachical structure, that can be easily specialised to describe specific requirements.

The IFLA-FRBR permits to distinguish different aspects of the same 'work': the distinct intellectual or artistic creation (the Work entity) the intellectual or artistic realisation of a work (the Expression entity), the physical embodiment of an expression of a work (the Manifestation entity) and a single exemplar of a manifestation (the Item entity). The relationships are defined as follows: a Work can be implemented as one or more individual Expressions; A Expression can be embodied by one or more Manifestations; Manifestation can contain several Items and an Item refers only to one Manifestation. The division into these related entities makes it possible -within a single catalogue description - to distinguish between the different types of publication channels and physical and digital carriers, that can stay linked to descriptive information regarding the same Work. IFLA defines a second group of entities, that represent the persons of corporate bodies that are responsible for the intellectual or artistic content, the production and dissemination and the custadionship of the entities in the first group A third group of entities represent the subjects of Works, classified in concepts, objects, events and places.

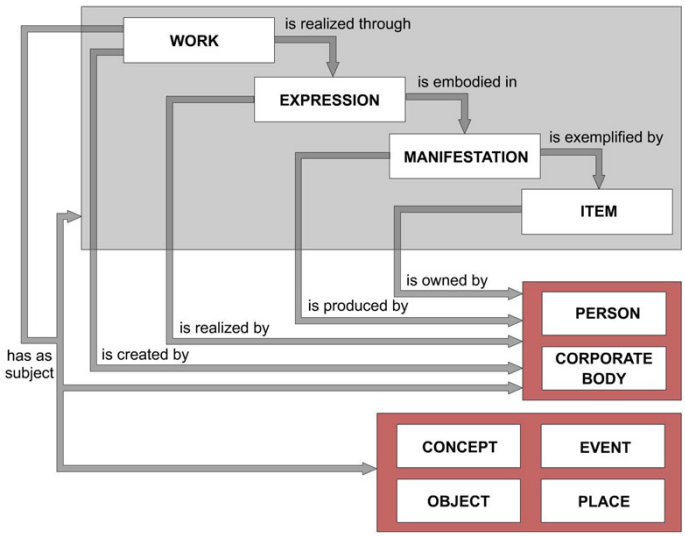


Fig. 10 *A general view of the IFLA-FRBR metadatamodel.*

IFLA provides a high leveled, logical metadata structure. It does not include or prescribe grouping, definitions of names, types and values of metadata fields. The generic features of the model make it very suitable as a reference for the digital audiovisual environment, where it can function as a conceptual framework for heterogenous media resources, and provide a multi-dimensional structure for several types of digital and analog audiovisual formats and distribution channels.
www.ifla.org/VII/s13/frbr/frbr.htm

3.5.2 The SMEF: production of broadcast programmes

BBC's Media Data Group has created the Standard Media Exchange Framework (SMEF) as a strategic tool for integrating its own information and media systems over time.

SMEF is developed on user needs in the BBC broadcast production environment, with an emphasis on exploitation of the content. The framework defines a standard set of metadata for programme-related information, covering pre-commission to delivery to the audience; the information changing hands at the interfaces, and the required outputs and inputs from one process to another. The SMEF gives a unified data structure for safeguarding information and eliminating re-entry of metadata into different systems throughout the production chain. This is accomplished through origination, exploitation and re-use of information, including the possibility to generate much of the metadata automatically, and to make it easier to identify material from the archive, that is relevant to making of new programmes, including the rights clearances that are needed for re-use.

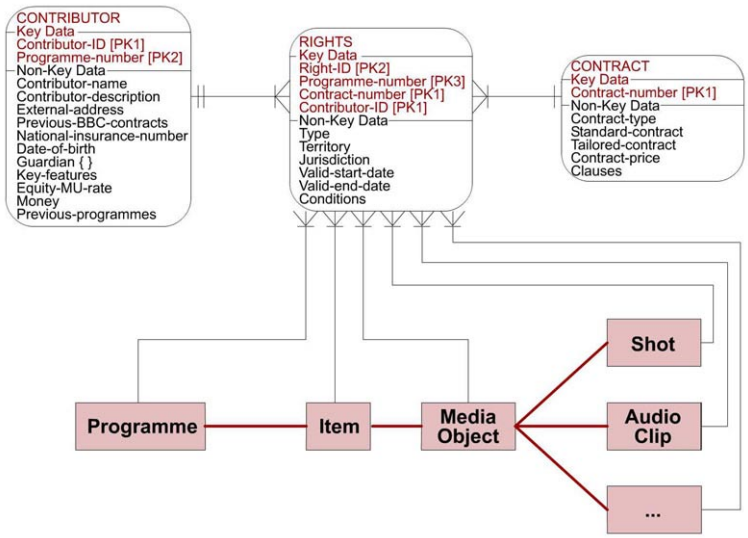


Fig. 11 *A part of the ERD of the Standard Media Exchange Framework.*

The SMEF aims to identify the existing technical exchange formats between information systems and between digital production and distribution systems, understand how electronic metadata might enable links between them, and design a target technical architecture. SMEF includes a metadata dictionary in which metadata attributes, and the entities into which they are grouped, are defined. The data dictionary forms a compendium of metadata fields with their definitions and BBC local synonyms; it is a list of all metadata on media items throughout their life-cycle, aiming at flexibility to cope with specialist terminology and future developments. The SMEF entity-relationship diagrams show the rules for the structural integrity of the metadata and media-files as represented by relationships between the entities.

The BBC's SMEF as a whole is not free licensed, only the so-called OpenSMEF is. Open SMEF defines the minimum set of metadata attributes required to exchange information between organizations (aspects of identity, content description, technical specifications and copyright matters). The BBC proposes for presenting the metadata elements from the OpenSMEF flat list, to use a tagged language such a XML
www.bbc.co.uk/rd/pubs/opendays99/metadata.pdf

3.5.3 <indecs>: digital rights management

Inspired by the IFLA-FRBR concept, a conceptual metadatamodel has been designed by <indecs>, an international collaborative project of copyright owners, founded to develop metadata specifications for the support of network commerce in intellectual property. The <indecs> model is a formal structure to describe and uniquely identify intellectual property itself, as well as the people and the businesses, the contracts and the agreements involved in its trading.

The focus of <indecs> is rights management. However, rights management is not a terrain seperate from other metadata. The particular legal aspects involved in the establishment and use of rights are intimately connected with the production, distribution, archiving, use and re-use of digital materials. The framework therefore also provides means for the interoperation of metadata belonging to these other processes.

The <indecs> framework comprises: a generic entity structure for all metadata; events as the key to metadata relationships; a metadata dictionary for multimedia intellectual property commerce, and the unique identifiers to be assigned to all metadata elements.

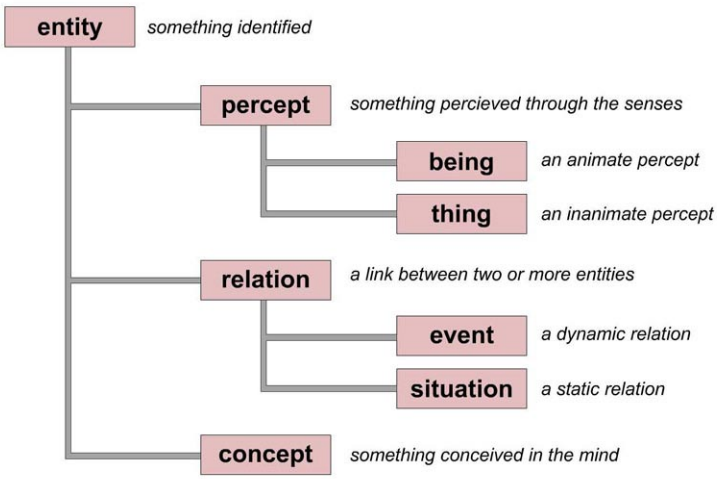


Fig. 12 *High level view of the <indecs> metadatamodel.*

The <indecs> framework is based on the assumption, that it is possible to produce generic systems to handle complex metadata for different media types like sound carriers, books, videos and stills. These media types are all recognized as *creations* with different values of the same higher level metadata. Heart of the <indecs> metadata framework is the commerce model. Commerce is defined in the widest possible way, to cover free transactions (social and educational use) as well as of commercial trade. There are three primary entities (people, creations and agreements), four supporting entities (events, time, place and rights), and eight links that join them. All thinkable metadata needed to support rights management, is part of one of these entities. The model has developed detailed characteristics of each of these entities, attributes and values, which form the components of data storage and data interchange. These metadata attributes include elements such as identifier, name, form, extent, role and subject. Many attributes have specifying, low level qualifiers that are included in the model.
www.indecs.org/pdf/framework.pdf

3.5.4 The ABC Ontology: archive, library and museum collections

ABC has been designed to model digital and analogue objects held in libraries, archives and museums and on the Internet. The goal of the ABC metadatamodel, developed with the Australian Harmony Digital Library Project, is to give guidance to communities beginning to develop descriptive vocabularies, and to provide for a conceptual basis for automated metadata mapping. ABC has deliberately designed a primitive ontology, so that individual communities are able to build on top of it.

System builders might use the ABC principles as the basis for implementing tools, that permit mapping across descriptions in multiple metadata formats. The modelling methodology of ABC continues to build on concepts from RDF. The initial version of the model has benefitted from collaborations with IFLA and <indecs>.

The ABC model formally defines common entities and relationships such as people, places, creations, organisations and events, to be extended to domain and application specific metadata vocabularies. The ontology can also be used to model abstract concepts, such as intellectual property and temporal entities, such as performances or life cycle events of an information object. For the acquisition, maintenance and presentation of museum, archive and library collections, the description of temporal transitions of an object is considered essential. The ABC model cleanly separates the various entities from the conceptualization of object transition. Its core intent is to model the creation, evolution, and transition of information objects *over time*.

Three categories of entities lie at the basis of the ABC ontology:

- Temporality (expresses the state in which object properties exist, the transitions that demark those states and the actions and persons that participate in those transitions).
- Actuality (encompasses categories that are tangible and concrete).
- Abstraction (expresses concepts or ideas, that are linked to the realisation and manifestation in the Actuality category).

These categories are again subdivided into several classes and subclasses, for which the ABC model has defined properties and subproperties.
http://metadata.net/harmony/lagoze_hunter_dc2001.pdf

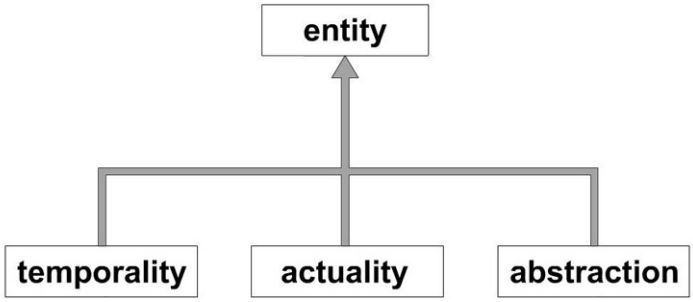


Fig. 13 *The three categories of entities that are distinguished in the ABC model.*

4 Audiovisual metadata standards

4.1 The horizontal market

In order to make sure that media systems can communicate with one another it is necessary to use common metadata definitions and therefore to have open standards. 'Open' implies that the standards are system independent, (freely) available and may be extended to fit local requirements. The use of standards encourages the spreading of data among organisations and professional and private users, so as to create what is called a 'horizontal market'. Standards are essential in controlling and exploiting both digital materials and metadata. They are needed for any type of exchange at any level, be it System to System (S2S), Business to Business (B2B) or Business to Consumer (B2C).

After having defined ones own metadata requirements - or preferably while doing so - they will need to be synchronised with internationally accepted standards. Whenever possible, local metadata specifications have to be mapped to standards from the start on. Failure to adopt international standards effectively means that local systems are inefficient and become more inefficient. Subsequent adaptation of local systems is extremely labour-intensive, and the gradual implementation of standards tends to be guided by technology rather than by user requirements. In this scenario the number of 'unique' metadata definitions and schemes would slowly grow, and the chances for interoperability on the S2S, B2B and B2C levels would diminish. Broadcasting companies could be manoeuvered into a very unfavourable position, compared to audiovisual organisations that are more experienced in e-commerce. Obviously, many local requirements can and need to be integrated into international standards, but there will always remain many elements of purely local importance, which may be taken on as extensions.

4.2 The standards domain

Metadata standards are being developed in various information areas. The realms of publishing, cultural heritage, education, industry, academic, government, geospatial, environment and audiovisual all can be seen to define their domain specific metadata. It is clear that the areas of publishing, and audiovisual production and archiving are linked to the area of cultural heritage. Industrial and audiovisual sectors too, cover some of the same ground. Evidently, in the digital multimedia domain, the conventional divisions, neatly represented by physical media types and their identifiers, do not apply to metadata standards which increasingly embrace *all forms* of creations. The fact that one sector is more biased towards text, visual, audio or audiovisual, is not a very useful distinction when it comes to designing metadata systems for the multimedia environment, in which *all* media types should be well described, irrespective of their predominance. In addition, metadata can be seen to become highly multifunctional.

Metadata related standardization in the areas mentioned, may be summarized as follows:

- Regarding the definition of a central registration structure that implements the mapping of different metadata schemes.
- Regarding the development of (software) tools with generic functionalities, to develop and use metadata repositories.
- Regarding metadata taxonomies and ontologies related to the characteristics of metadata and to the definitions of data elements such as designation of fields, types, classification and semantics.

Standardization activities can be subdivided into two classes: the old or 'pre-web' approach, and the 'web oriented' approach. The majority of the working, tested and viable standards is non-web oriented. The terms metadata and schema are generally applied to databases, in particular relational databases, which conform to different schemas. It will be needed to develop more tools that continue the quality of the 'old school' with the web-awareness of the 'new school', into products that can transparently work with content in relational databases as well as webcontent. Developments in the context of audiovisual production in particular, are not heavily webfocused at the moment. Although web-protocols can be transmitted using almost any physical medium, terrestrial broadcast, radio and video, metadata related activities here primarily adress the many types of non-web based content.

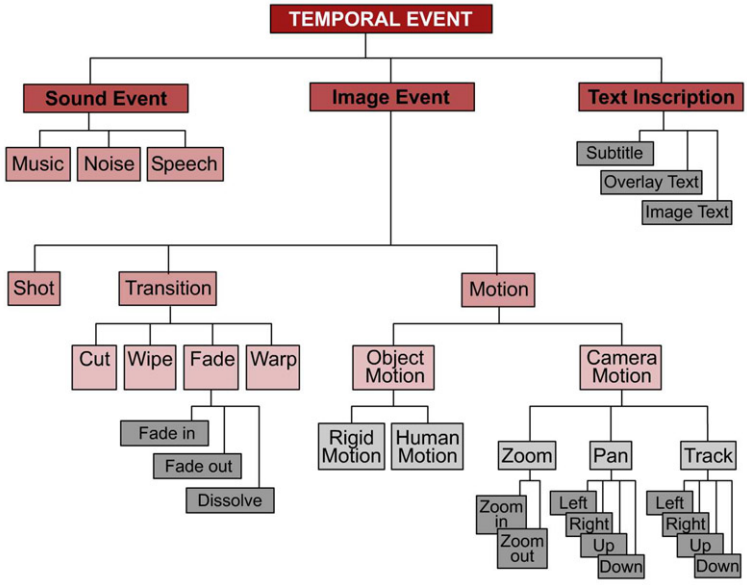


Fig.14 *Example of an ontology structuring the formal characteristiscs of moving image materials.*

4.3 Audiovisual metadata standardization

Audiovisual metadata standards are to support the production, distribution and archiving of video and audio materials, whether as terrestrial broadcast or via Internet protocols. These standards may be applied to broadcasting; audiovisual archives; multimedia libraries and image banks; to digital news agencies and interactive and Web-TV. Processes they adress are: capture and creation, pre- and postproduction, content identification and description, rights protection, exchange, and delivery and consumption. The work of the standardizing committees encompasses the various classes of metadata, be it media-processing metadata, technical metadata, production related metadata or descriptive metadata. It may aim at:
-Defining the semantics and syntax of the metadata.
-Defining the (relational) structure of the metadata.
-Defining the encoding mechanisms for their transmission.
-Defining requirements for delivery via broadcast or web.
-Defining inserting into a stream via broadcast or web.
-Defining the way applications access the metadata.

The objectives of standardizing these definitions may be to enhance:

- Interoperability between mediaformats and systems with automatic exchange of metadata.
- The semi- and full-automatic creation of embedded (wrapped) metadata within the content streams and files.
- The development of unique identifiers, to link the stored audiovisual material with the related metadata through the process of creation, delivery, use and re-use.
- The migration of the embedded metadata into unwrapped metadata, stored in databases, that can be managed and controlled over networks.
- Automated (formal and semantic) indexing, to be able to use image analysis, teletext information, speech recognition and sound analysis for extraction, searching, evaluation and validation of the content.
- Version management: the incorporation of different versions of the same document in different stages of the production process, as well as descriptions that cover different copies of the same document.
- Multilingual indexing and searching.

4.4 Standardization bodies

The standards are developed by specialised (international) institutions like the International Standard Organization (ISO) and the European Broadcast Union (EBU) and by the media industry. The contributions stem from the respective professional qualifications and commercial interests of the participants. Involved are broadcast organizations, producers, archives, broadcast-engineers, governmental departments, professional federations, software vendors, telecommunication companies and academic partners. The work is done both internationally and locally, and the dynamics and objectives are different in scope and effect. There are standards that concern themselves with all forms of access to, and (re)use of all digital content on the web, as well as for professional use, while others are dedicated to one single area. Some standarzation bodies aim at developing rather abstract conceptual frameworks, others generate very detailed metadata dictonaries.

The work is being executed in project formats, as part of regular business developments, as government programmes, as European Union funded initiatives and so on. Metadata development might be the core objective of an activity (e.g. the standardization committees), in other cases it is (inevitable) part of a smaller or larger digital (private or public) media project. The various ‘stakeholders’in the media field have differents interests here, due to industrial politics, commercial and organizational circumstances and professional ethics. Manufacturers would like to see nothing better than standards being developed as soon as possible, to be able to use them for their media management systems. The broadcasters, forced by the lack of implementable standards and the rapid migration of production processes, often work with either ad-hoc or proprietary solutions. The archive and documentation profession, with its vast experience in information management, prefers to develop standards gradually, after serious research and experience. The need to cooperate in standardization bodies may run counter to industrial and organisational notions of product differentation and confidentiality. The contributors must reconcile these conflicting motivations, as cooperation can benefit all players and create commercial opportunities

The membership of most standarizing commissions is highly technically. Despite the fact that the convergence of documentation and technology is extremely manifest here, the technical expertise generally exceeds the archival and 'documentational' know-how. Audiovisual archives is by far not evenly represented in most of the workpackages, even though subjects as migration scenarios, user requirements and datamodelling are highly documentation and archive fields. The level of understanding among members of some committees, of the issues and techniques associated with media technology, is not very even. A fair number of committees and bodies is very large and their list of required specifications is often so extensive, that difficulties can be foreseen in generating an implementable standard.

In the end most committees will have to come up with both an archive format and a common data format. It is expected of broadcast archives to play a big role in developing these formats, even though these archives have up till now not really done any serious work within this area. Matters that should be more adressed by documentalists and archivistst would be the storage of (embedded or separate) metadata, the development of unique identifiers and the various practical implications of standardization. Additionally, these professional groups could offer input as to matters covering quality control and maintenance of the metadata proper.

4.5 Metadata registries

Information on audiovisual metadata standards is directed towards professional communities and is often publicly available on the web. Not all of these metadata web sites can be defined as 'official' metadata registries, but most of them do offer detailed, structured information on ongoing standardization work. These sites should be seen as a publication context, for work on attributes (names, definitions, usage, syntax) and metadata schemes (for storing, processing and/or exchanging metadata and essence).

Although a few sites report about 'real world' experiences and usage concerning specific models and dictionaries, the emphasis generally lies on providing information on the theoretical work. The websites are usually set up and maintained by the organisation that coordinates the work.

The general objective of the sites is to inform the members and other interested parties alike, on achieved and/or ongoing work and thus contribute to the overall synchronisation of metadata. The sites may also serve as an interactive, virtual 'meeting place', that holds repositories of dynamic documents, each describing parts of the work-in progress. These documents may contain recent working output of working groups, as well as formal recommendations. Comments and modifications to draft documents may be processed online. The contributions, sent in by members, are collected, structured and integrated in new versions of the publications on a regular basis.

The approach to the public availability of the documents may vary. Not all the information on the sites can be publicly accessed. The access level usually depends on the stage the work is in. When documents are still subject to change, they may only be distributed for ballot. Only members may have access to these documents, in order to send in editorial responses, comments on outstanding issues and ballots. Some standardizing communities offer non-profit organisations and public broadcasters a free, online possibility to become an associate member. In other cases a company or individual has to become a (paying) member to access any document still under ballot.

4.6 Harmonization and consolidation

Over the last years, the various standardisation initiatives can increasingly seen to be co-ordinated at national and international levels. At the same time, organisations that produce audiovisual materials, have their own internal services work together much closer than before. Broadcast engineering, information technology and the world of documentation and archiving, are joining forces more and more to the benefit of quality levels all over. Professional platforms have been established (workshops, conferences, websites) where the research community can meet with the day-to-day practice of media organisations and the developments within the industrial circles, in order to exchange information and synchronize activities. Several European projects within the context of the IST programme adress metadata-related issues, and enhance the communication and coordination on organisational, national and international levels. Contacts between the projects partners lead to overall harmonization and synchronization of metadata vocabularies and models, and have a favourable effect on efficiency and interoperability.

In the next period an overall picture of the audiovisual and multimedia metadata landscape should be consolidated. Project and organisational implementations, relationships and possible combinations of solutions need to be assessed. To support cross-fertilisation, the results of the different implementations must be more widely published. It is necessary to ensure that each player in the media-management field, be it media organisations, projects partners or commercial technology providers, stays aware of the choices of other players and incorporates harmonisation as an important decision factor. The need of communication between organisations in different environments will push to further refine the way of performing a standardized media-related data interchange. Active participation in standardisation is an absolute requirement in a framework organised around the exchange of information. The difficulty will remain in the synchronization of the work within the different committees.

Besides, harmonisation of metadata has only value if the solutions are integrated into systems. Presently, more and more professional media management systems are being set up and operationalized by media organisations and as project deliverables, be it as pilot, proof of concept or as 'real life' systems. Within the next few years, these implementations will have generated more practical information and experience, as to the usabillity and applicability of both common and proprietary metadata specifications. The possibillities and limitations of the 'practical' integration of standard metadata dictionaries and models will be further exposed.

A number of issues will have to be more widely adressed and documented. Process models and working procedures within media organisations have to be synchronized in depth and structured connections will have to link and synchronize metadata models and workflow management systems. Much more work has to be done regarding the support and integration of audiovisual archive legacy material (metadata and essence) into the digital media environment.

The requirements of different user communities will have to be inventorized and harmonized, and the distributed (re)use of audiovisual content should be further supported, including the improvement of existing models for the clearing and handling of copyrights.

The domain of multi-lingualism is also an important metadata aspect that deserves more attention. Another key metadata domain is the affordable capture of metadata. Next to the capturing of 'technical'metadata (e.g. camera positions, shooting conditions, coding parameters) another important metadata segment is the automated capture of descriptive metadata. Harmonisation of metadata being used for statistical applications, is an area that needs to be further studied as well, as statistics are going to play an important role in the analysis of e.g. the metadata related to user preferences and the user consumption history.

4.7 Important standardization initiatives

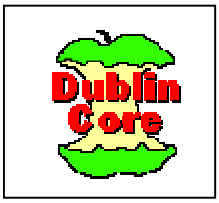
4.7.1 Advanced Authoring Format

Name and organization: Advanced Authoring Format (AAF), commercial, industry-driven standardization platform.
Objective: AAF aimes at a new media industry standard file format for multimedia authoring, designed to meet information interchange needs for images, sound and metadata, across platforms and applications. AAF is an authoring format, capable of supporting the full requirements of storage, during the dynamic process of creation.
Description: S2S standard. Authoring is the process of creating multimediacontent, including the related composition metadata. The AAF format prevents having to convert media coming from many different sources into formats, that can be used by different authoring applications. AAF is designed to work with large collections of interrelated sets of metadata and essence in the authoring stage. It does not support the delivery phase of multimedia content (play-out, broadcast) or the permanent storage and archiving. The AAF format has an extensive edit capability, to specify and store e.g. complex special effects. The format defines a base set of the built-in SMPTE classes that can be used to interchange a broad range of data between applications. The metadata in an AAF file can provide the information needed to combine and modify the sections of essence in the AAF file, to produce a complete multimedia programme and provide supplementary information about the essence itself. Applications may have additional forms of data that cannot be described by the built-in classes. AAF provides a mechanism to define new classes that allow these applications. Besides the ability to format and manipulate metadata itself, the AAF software toolkit provides added capabilities for management of metadata sets, for user extensions and for pluggable modules.
Application domain: Preproduction, production and postproduction processes within multimedia companies, film industry, broadcast companies, music industry.
Key Elements *: the major parts of AAF are:*

- The AAF Object Specification (structured container for storing essence and metadata, describing the logical contents of the objects and the rules for how they relate).
- The AAF Low Level Container Specification (describes how each object is stored on disk).
- The AAF Software Development Kit Reference implementation (programme toolkit and documentation, which allows client applications to access the data stored in an AAF file).

Availability : licensed; informative documents available on the website.
Collaboration with other standards: AAF is a software implementation of **SMPTE** metadata and SMPTE labels. The complexity of AAF has significant impact within embedded systems such as VTR's or camera's, where processing and memory reources may be scarce. To solve this, the AAF association contributes to the developement of a related file format, the Media Exchange Format (**MXF**) by the Pro-MPEG Forum. AAF and MXF metadata dictionaries are highly simular and MXF will be based on a subset of the AAF object model.
URL: http:www.aafassociation
http://www.aafassociation.org/specs/aafapi/contents.html

4.7.2 Dublin Core



Name and organisation: Qualified Dublin Core, of the Dublin Core Metadata Initiative.
Objective: The aim of the Qualified Dublin Core Standard is the design of a universal set of descriptors, that provide access to heterogeneous information resources, and filters and structures these data, presenting the results in a standardised format. Dublin Core is a simple and flexible description technique, that can be easily extended to more complex applications in various domains, including the audiovisual environment. Its specifications are recognised by the World Wide Web Consortium, and widely used by both information professionals and non professionals.
Description : Work on Dublin Core began because of the need to link information in databases to the WWW. At the start the work concentrated on electronic text sources such as bibliographic information, but later it widened its scope to developing a semantic model for all media. The standard is the result of contributions from many experts in the world of libraries, archives, museums and IT. Provided the information may be read by search engines and by human users, the standard may be applied to all types of file formats, and may be extended to make more complex descriptive standards. Most work on DC so far, has focused on providing bibliographical metadata for information resources and adresses text resources. However, Dublin Core is proving more and more to be instrumental in standardising metadata for recorded sound and moving images. For the purpose of describing multimedia and audiovisual resources, a number of qualified extensions have been introduced, to cover specific aspects of audio and video streams, for instance visual attributes of individual frames in a video stream.
Application Domain : (descriptive) Metadata exchange on the web. Together with the standards for broadcast production and distribution, Dublin Core may well fit into the audiovisual production environment.
Key Elements : Basic metadata exchange scheme, consisting of 15 metadata fields, divided over three categories:
1. Content (temporal and spatial definitions; description; type; relation [i.e. 'part of' or 'related to']; source; subject; title)
2. Intellectual property (producer; maker; publisher; copyright status)
3. Version (date; format; language; identification code)
Each field may be provided with ‘qualifiers’ that detail the fields (nb. qualifiers may be still in the process of development). In addition Dublin Core uses two coding schemes called Scheme (to standardise the coding of content) and Language (to standardise language within content).
Availability: Reference descriptions of the elements, links to information and implementation projects, all available at the official Dublin Core pages.
Collaboration with other standards : Presently, Dublin Core is the most well known and widely-used international standard for the exchange of descriptive metadata. Practically all standard developments for audiovisual metadata and media, have included Dublin Core specifications in their work, or have used the standard as an important reference. **MPEG-7, SMPTE, MPEG-21** and **P-Meta** have made formal mappings from their dictionaries to the categories and metadata elements, as defined in the Dublin Core Standard. The work of **P-FRA** is fully based on Dublin Core Metadata.
URL : http://purl.oclc.org/dc/

4.7.3 FIAT Minimum Datalist

Name and organisation: Minimum Data List (MDL), metadata specification of the International Federation of Television Archives (FIAT-IFTA).
Objective: Standardizing the most important information elements describing content-, copyrights and physical characteristics of audiovisual materials, used in audiovisual archive catalogue descriptions; providing an aid to the setting up of cataloguing system in newly established archives; supporting the communication on archival materials between different audiovisual archives internationally.
Description: As far back as 1981 the FIAT-IFTA Documentation Commission has defined the Minimum Data List, for use in cataloguing video and film materials. Before the days of Internet and professional networked environments, the MDL has provided an effective 'analogue' standard. The Minimum Data List has been formalised thanks to many contributions from different disciplines, in particular from the broadcasting world. The list consists of a core of 22 defined metadata fields, that may be extended by every audiovisual archive with additional metadata, depending on its specific needs. After an extended period of practical experience, the MDL was finally published in 1992 in English, French, Spanish, Portugese, German, Swedish, Italian and Dutch.
Application Domain: audiovisual archive catalogue systems; broadcast production environment.
Key Elements: Metadata specification, consisting of 22 fields subdivided in three groups:
1. Identification (title; date; number; producer; author).
2. Technical data (content; keywords; carrier; format; language; location of production;
dates of broad casting or screening; additional technical information).
3. Rights (origin of materials; contracts; copyrights; property).
nb. The MDL does not yet exist in a machine readable format; its elements will need to be transposed for use in a digital environment.
Availability: The FIAT-IFTA Minimal data list is published on the FIAT website in a restricted area, to be accessed by members only.
Collaboration with other standards : The FIAT-IFTA list is used as an audiovisual archive reference list in the development process of other audiovisual metadata standards. The **SMPTE** has formally mapped the MDL-fields to the metadata elements within its own metadata dictionary.
URL: www.fiatifta.org

4.7.4 MPEG-7

Name and organisation: Multi Media Content Description Interface. MPEG-7 is a working group of the International Standardization Organisation (ISO).
Objective: to provide a set of standardised tools that (automatically and manually) describe multimedia materials, which can be passed on to, or accessed by a computer device, allowing quick and efficient content identification.
Description: Wide ranging, weboriented S2S and B2C standard for content-based indexing. MPEG-7 concentrates on defining a representation of the characteristics of form and content of multimedia. MPEG-7 thus facilitates the contentbased retrieval from different kinds of video and audio databases. By developing ontologies (standardized human readable interpretations of audiovisual attributes, that structure the material, using its properties as well as their hierarchical relations), the link is made between databases, search engines and the human user. The main focus of MPEG-7 is to generate a set of decription tools, in order to yield a generic description scheme. These tools comprise standardized descriptors, descriptions and a metadatascheme, and should be able to handle every kind of content. An MPEG-7 description will be highly structured, and is linked to the digital content itself, that may be stored elsewhere. Any search engine based MPEG-7 should be able to approach this information. Research within MPEG–7 focuses on interoperability between archives; automatic indexing during digitization; the accessing of stock collections; the labelling of production information and video sequence indexing. MPEG-7 is not aimed at any one application in particular, its elements shall support as broad a range as possible. The MPEG-7 tools may be implemented by means of XML.
Application Domain: the indexing of audio, speech, video , stills, graphics and 3D models, to be applied to digital libraries, audiovisual archives and image banks (for storage and retrieval of databases), broadcasting (for media selection and distribution) and to the Web ('push and pull' services like teleshopping and educational applications).
Key Elements: The MPEG-7 standard, subdivided into seven parts:
1.MPEG-7 Systems: the tools that are needed to prepair MPEG-7 Descriptions for efficient transport and storage, and to allow synchronization between content and descriptions; the tools related to the managing and protecting of intellectual property.
2.MPEG-7 Description Definition Language (DDL): the language to define new Descriptions Schemes (DSs)
3.MPEG-7 Visual: Descriptors and Descriptions Schemes dealing with visual elements only.
4.MPEG-7 Audio : Descriptors and Description Schemes dealing with Audio Elements only.
5.MPEG-7 Generic Entities and Multimedia Descriptions Schemes: Descriptors and Description Schemes dealing with generic features and multimedia descriptions.
6.MPEG-7 Reference software: software implementations of relevant parts of the MPEG-7 Standard.
7.MPEG-7 Conformance: guidelines and procedures for testing conformance of MPEG-7 implementations.
Availability: Free, informative and normative documents to be downloaded from the website.
Collaboration with other standards: MPEG-7 will not replace MPEG-1, MPEG-2, MPEG-4 or MPEG-21. It is intended to provide complementary functionality to these standards, respresenting information *about* the content, *not the content itself*. But some characteristics that are automatically extracted from an MPEG 4 file for instance, can be used at once in an MPEG-7 description. MPEG-7 has official liaisons with **SMPTE, TV-Anytime** and **P-Meta**. In 2000, the MPEG Ad-hoc Group on Integration was established in the awareness of the need for bringing different metadata schemes in the audio-visual domain together. The first step to be taken was the mapping of SMPTE and MPEG-7 dictionaries. The ISO organisation will combine and integrate the work of MPEG-7 and **Dublin Core**, by working with XML mechanisms. **URL**:http://mpeg.telecomitalialab.com/standards/mpeg-7.htm

4.7.5 MPEG-21

Name and organisation: MPEG-21. MPEG-21 is an ISO working group.
Objective: Developing a common normative multimedia framework for delivery and consumption; to facilitate co-operation between content creator and content consumer; defining a technology needed to support users to exchange, access, consume, trade and otherwise manipulate digital materials. This is done by way of describing how the various elements - either in existence or under development - that build an infrastructure for the creation, delivery and consumption of multimedia content, fit together.
Description: High level B2C standardization initiative, that will integrate the critical technologies within the audiovisual and multimedia domain, intending to generate the lacking 'big picture'. MPEG-21 is based on two essential concepts: the definition of a fundamental unit of distribution and transaction (the Digital Item) and the concept of Users Interacting with Digital Items. MPEG-21 wants to enable transparent and augmented use of multimedia resources, across a wide range of networks and devices, supporting reliable delivery, the management of personal data and preferences, taking into account user privacy and the management of (financial) transactions. MPEG-21 recommendations will be determined by interoperability requirements. Their level of detail may vary for each framework element. The actual instantiation and implementation of the framework elements below the abstraction level required to achieve interoperability, will not be specified. MPEG-21 is exclusively focusing on the integration of MPEG systems. Other content formats would duly need to be taken into account.
Application Domain: the integral multimedia content delivery chain, encompassing content creation, production, delivery and consumption within financial, communication, content, computer and consumer electronics communities, and their customers.
Key Elements :
1.Digital Item Declaration (a uniform and flexible abstraction and interoperable schema for declaring Digital Items).
2.Digital Item Identification and Description (a framework for identification and description of any entity, regardless of its nature, type or granularity).
3.Content Handling and Usage (provide interfaces and protocols that enable creation, manipulation, search, access, storage, delivery of content across the distribution and consumption value chain).
4.Intellectual Property Management and Protection (the means to enable content to be persistently and reliably managed and protected across a wide range of networks and devices).
5.Terminals and Networks (the ability to provide interoperable and transparent access to content across networks and terminals).
6.Content Representation (how the media resources are represented).
7.Event Reporting (the metrics and interfaces that enable users to understand precisely the performance of all reportable events within the framework).
nb. The first part of the MPEG-21 standard is an ISO Technical Report (ISO/IEC TR18043-1) that studies the multimedia framework and offers recommendations for new standardization activities.
Availability : free, informative and normative documents to be downloaded from the website.
Collaboration with other standards: The integration of disparate technologies into MPEG-21 specifications will be achieved by working in close collaboration with other standardizing bodies, using their results in the process. Where gaps exist, MPEG-21 intends to develop new standards as appropriate. MPEG-21 has identified several multimedia initiatives that should be considered as candidates for future interaction. Among them are **SMPTE, P-Meta, TV-Anytime** and **Dublin Core**. Currently, there exists some overlap between the work of MPEG-21 and these other standardizing groups. Some of the issues MPEG-21 adresses, like Intellectual Property Rights (IRP), content related usage rules, and metadata security aspects, are equally being looked at by initiatives as TV-Anytime.
URL:http://mpeg.telecomitalialab.com/standards/mpeg-21.htm

4.7.6 Material Exchange Format

Name and organization:. Media Exchange Format (MXF), standard initiative of the Pro-MPEG Forum.
Objective: to specify a file format for the transfer of different types of multimedia programme material, between storage and processing equipment, including servers, tape streamers and digital archives. MXF is a wrapper format, specifically meant for storing and forwarding finished and unfinished work. It should support essence and metadata transfer without the metadata-elements having to be manually re-entered.
Description: S2S standard; a MXF file bundles together video and audio, data essence and associated metadata, and places them into a unified 'wrapper'. The MXF wrapper is cross–platform, being independent of operating system, compression system and network infrastructures. MXF files are intended for sequential writing, and for sequential and random access reading. They are thus streamable, and may be directly converted to and from standardised streaming formats. MXF can provide capabilities such as playing while recording and operating with isolated streams. It is not meant for authoring and has basic edit capability. MXF uses the KVL coding. The combination of the normative and informative sections facilitates flexible television equipment, that will be interoperable over a variety of user-specific applications. The structure of an MXF file is divided into a file Header (information about the file as a whole); a file Body (essence container which comprises audio and video) and a file Footer (terminates the file). Structural metadata defines the essence structure, and Descriptive Metadata describes the content. Descriptive Metadata are linked to the Structural metadata. MXF have modelled the Descriptive metadata into DMS-1, an object-oriented MXF metadatamodel. DMS-1 is meant for the production environment and is based on SMPTE metadata labels. DMS-1 specifies around 30 metadatasets, which describe for example: programma classifications, people, organisations, and shot annotations. Metadata sets are grouped together with 'frameworks': MXF distinghuishes a production framework (describing a production as a whole); a scene framework (giving editorial descriptions like period and location of storyline), and a clip framework (describing source material).
Application Domain: professional broadcast production, play out and archive environment
Key Elements : the MXF Specification, containing 5 parts:
1. Engineering Guideline
2. Normative Definition of an MXF file
3. Sequence of Related Operational Patterns Specifications
4. DMS-1 for Descriptive Metadata
5. Documents on the Essence Containers and the Body Containers

Availability : normative and informative documents available on the website.
Collaboration with other standards : The definition of MXF metadata is based on **SMPTE** labels. DMS-1 is provided as an input the SMPTE work on metasdatasets. A liason with **MPEG-7** has recently been established. **P-Meta** has formally reviewed the MXF DMS-1. Despite the difference in scope (the MXF format is intended to allow the interchange of finished or unfinished materials and P-Meta has the broader scope of the entire B2B metadata exchange), the relationship between MXF and P-Meta is appointed as the subject of a recently set-up mapping project of the EBU. Up till now, the P-Meta Metadatascheme were seen to be used as a plug-in in MXF (as are other metadata schemes). MXF uses the **AAF** metadata object model. Renderend finished programmes for play out or archive may be stored as MXF, while the AAF version can also support re-versioning. The parts dealing with materials (rushes or rendered finished programmes) are carried over into MXF, while the parts dealing with compositions effects are being handled by AAF. **URL** www.pro-mpeg.org/mxf.htm

4.7.7 Project Future Radio Archives

Name and organization : Project Future Radio Archives (P-FRA), European Broadcast Union (EBU) working group
Objective : To define a simple set of metadata, which is adapted for use in radio archives and which is aligned both with the main standards of the broadcasting industry, and with the Dublin Core metadata, as the general metadata approach used by libraries and archives on the WWW.
Description : S2S metadata structure, based on the qualified Dublin Core standard, chosen because of its relatively simple format, its international support, its usage in websites and in databases, its stability and its continuing development. The metadata of P-FRA are listed in the order in which they were developed by Dublin Core (i.c 15 metadata elements, subdivided over the three categories: Content, Intellectual Property and Instantiation or Version). To make the DC elements specific, unambiguous and helpful in the broadcast production, retrieval and and archiving processes, the P-FRA specification gives three further sorts of information:
1.An interpretation of the elements for the purposes of broadcasting;
2.Where necesarry, the metadata elements can be refined to allow greater detail;
3.Controlled text is provided (lists, encoding schemes) for certain elements, to force broadcasters to use a common terminology.
Application Domain: the retrieval of material (video as well as audio) from broadcast archives and the exchange of this material with other broadcasters and other archives.
Key Elements: P-FRA EBU Core Metadata Set for Radio Archives Tech 3293. The metadatascheme provides a structure or a set, to group useful metadata elements. The metadata set defined in this document contains the 15 DC elements with their qualifications and recommended usages. Supplemented are controlled vocabularies and authority files. Tech 3293 also provides information on the relation between the P-FRA metadata and overall EBU standardization.
Availability: free, by registering, informative and normative documents to be downloaded from the website.
Collaboration with other standards: The work of the P-FRA group has benefited from the work done earlier by the Scandinavian Audiovisial Metadata Group (SAM). The specific task of P-FRA was to establish whether the approach had general consent, and was compatible to overall EBU metadata activity.The individual metadata elements defined in Tech 3295, have been mapped to be fully compatible with **P-Meta** standardization. The set construction also allows a formal definition of the mapping from the 15 **Dublin Core** elements to elements or sets of elements drawn from the **SMPTE** Metadata dictionary. The Audio Engineering Society (AES) metadata effort started independently but also adopted Dublin Core. Work is in hand to ensure that the final AES document is as close to P-FRA's Tech 32 93 as possible.
URL: www.ebu.ch/tech_t3293.html

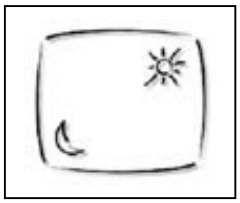
4.7.8 Project P-META

Name and organization: Project P-Meta, working group of the European Broadcast Union (EBU).
Objective: developing a standard approach to structuring metadata, related to media items and their exchange between process stages and business entities (i.c. broadcasters, archives, producers and distributors) by way of building an exchange model for information about programme material. Implementation and contribution should lead to an improvement of commercial and system interoperability between EBU members.
Description: B2B en S2S standard for metadata exchange between organisations. P-meta focuses on metadata definitions and architecture and on unique identifiers and technical metadata in broadcast use. It has defined metadata for identification, description, discovery and use of content, supporting the exchange of metadata that will be typically separate from, but may be embedded in a programme stream or file. P-Meta developed an inter-business data flow model with three trading entities: content creator, content distributor and content archive. The P-Meta standard is divided into sets that describe possible sales and other (commercial) transactions between these entities, defining and structuring the metadata that is involved, including editorial and descriptive information about the programmes that are being 'traded' or informed after, extensive metadata on the right to use the material, and metadata needed to inform the user how to properly open and/or to play back the material. The P-Meta standard is system independent and may be implemented on any appropriate platform, using XML or KLV (or any other appropriate coding) 'on the wire'. It is expected that P-Meta will be implemented using both XML and KLV.
Application Domain: (commercial) transactions in the professional broadcast- and archive environment; i.c. the exchange of metadata on television programmes between producer/broadcaster, broadcaster/broadcaster, broadcaster/archive, archive/archive and broadcaster/distributor.
Key Elements: The EBU P-Meta Metadata Exchange Scheme V.1.0, comprising
-A flat list of attributes including semantic definitions
-A list of transactions sets, each of which is built from attributes and other sets; eachs set has its own definition of purpose and content
-A list of reference data (also known as 'enumerated values', 'code values' or 'controlled value sets') for appropriate attributes.
-A syntax and notation for set construction., which supports members' requirements for the assembly of a logical set.
Availability : free, by registering, informative and normative documents to be ordered via the website.
Collaboration with other standards: P-Meta has developed relationships with **SMPTE**, **MXF**, **P-FRA** and **TV-Anytime**. Once validated, P-Meta metadata en sets not provided by SMPTE will be registered for inclusion in the SMPTE Metadata dictionary. Recently, a project has been set up by the EBU to establish formal mapping specifications between P-Meta and **MXF**. As for **P-FRA**: a unilateral mapping has been provided from the qualified Dublin Core Radio Archive set to the P-Meta scheme. P-Meta metadata elements have also been mapped to the metadata requirements of **TV-Anytime,** specifically in regard to the work done to develop the Radio and Television Genre Classification Scheme, based on EBU Escort 2.4 . New work is leading towards support of the B2C domain through further collaboration with TV-Anytime. The P-Meta specifications will be extended to include the data required by this consumer domain, from the professional domain.
URL:www.ebu.ch/pmc_home.html;www.ebu.ch/pmc_meta.html

4.7.9 SMPTE

Name and organisation: Society of Moving Pictures and Television Engineers (SMPTE), industry-leading society.
Objective: To develop and harmonize standards for the exchange of programme material within broadcast organisations; to support global interoperability by defining and structuring metadata tags in a way that enables the interchange of SMPTE metadata with metadata from different sources and originated by other bodies.
Description: S2S standard for professional pre-production, post-production, acquisition, distribution , transmission and storage of broadcast materials. The SMPTE metadata standard focuses on the conditions for network layer interoperability and aimes at solving the problems caused by incompatible formats in both video and audio. Its Metadata Dictionary serves as a reference book for mainly media specific descriptors in the production chain, that are being considered relevant by the industry. The Dictionary supports flexibility in capturing metadata and exchanging it among applications, through a standardized hierarchy of Universal Labels for the metadata elements that are grouped in classes, i.c. collections of metadata with common characteristics or attributes. The SMPTE Dictionary has defined classes for identifiers and locators, administrative metadata, descriptive metadata, process metadata, parametric metadata, spatio-temporal metadata, metadata about the producing organisation or owner of the material, and metadata on the internal relations between the metadata and the essence. The Dictionary also contains information on the required format of metadata values and their allowable range. It consists of Structure and Contents, which must be used as a pair. SMPTE uses Key-Lenght-Value (KLV) as the structure for its metadata elements and sets, and intends to create an XML representation of both metadata elements and sets.
Application Domain : Professional broadcast production environment.
Key Elements:
1. The SMPTE Metadata dictionary, specified in SMPTE Recommended Practice (RP) 210a, a dynamic collection of registered names and datatypes, most of them being media specific (such as timing information). The Metadata Dictionary Structure (SMPTE 335M) covers the use of metadata for all types of essence (video, audio, data); the Metadata Contents Recommended Practices define a registered set of metadata element descriptions for associating with the essence or with other metadata. The SMPTE Engineering Guideline provides a node structure for the Dictionary for easy reference.
2. The SMPTE Set Registry, defines recognized groups of data elements for storage or exchange. The Sets Registry describes the business purpose and the structure of the Sets that can be used to support any transaction sets required for the exchange of metadata.
Availability : Licensed, information on purchase/ downloads on the SMPTE website.
Collaboration with other standards: The SMPTE metadatawork picks up on the work of the EBU-SMPTE Taskforce for Harmonized Standards for the Exchange of Programme Material as Bitstreams, that completed its final report in 1998. The Dictionary has harmonized various existing metadata sets, by incorporating the work done by other bodies. Mappings have been carried out between several metadata elements, that were defined by **P-Meta, MPEG-7** and FIAT **(the MDL).** The SMPTE work is used a an important and influential reference in practically all metadata efforts of other standardizing initiatives. The Advanced Authoring Format **(AAF**), a file format, designed for post-production and authoring, has integrally implemented SMPTE metadata. The Media Exchange Format (**MXF**), a file transfer format, has based its metadata solution directly on the the SMPTE Metadata Dictionary.
URL: www. smpte-ra.org; www.smpte.org
EBU/SMPTETaskForceFinalReportwww.ebu.ch/pmc_es_tf.html#rep

4.7.10 TV- Antytime



Name and organisation: TV-Anytime Forum, cross industrial standardization initiative.
Objective: To develop specifications to enable audiovisual and other services based on mass-market high volume digital storage in consumer platforms (local storage, setup boxes). The Forum develops specifications for open interoperable and integrated secure systems, from content creators/providers, through service providers, to consumers. The Forum has defined specifications for content referencing, metadata and rights management.
Description: B2C standard. The main concept of a TV-Anytime system is about searching, selecting, locating and acquiring content *wherever* (i.e. traditional broadcasting or internet based) or *whenever* (i.e. scheduled or instantly accessible) this content is made available. Features: content on demand; pause, skip and review live television; personalized content recommendations; personal virtual channels. TV-Anytime has designed an enhanced dataflow model and a common metadata representation format for the distributor of digital programme content. As a result, the TV-Anytime metadata system allows development of competitive or complementary applications and services, which support for example interactive TV, parental guidance systems, multilinguality, different views, indexes, identification and differentiation of the content, storage of content, various e-commerce models, personal annotations, links to other programmes, history information, synchronisation between content and metadata, and protection of personal data.
Application Domain: (professional) broadcast programme delivery, web/new media.
Key Elements:
-S1: Benchmark Applications (Business Models)
-S2: System Description (End-to-end design)
-S3: Metadata Specifications (Content description)
-S4: Content referencing (Content identification and acquisition)
[nb. One of the most important products in this area: a normative TV-Anytime set of programme genres: the TV-Anytime Radio and Television Genre Classification Scheme, based on EBU Escort 2.4 (RTV-genre classification of the EBU)].
-S5: Content Rights managements and protection (Rightful use of content)
Availability: informative and normative documents freely available on the website.
Collaboration with other standards: To meet the need for compliance and interoperability between production, exchange, indexing and distribution, TV-Anytime is closely looking into the work of **SMPTE, P-Meta** and **MPEG-7**. TV-Anytime metadata specifications directly refer to many MPEG-7 metadata definitions such as MPEG-7 defined datatypes, and uses the MPEG-7 Description Definition Language (DDL) to describe metadata structure as well as the XML encoding of metadata. Between TV-Anytime and P-Meta there are two areas of collaboration: the mapping between the schemes at the B2C interface (thus connecting the 'backoffice' with the 'frontoffice') and the further development of the TV-Anytime Radio and Television Genre Classification Scheme.
URL : www.tv-anytime.org

Glossary

Attribute	Also: property. A characteristic of an entity, something which an entity has.
Asset	Any type of material -complete programme, or programme item, that may consist of image, recorded sound, stills or text. See also media object.
Authority files	Lists containing the authorised spelling of personal or corporate names, geographic locations, etc.
Bandwidth	For digital use the term refers to the capacity of sending a certain quantity of data within a certain period of time.
Bitstream	E.g. the essence or metadata stream
Browser	Programme for finding information in networks
Clip	Uninterrupted string of content units
Coding scheme	Scheme containing the syntax instructions for the computer
Compression	Technique to reduce the number of bits by removing possibly redundant information. Because of limitations in bandwidth for transmission and/or storage it is usually necessary to remove information that can be regarded as less essential for the representation of the audio and video.
Content	Collective noun for essence and metadata.
Content based	Automatic indexing and retrieval of materials based on intrinsic content characteristics
Content unit	Duration of a content, which may be anything between an audio segment of a few seconds and a series of images in MPEG-2 (which would be called a 'group of pictures')
Conversion	Adaptation of software, hardware, staff, data and working processes from an old to a new information system or information carrier.
Database	Set of logically integrated and related data that is stored structurally.
Data definition	Definition of the content of a data element or of a set of data elements.
Data dictionary	The assembled technical descriptions and definitions of data elements and their characteristics.
Data flow diagram	Graphical representation that shows graphically and with a limited number of symbols what data go where, what processes there are to treat and/or store data and what external elements are related
Data insertion	Addition of metadata, that may or may not be automatically generated from audio or video, to a description of the materials
Data model	Technical model for a logical database structure of an information system.
Digital workflow	Relation between various services and units in a networked organisation that serve to connect different stages of the work process in such a way that information has to be generated just once to become available wherever required: 'write once, read many'

Distributed databases	Databases that are positioned at different locations and are accessible through a common network
Document	Any type of information carrier. Examples here: scripts, catalogue descriptions, analogue and digital audiovisual carriers.
Download	The reception and storage of a programme or datafile from a distant computer through data communication links
EBU	European Broadcasting Union, for the European broadcasting organisations.
E-commerce	Electronic trade; commercial applications on Internet
EDL	Edit Decision List, editing list with timecodes, generated offline
Embedded	Integrated; 'embedded metadata' are an integral part of the document they refer to
Encode	'To encode' means to transfer information to another form of presentation
End user	(Professional) user of information systems
Entity	Something which is identified. Attributes or properties can be assigned to an entity
ERD	Entity Relation Diagram. Graphical representation of entities and their mutual relationships
Error rate	Rate of the number of digital errors within a given period as measured against the total number of bits processed in the same period
Essence	Term used to describe digital audiovisual materials, content without metadata
FIAT/IFTA	International Federation of Television Archives. Worldwide non-government organisation for film, audio and video archives
File	An organised set of related records, e.g. essence + metadata, that may be accessed from a storage medium
File transfer	The transfer of digital data as files
Fire walls	Security system that permits only authorised communication between (parts of) the internal network or Intranet, and Internet
Format	Representation *s*tructure of data or the form in which they are stored on a medium
Frame/framing	The use of the edges of a video frame to select and compose what will be visible on the screen
Granularity	Detailling level of metadata and their associated information objects within a metadata structure: i.e. the granularity determines the 'depth' in which information is identified and may be accessed, often based on the users' needs.
Graphics	Elements of an audiovisual production such as animation, statistics, drawings, maps

Header	Group of labels with (usually formal) metadata integrated in a document
HTML	Hyper Text Markup Language, i.e. the language used to format and usually write pages on the www
Index	Structured list of keywords and their locations, used for quick access to texts or datafiles
Information architecture	Framework of concepts to define the basic shape, content and relation of databases within a network, that process data for information management processes.
Information object	Information resource (book, document, webpage, video, audio, still etc.) that can be described and made accessible by metadata.
Input	Any kind of information that is fed into a process or a system for further processing
Interface	Common borderline of two different systems; communication between user and programme or computer system; relation between application and operating system. Defines input and output, and regulates conversion of data to a machine readable form
Interoperability	The ability of systems to understand and work with information passed from one to another defined by protocols based on semiotic elements
Intranet	Set of applications based on Internet principles, used within an organisation
ISO	International Standards Organisation, based in Geneva
Keyframe	Still images of video material derived by specific software on the basis of parameters, e.g. shot transitions, contrast of cameramotion. Keyframes are useful as an image selection instrument
Link	Link between different elements of a document or a file
Mapping	Process of linking and synchronising fields and data elements in different (meta)data dictionaries and schemes, with the purpose of making them communicate and exchange information
Media management	Management of production, distribution, storage, indexing and retrieval of multimedia, using media systems
Media objects	Elements that together make up the digital content (sound, image, text, graphics, stills, animations, etc.). A media object may be a completed programme, but also parts of the programme like single shots. See also assets.
Media summary	Audiovisual summary of a radio programme or television programme. May be automatically generated
Media type	Text, audio, video, still images, etc.
Metadata	Information which describes data including the content, shape, technical and editorial characteristics of electronic information which are generated, consulted, manipulated and distributed on a network

Metadata dictionary	*A* central and controlled information resource, that lists and defines all metadata elements, including their naming, definitions, identifiers, values, where and how they are used and their relationship to other metadata
Metadata element	An item of metadata
Metadata registration	Common, central location containing machine-readable metadata schemes
Metadata schema	Also: metadata model. Full, logically organised structure of relations between defined (groups) of metadata and the information obejects they describe.
MPEG	Motion Picture Experts Group, one specialist area of ISO. Developed standards such as MPEG-1, -2 and –4, used as compression standards for video, respectively at consultation quality level and at professional broadcasting level. MPEG-4 is still being developed.
Multimedia	A computer-based method of presenting information by employing more than one medium for communication and emphasizing interactivity. It combines graphics, sound, video, text etc.
Navigation tools	Search instruments used to navigate a programme, a file or a collection
Near online storage	Storage of digital data on tape carrousel or other storage device except an on line server. To retrieve such data, it first has to be transferred from the external storage medium to the server, where is will be directly accessible. However, in some cases the data may be retrieved directly from the external storage medium. See also Offline and Online.
Network	A computer-based communications and data exchange system created by physically connecting two or more computers
Offline storage	Storage away from an online access medium. Data that is stored off line has first to be converted to a digital format or to be put onto a medium connected with a server. Data stored off line is sometimes also called ‘deep archive’
Online	Applied to the status of any data that is directly available from the server.
Ontology	Representation of knowledge concepts that apply to a certain information area
Performance	The measured performance of a computer system
Play out systems	Systems that facilitate representation and broadcasting of audiovisual productions
Pointer	Link to the location in a networked environment where the values of a variable of the content of a record have been stored.
Post production	Final stages in radio and television programme production, such as translation, subtitling, final editing
Protocol	Set of rules and procedures devised to control communication in a network

Procedure	Set of instructions for humans and/or computers needed to carry out a specific duty
Production chain	Sequence of stages in the broadcasting production process.
Qualifier	Sub element used to further detail a metadata element
Query	Search action on a database formulated in a human language
Router	Routers interconnect local networks in an organisation to form a single network. The router organises the network and assigns address domains
Record	Set of related data, that is treated as a single unit
Retrieval	To get back data from a database
Sample frequency	Number of samples per second in which a signal is digitised
Semiotics	Science of the signs with semantics, syntax, structure and practice as its constituent parts
Server	Computer that serves as the core of a network
Still	Fixed image from a sequence of moving images. Often used like a photograph
Streaming	The transport and distribution of data in a sequential manner. In the audiovisual domain data that are being streamed may be accessed during the streaming process, contrary to data being downloaded. Data are sent in packets and do not have to be copied on hard disk first
Tape carrousel	Large storage medium for data tapes, used in near online storage and connected with the network
Technical architecture	Basic set-up for a data communication environment. Defines hardware and oftware, standards, communication protocols and interfaces between systems and user
Thesaurus	Structured list of indexing terms together with their cross references and semantic relations, based on equivalence, hierarchy and associative relations
Transmission	The signalling of data over communication channels
Value	An instance of an attribute
Wrapper	A wrapper connects the essence and its related metadata prior to regulated transfer and storage