A Case of Adoption of 25000 Standards Family
Establishing Evaluation Requirements in the Audio-Visual Preservation Context

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Abstract: The digital preservation want to guarantee accessible and usable over time digital audio-visual media content, regardless of the challenges of media failure and technological change. For this aim, the current technologies for digital audio-visual media preservation deal with complex technological, organizational, economic and rights-related issues. Ensuring the development and use of high-quality software could be a key factor for their success. The paper reports an experience matured inside the Presto4U project, with the contribution of the TATE Gallery. Aim of the experiment was the identification of preservation needs and corresponding preservation requirements in order to set up a quality evaluation process for used software tools making easy the technology transfer of research results into digital preservation environment. Using the framework of the international standards on software products quality, the evaluation requirements were mapped on the characteristics and sub-characteristics of a quality model and a specification of high-level software product quality evaluation plan has been obtained and presented.

1 INTRODUCTION

The long-term preservation of digital audio-visual media presents a range of complex technological, organizational, economic and rights-related issues, which have been the subject of intensive research over the past fifteen years at national, European and international levels. Although good solutions are emerging and there is a large body of expertise at a few specialist centers, it is very difficult for the great majority of media owners to gain access to advanced audio-visual preservation technologies.

Considering the dynamic nature of the IT industry, audiovideo media and research technologies are subject to many changes in hardware and software capabilities. Technology cycles are short and therefore product lifetimes tend to be short, producing decay and technological obsolescence. These problems have an impact on digital material preservation in terms of source and process of preservation.

In this context one of the currently on-going European project targeting the topic of audiovisual preservation is Presto4U project - European Technology for Digital Audiovisual Media Preservation (www.prestocentre.org/4u). Supporting an important technology transfer between research and industry, the Presto4U project focuses research efforts onto useful technological solutions, in order to raise awareness of the needs of audiovisual preservation and to improve the adoption of audiovisual preservation research results, both by service providers and media owners. Encouraging the organization of the principal actors of audiovisual media preservation (users, technology vendors and service providers) in a set of Communities of Practice (CoPs), the project aims to develop a body of knowledge on the status of digital preservation practice (problems and needs), to identify useful research results and to promote their adoption and implementation.

In particular, identifying a quality evaluation process able to guarantee the development and use of high-quality software both by technology and service providers as well as media owners constitutes the main objective. Thus a crucial work of the project, and thus of this paper, is the identification of the quality needs and the identification of models for quality achievement. Indeed these models will be useful to achieving the established quality level and to make easy the technology transfer of research results into digital preservation environment. The ultimate purpose is improving the commercial technologies

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development and promoting new technical approaches to match the specific preservation needs of each CoP.

On the other hand, software quality and its evaluation are not new research topics. They have been discussed for several years and from different points of view (Krause, Freimut, Suryn, 2003, Pfleeger 2009, Vliet, 2002). Achieving software product quality could be summarized as achieving the required quality through the definition and implementation of quality requirements, the measurement of appropriate quality characteristics and the evaluation of the resulting quality. Also in the context of standardization, quality is very well defined and many international standards have been published about software processes and products quality (ISO 9126, 1991, ISO/IEC 9126 – 1, 2001, ISO/IEC 14598, 1998, ISO/IEC 15504, 2004, ISO/IEC FDIS 25000, 2005).

In the digital preservation context, one of the most important reference model developed in a ISO standard is Open Archival Information System (OAIS) (ISO 14721, 2012). This model concerns technical aspects of digital object's life cycle, as ingest, archival storage, data management and access, and it also recommends metadata issues. It mainly targets the preservation functional aspects and it does not deal with non-functional quality aspects. Consequently, this paper does not rely on OAIS standard but it overviewed available standards on software technologies from point of view of the quality characteristics and their adherence to preservation needs.

However to the best of our knowledge none of the available quality standards and/or best practices has been currently specialized and adapted for the specific digital audio-visual preservation context.

Indeed all these documents and sources of information constitute a very interesting base for the digital preservation context, as models, characteristics, measures and methods that they present can be considered or readapted for preservation purposes. Current and available audio-visual technologies could be evaluated on the basis of software quality standards and the results could suggest important decisions about their adoption or improvement. Nevertheless, for this aim it is necessary a preliminary activity of preservation requirement elicitation and a successive mapping of the preservation needs on the characteristics and sub-characteristics of a quality model on which these requirements impact. Only later an evaluation process could be implementable.

Regarding to the software quality evaluation process, the paper reports an experience of "establishing the evaluation requirements" (ISO/IEC 25040, 2010) matured inside the Presto4U project. TATE Gallery (www.tate.org.uk) contributed to the detection of some preservation needs in the context of audio-visual collection.

With respect to specific quality issues for the digital collections, following activities are carried out:

- the definition of preservation needs;
- the specification of these needs in software product quality evaluation requirements;
- the identification of a software product quality model;
- the mapping between the requirements and characteristics and sub-characteristics of the detected quality model;
- the refinement of a preliminary high level software product quality evaluation plan, according to selected quality model and with a focus on the more perceived quality issues.

During the implementation of case study, both the on-the-field practice and the research experience of the involved partners have been exploited. The obtained results are a specification of software product quality evaluation requirements and a specification of a preliminary high level software product quality evaluation plan. In the perspective of a software product quality evaluation process, these results represent a necessary intermediate product, for carry on the evaluation and obtain important results (ISO/IEC 25040, 2010).

The paper is organized as in the following: the Section 2 presents the motivation of this work. The Section 3 introduces the topic of software quality and an overview about the international standards for software quality. In Section 4, the quality evaluation procedure and the adopted quality model are presented. In Section 5, the explorative case study is shown, and a mapping between requirements and characteristics was performed. Discussion and conclusion close the paper.

2 MOTIVATION

The decay and the technological obsolescence of the software products that are used in digital material preservation context represent a serious problem in terms of sources and process of preservation, content management, digital archiving, etc.

Identifying a quality evaluation process able to guarantee the development and use of high-quality

software could help both technology and service providers as well as media owners.

The identification of international standards for the software products quality could be useful to limit the above-cited risks of decay and the technological obsolescence. Besides, involving multiple stakeholders, the quality evaluation process could make easy the technology transfer of research results into digital preservation environment. Thus models, characteristics, measures and methods that the standards offer could be considered or readapted for audio-visual preservation purposes.

However as discussed in Polillo (Polillo, 2012) these standards only provide a conceptual framework, and not a ready-to-use solutions usable in every context. The necessity of adaptation and revision becomes a pressing exigency, mainly when the considered systems or products do not perfectly fit with the characteristics and peculiarities of classical software engineering

Besides, even when the standards are very comprehensive and specific, they still show some common weaknesses, which could have an important impact on applicability of the standards themselves (Azuma, 2011)

As an example in Rafa and Al-Quataish (Rafa E. Al-Quataish, 2009) problems with (ISO/IEC 9126 – 1, 2001), not already completely solved in the new SQuaRE version, have been highlighted.

In particular some weaknesses of the available standards that have been identified by different researchers concern over the years are (Olsina, Lew, Dieser and Rivera 2012):

- the terminology: it could be not fully aligned with the classic measurement terminology in software engineering (Abran, Al-Qutaish, and Desharnais, 2005);
- the metrics identification: the metrics provided by the various standard could not be properly aligned. For instance ISO 9126 metrics should be classified and mapped according to those proposed by the ISO 15939 (Abran, Al-Qutaish, Desharnais, and Habra, 2005);
- the results analysis: not all the standards propose the same ranking for the considered metrics. Thus possible conversions or alignment of various ranking considered should be defined. For instance a possible conversion of the result of the ISO 9126 metrics from percentage values to ranked values in terms of qualitative values should be considered (Abran, Al-Qutaish and Cuadrado-Gallego, 2006);
- the same reference scale: wherever possible for the same ranking the same reference scale should be adopted so make easier finals quality assessment value. For instance every metrics of the ISO 9126 should be mapped to the same reference scale (Koscianski and Bracarense Costa, 1999);
- the extension of the characteristics: each quality standards should try to include or extend the characteristics already defined in different available standards so to have a more uniform and complete coverage of quality requirements. For instance the opportunity the usability characteristic the ISO 9126 standard could be extended to include more specific sub-characteristics such as consistency, simplicity, legibility, colour use, and help (Chua and Dyson, 2004 and Zádor, Balla, Trienekens, Kusters, 2008).

As highlighted in Bhatti et al. (Bhatti, Abdullah and Gencel, 2009) about 80% of the measurement programs were reported to fail to helping in decision making or to delivering performance improvements. According to Bundschuh et al. and Gopal et al. (Bundschuh, Dekkers, 2008, Gopal, Krishnan, Mukhopadhyay, Goldenson, 2002 and Hall and Fenton, 1997), the risk of failure for the measurement programs could be:

- a misunderstanding of what is to be measured, why and how it is to be measured;
- an inadequate data collection;
- a wrong interpretations of data;
- the lack of trained and expert resources required to dedicate to measurement;
- the expensive costs for measurement programs;
- the incorrect mapping of organization goals with appropriate measures.

The criticalities underlined in the various quality evaluation procedures in many cases make very difficult the adoption of the standards into the products development.

In spite of the limits of international standards applicability, considering the quality as a limited number of independent characteristics (ISO/IEC 9126 – 1, 2001) allows to evaluate the most interesting for each Communities of Practices characteristics and quality levels (“internal”, “external” and “in-use”).

The ambition of this paper is to overcome some of the above-mentioned weaknesses considering the specific context of the audio-visual preservation.

In particular, for improving the common understanding and decreasing as much as possible the points of doubts, an alignment of the classical

terminology of the software engineering context with the one that is specific for the preservation context has been pursued. In order to reduce the gap between general definition of the characteristics and associated metrics defined by the ISO standards and terminology and goals of the preservation environments, a shared and informal glossary has been defined preliminary.

As main objective of the project, and thus of this paper, is identifying a quality evaluation process able to guarantee the development and use of high-quality software both by technology and service providers as well as media owners, a crucial activity is the identification of the quality needs and the quality models for quality achievement. Therefore, this work focuses on the audio-video preservation needs and related requirements so to enhance the quality evaluation procedure and the adoption of the international standards.

In this paper, the experiment stops at this phase, because, as above reported, the project is currently on-going. As future work, the result of this experiment, that is a high-level software product quality evaluation plan, will be refined and specialized with measures, techniques, criteria, etc. and used by each CoP for evaluating their tools.

Since the standards applicability is expensive and involves many resources requiring strong agreement among stakeholder groups, in this phase a quality evaluation plan has been specialized by means of an accurate selection of measurable characteristics, related to the organizational goals, in order to reduce costs and efforts due to the evaluation of the quality.

3 BACKGROUND

In the field of software engineering, the evaluation of software product quality is vital to both acquisition and development of software that meets quality requirements.

In the following, some of the most important international standards will be presented.

For aim of completeness, some of the specific terms used inside this paper, according to the indications of many international standards, are firstly reported. In particular:

- Software quality, that is defined as "the totality of features and characteristics of a software product that bear on its ability to satisfy stated or implied needs" (ISO 9126, 1991).
- Software quality characteristics, that are defined as "a set of attributes of a software product by which its quality is described and evaluated. A software quality characteristic may be refined into multiple levels of sub-characteristics" (ISO 9126, 1991).
- Software quality metric, that is "a quantitative scale and method, which can be used to determine the value a feature takes for a specific software product" (ISO 9126, 1991).
- Assessment, that is defined as "an action of applying specific documented assessment criteria to a specific software module, package or product for the purpose of determining acceptance or release of the software module, package or product" (ISO 9126, 1991).
- Software quality assessment criteria that are meant as "the set of defined and documented rules and conditions which are used to decide whether the total quality of a specific software product is acceptable or not. The quality is represented by the set of rated levels associated with the software product" (ISO 9000-3,1991).

About software quality, the standardization bodies that have mostly published are:

- ISO (International Organization for Standardization).
- IEC (International Electrotechnical Commission).
- IEEE (Institute for Electrical and Electronic Engineers).

The IEC cooperates closely with ISO and IEEE, and the standards developed jointly with ISO carry the acronym of both organizations. In the following section some of the most important standards of the above mentioned standardization body are briefly introduced.

3.1 ISO/IEC Standards

Considering the ISO and IEC, two of the most important joint standards developed for the software quality evaluation have been: the ISO/IEC 9126 "Software engineering - Product Quality" with its four versions (ISO/IEC 9126 – 1, 2001, ISO/IEC 9126 – 2, 2001, ISO/IEC 9126 – 3, 2001, ISO/IEC 9126 – 4, 2001) and the ISO/IEC 14598 "Software engineering – Product Evaluation" (ISO/IEC 14598, 1998).

The principal merit of ISO/IEC 9126 standard can be found in its attempt to reduce the *product quality* concept to a limited number of independent characteristics and to have developed the notion of various levels of qualities ("internal", "external" and "in-use"). Nevertheless, it was not successful in providing meaningful, quantitatively expressed (or

measurable) indicators associated to quality characteristics (Software Engineering Institute, 2006).

These two standards (ISO/IEC9126 and ISO/IEC 14598) are converged into the ISO/IEC 25000, SQuaRE - Software Product Quality Requirements and Evaluation - series (ISO/IEC FDIS 25000, 2005). It represents families of standards and constitutes the result of an effort to harmonize previous standards in order to establish criteria for the specification of software products quality requirements, their measurement and evaluation.

The general objective for SQuaRE is to respond to the evolving needs of users (those who develop and those who acquire software products) through an improved and unified set of normative documents covering three different and complementary quality processes: requirements specification, measurement and evaluation (Suryn Witold, Abran Alain, 2003).

SQuaRE consists of five thematic areas called divisions: **Quality Management**, that contains all common models, terms and definitions referred to by all other standards from the SQuaRE series, **Quality Model**, that presents detailed quality models including characteristics for internal, external and quality in use, **Quality Measurement**, that includes a software product quality measurement reference model, mathematical definitions of quality measures, and practical guidance for their application, **Quality Requirements**, that helps to specify quality requirements, based on quality models and quality measures, and **Quality Evaluation**, that provides requirements, recommendations and guidelines for software product evaluation, whether performed by evaluators, acquirers or developers.

Other standards involved in the quality assessment are: ISO/IEC 15939 standard "Systems and software engineering - Measurement process" (ISO/IEC 15939, 2007), that defines a measurement process applicable to system and software engineering and management disciplines, the ISO/IEC/IEEE 12207 "Systems and software engineering — Software life cycle processes" (ISO/IEC/IEEE 12207, IEEE, 2008) which focuses on the processes in the life cycle of a software product or service and the ISO/IEC/IEEE 15288 "Systems and software engineering - System life cycle processes" (ISO/IEC/IEEE 15288, IEEE, 2008), which targets the processes in the life cycle of a system. Finally there is ISO/IEC 15504, "Information technology — Process assessment" (ISO/IEC 15504, 2004) (noted as SPICE - Software Process Improvement and Capability dEtermination) which deals with process assessment and its implementations in terms of guidelines and tools.

3.2 IEEE Standards

The IEEE standards encompass software and systems lifecycles, from concept and development to delivery and maintenance. Also the reuse of software components is included. The most important are: the standard IEEE 830 "Recommended Practice for Software Requirements Specifications" (IEEE 830, 1998) which focus on content and characteristics of a Software Requirements Specification, the standard IEEE 1012 "Software Verification and Validation" (IEEE 1012, 2004) which defines the Verification & Validation (V&V) processes in terms of specific activities and includes the (ISO/IEC/IEEE 12207, IEEE, 2008) and the standard IEEE 1074 "Standard for Developing Software Life Cycle Processes" (IEEE 1074, 2006) which defines the process activities mandatory for the development and maintenance of software.

4 QUALITY EVALUATION PROCEDURE

In this section the experience matured inside the Presto4U project for the definition of the software quality evaluation procedure is reported. This activity should ideally involve multiple stakeholders and provide information to each of them to use.

Inside Presto4U, for example, in tune with its nature and particular interests, each community of practices worked for producing a customized set of preservation needs to be given to software quality expert evaluators. According to a bottom-up approach, on the basis of detected preservation needs, the evaluators have defined the preservation requirements specified using a quality model as reference and have mapped the requirements on characteristics and sub-characteristics of this quality model. In this paper, the exploratory case study stops at this phase, producing an intermediate result that is a high-level software product quality evaluation plan.

Subsequently, the plan will be refined with measures, techniques, criteria, etc. On the basis of the implementation degree of the detected in the plan characteristics and sub-characteristics, the used by each CoP tools will be evaluated.

In spite of the results will be preliminary, the most important for each CoP quality aspects will been highlighted and defined.

After all, the quality is highly context-dependent, because it means different things to different people (Kitchenham, Pfleeger, 1996).

The aspects considered during the requirements elicitation activity have been:

- the definition of the project *scope*: digital audio-visual preservation;
- the definition of the project *purpose*: the project aims to develop a body of knowledge on the status of digital preservation practice (problems and needs), to map preservation needs in quality characteristics, to evaluate the used tools, to identify useful research results and to promote their adoption and implementation;
- the definition of the different *products* that could be considered as a target for the quality evaluation procedure: in the audiovisual preservation context, they can be either tools for mapping between metadata formats and standards or for archiving and restoring of audiovisual files, or for automatic extracting and enriching of metadata of audiovisual contents, or for evaluating the quality of the various contents (like images and sounds).

On the basis of these elements and the availability of the involved stakeholders, the first steps of a quality evaluation process have been performed and the most important quality aspects in the digital audio-visual preservation context have been highlighted.

4.1 Establishing the Evaluation Requirements

Inspired by the ISO/IEC 25040 (ISO/IEC 25040, 2010) and by the software product quality evaluation process that it contains, in this section the activity of "establishing the evaluation" requirements adopted inside the Presto4U is presented. In the project, as target of preservation products, software tools have been considered.

Without the pretense to define general results, here below the identified steps useful for producing a *high level software product quality evaluation plan* are presented. Inside a complete software product quality evaluation process, this type of plan constitutes an *outcome* of the first phase of the process, called "establish the evaluation requirements", and an *input* of the second phase called "specify the evaluation". Running parallel to the project development, currently this work is placed in the first phase of the evaluation process, and the high level software product quality evaluation plan is just an important intermediate result.

For the phase called "establish the evaluation requirements", different steps have been identified and every step has been implemented as follows:

1. *Establishing the purpose of the evaluation:*
   As a purpose of the project was evaluating the used tools in order to identify useful research that could promote their adoption, purpose of the evaluation is reconsidering the acceptability of these products.
2. *Obtaining the software product quality requirements:*
   In order to ensure that the products meet user and customer needs, *stakeholders* were detected for collecting information and a *quality model* was defined as reference because software product quality requirements shall be specified using a quality model. About the stakeholders, in the evaluation process, they were identified among the staff of the CoPs. By interviews and questionnaires, a list of audio-visual preservation needs came to light. In particular, for overcoming initial differences between basic terminologies (software engineering vs audio-video preservation), a shared and informal glossary has been preliminary defined preliminary. For confidential reasons this glossary can not be included in this paper. On the basis of detected preservation needs, a list of audio-visual preservation requirements has been defined using as quality model the *product quality model* reported in standard ISO/IEC 25010 and below shown.
3. *Identify product parts to be included in the evaluation:*
   Inside the audio-visual preservation environment different products could be considered as a target for the quality evaluation. They can be either tools for mapping between metadata formats and standards or for archiving and restoring of audiovisual files, or for automatic extracting and enriching of metadata of audiovisual contents, or for evaluating the quality of the various contents (like images and sounds). Besides, each product can have specific preservation quality requirements due to the target usage or its different nature (product purchased, in a development stage, fully

developed, etc.) or the hardware, software and network environment in which the product will be used. Overall, these products cover different tasks that have to be addressed throughout the preservation workflow of digital audiovisual media. The types of identified products are tools that perform different quality aspects. For example, in the audio-visual preservation context, these quality aspects could refer to the quality of the content ("are the images good and the sound clean?") but also to the validity of the files ("are they adherent to the file standards and correctly playable?", "Content can be accessed on master archival items or on items produced for dissemination?"). The parts of tools that could response to these questions are these parts to be included in the evaluation.

4. *Define the stringency of the evaluation in order to provide confidence to it:*
   As the evaluation stringency should be related to a set of characteristics and sub-characteristics that establish the expected evaluation levels, the detected quality requirements have been mapped on the characteristics and sub-characteristics of the detected quality model, which is the *product quality model* of ISO/IEC 25010 (ISO/IEC FDIS 25010, 2011).

The mapping of the preservation requirements into the quality model constitutes a preliminary high level software product quality evaluation plan. Subsequently to quality evaluation plan development, in the phase called "specify the evaluation", the evaluation measures to be applied, the decision criteria to be defined and the evaluation results to be achieved will be detailed. However, this phase and those that follow (ISO/IEC 25040, 2010) are out of the scope of this paper.

Below, the product quality model is shown.

4.2 Quality Model

The standard ISO/IEC 25010 proposes two quality models for software product evaluation: *quality in use model* and *product quality model.* Inside the 25000 standard family, measures for each quality model are proposed (ISO/IEC 25022, 2012, ISO/IEC 25023, 2012). The *product quality* was adopted as quality model reference and in table 1 it is shown. The model consists of eight characteristics and each characteristic is composed of a set of related sub-characteristics. These characteristics and sub-characteristics will be the basis of the definition of the specialized high level quality plan according to needs and requirements of the CoPs. Therefore, the specialization could include the reduction of the sets of characteristics and sub-characteristics depending on the software tools to be evaluated and the CoPs constrains. An example of this specialization is presented in Section 5.

Table 1:Product Quality Model.

Product Quality Model	
Characteristics	Sub-Characteristics
Functional suitability	Functional completeness
	Functional correctness
	Functional appropriateness
Performance efficiency	Time behavior
	Resource utilization
	Capacity
Compatibility	Co-existence
	Interoperability
Usability	Appropriateness recognisability
	Learnability
	Operability
	User error protection
	User interface aesthetics
	Accessibility
Reliability	Maturity
	Availability
	Fault tolerance
	Recoverability
Security	Confidentiality
	Integrity
	Non-repudiation
	Accountability
	Authenticity
Maintainability	Modularity
	Reusability
	Analyzability
	Modifiability
	Testability
Portability	Adaptability
	Installability
	Replaceability

5 EXPLORATIVE CASE STUDY

In this section, the steps of the activity presented in Section 4 are exploited in order to develop the quality evaluation plan for the TATE Gallery as partner representative of the *Video Art, Art Museums and Galleries* CoP (Presto4U). Therefore, in the case study, the considered stakeholders have been identified among the staff of TATE Gallery.

As reported in the section 4 about quality process evaluation, the "establishing the evaluation requirements" is a preliminary activity of the evaluation process.

Possible *inputs* for this activity should be:

- Software product quality evaluation needs
- Software product quality requirements specification
- Applicable measurement tools and methodology
- Software product to be evaluated including intermediate products

Possible *outcomes* for this activity should be:

- Specification of software product quality evaluation purposes
- Specification of software product quality evaluation requirements
- Specification of high level software product quality evaluation plan

To derive the quality plan the following steps have been defined:

1. *Definition of preservation needs:* by interviews and questionnaires, a list of preservation needs should be generated.
2. *Identification of preservation requirements:* through an iterative refinement process the preservation requirements should be identified from the declared needs.
3. *Definition of the preservation quality plan:* the preservation requirements should be mapped in some characteristics and sub-characteristics of the product quality model (ISO/IEC FDIS 25010, 2011). As result the high level software product quality evaluation plan is obtained.

In the rest of this section further details of the implementation of these three steps in the considered case study are provided.

5.1 Preservation Needs

As the case study presented in this paper has been developed considering the experience and the knowledge of the TATE Gallery partners, the identified preservation needs are therefore specific of useful for the digital video art collections software tools. Obviously, the list is partial and further implementable. In the following the first draft of the list of collected needs is reported:

1. *The software should perform the functions of data ingest, archival storage and migrating digital file to new formats or carriers when necessary.*
2. *The software should be modified without any impact on existing quality*
3. *The software should be interoperable with TATE Gallery collection management system*
4. *All copies must be recorded as components on the collection management system (TMS) and the purpose and status of a particular copy must also be recorded*
5. *Any access to the file is restricted*
6. *Location information must be accurate and kept up to date and record the presence of a digital file.*
7. *Ingest and storage activities must not compromise the video quality of the video material. The original video quality must be preserved.*
8. *Preservation actions and decisions must be documented and transparent.*
9. *Every action or modification on the media files must be recorded and traced*
10. *Looking, controlling and operating on the system content*
11. *The software should be able to be transferred in different broadcast environments and to be adaptable to their specific exigencies*

The list has been then elaborated to derive the set of preservation requirements as detailed in the next section.

5.2 Preservation Requirements

The second step of the proposed methodology has been the identification of the preservation requirements. Usually the requirements can be written either in natural language or in semi-formal language (with graphical notations, precise syntax and a non-rigorous semantic) or in formal language (mathematics-based language with syntax and semantics formally defined). Among them, the first is the most common and easy way to express software requirements despite the ambiguity risk (Berry, D.M., Kamsties, E., Krieger, 2003). Expressed in natural language requirements can be easy communicated and discussed among various technical and no-technical stakeholders, before being used in the subsequent product development phases. In this case study, natural language requirements have been necessary for the discussions among project partners that operate in different from software engineering fields.

From the previous list of preservation needs, a list of requirements has been refined.

Req. 1: The software has to perform all the functionalities that it is developed for.

Req. 2: The software should let the possibility to integrate/correct/modify user-specific features or components without any impact on existing product quality.

Req. 3: The tool should be interoperable with different collection management systems and should let the possibility to import data from different format.

Req. 3.1: The tool should import material in both 25Hz and 29.97Hz formats.

Req. 3.2: The tool should input/output different file formats like for instance MXF.

Req. 4: The software should track all copies and record the purpose or status of each copy.

Req. 5: Any access to the file is restricted.

Req. 6: Location information must be accurate and traceable.

Req 6.1: The tool should store different information about the file considered such as: Object No, Title, Artist, Dims, Comp No, Comp Name, Comp Desc, Media Fmt, Duration, Video Std, Aspect Ratio, When Made?, Where made?, Provenance, TiBM label, Current Location, Video Res., Colour, Audio, Details of Master, Misc, Author.

Req. 7: During its activity, the software should not allow the alteration of the ingested material video quality.

Req. 7.1: The system should include a quality control flags, monitor the level of errors, and support corrections when occurred.

Req. 8: Preservation actions and decisions can be proven to have taken place and cannot be repudiated later.

Req. 9: Every action or modification on the media files must be recorded and traced.

Req.10: The software should let easy control and operate on the content.

Req.11: The software should be adapted for different, evolving, operational or usage environments.

5.3 Towards an Evaluation Plan: Mapping between Requirements and Product Quality Model

The last step of the proposed methodology is the definition of a preservation quality evaluation plan. Considering the main just above-cited requirements and the characteristics and sub-characteristics of the adopted quality model (see paragraph 4.2), here below a possible mapping between these elements is reported.

For completeness, requirements and definitions of the sub-characteristics are reported.

Req. 1 – *The software has to perform all the functionalities that it is developed for.*

Characteristic: functional suitability

Sub-characteristic: functional completeness - Degree to which the set of functions covers all the specified tasks and user objectives.

Req. 2 – *The software should let the possibility to integrate/correct/modify user-specific features or components without any impact on existing product quality.*

Characteristic: maintainability

Sub-characteristic: modifiability - Degree to which a product or system can be effectively and efficiently modified without introducing defects or degrading existing product quality.

Req. 3 – *The tool should be interoperable with different collection management systems and should let the possibility to import data from different format.*

Characteristic: compatibility

Sub-characteristic: interoperability - degree to which two or more systems, products or components can exchange information and use the information that has been exchanged.

Req. 4 – *The software should track all copies and record the purpose or status of each copy.*

Characteristic: reliability

Sub-characteristic: availability - degree to which a system, product or component is operational and accessible when required for use.

Req. 5 – *Any access to the file is restricted.*

Characteristic: security

Sub-characteristic: confidentiality - degree to which a product or system ensures that data are accessible only to those authorized to have access.

Req. 6 – *Location information must be accurate and traceable.*

Characteristic: security

Sub-characteristic: authenticity - degree to which the identity of a subject or resource can be proved to be the one claimed.

Req. 7 – *During its activity, the software should not allow the alteration of the ingested material video quality.*

Characteristic: usability

Sub-characteristic: user error protection – degree to which a system protects users against making errors.

Req. 8 – *Preservation actions and decisions can be proven to have taken place and cannot be repudiated later.*

Characteristic: security

Sub-characteristic: non-repudiation - degree to which actions or events can be proven to have taken place, so that the events or actions cannot be repudiated later.

Req. 9 – *Every action or modification on the media files must be recorded and traced.*

Characteristic: security

Sub-characteristic: accountability - degree to which the actions of an entity can be traced uniquely to the entity.

Req.10 – *The software should let easy control and operate on the content.*

Characteristic: usability

Sub-characteristic: operability - degree to which a product or system has attributes that make it easy to operate and control**.**

Req.11 – *The software should be adapted for different, evolving, operational or usage environments.*

Characteristic: portability

Table 2: High level software product quality evaluation plan.

Product Quality Model		Requirements
Characteristics	Sub-characteristics	
Functional suitability	Functional completeness	REQ.1
Compatibility	Interoperability	REQ.3
Usability	Operability	REQ. 10
	User error protection	REQ. 7
Reliability	Availability	REQ.4
Security	Confidentiality	REQ. 5
	Non-repudiation	REQ. 8
	Accountability	REQ. 9
	Authenticity	REQ.6
Maintainability	Modifiability	REQ.2
Portability	Adaptability	REQ.11

Sub-characteristic: adaptability - degree to which a product or system can effectively and efficiently be adapted for different or evolving hardware, software or other operational or usage environments.

The below-presented table summarizes a specialized high level quality evaluation plan that will have to be refined with techniques, measures to be applied, decision criteria to be defined and evaluation results to be achieved for better specifying the evaluation. In spite of its high level detail, it is just an example of quality evaluation process refinement on only few of the possible characteristics and sub-characteristics of the quality model. The refinement highlights the most important quality aspects in the specific context of digital video art collections, which are mainly related to security.

6 DISCUSSION AND CONCLUSION

The paper has presented an experience in the identification of audio-visual preservation needs and corresponding requirements in order to set up a quality evaluation process for tools and applications identified inside the Presto4U project.

Considering in particular the digital collections, the definition of specific preservation needs has been performed in collaboration with TATE Gallery.

Subsequently the specification of these needs in software product quality evaluation requirements and the identification of a quality model for mapping them have been implemented. For this a selection of the most suitable characteristics and sub-characteristics of the detected quality model came to light and a preliminary high level software product quality evaluation plan has been defined.

The experience reported in this paper confirms some of the weaknesses identified by different researchers in the procedure of international standards applicability. In particular most problems rise in the alignment of the classical terminology of the software engineering context with the one that is specific for the preservation environment. Thus a shared and informal glossary has been preliminary defined so to avoiding possible misunderstandings. Moreover, this experience highlights the necessity of a quality evaluation plan customized according to specific needs to be considered and specific characteristics to be measured. Indeed the list of characteristics and sub-characteristics provided in the standards do not completely reflect the specific exigencies of the particular environments as, for example, the preservation environment. In line with

one of the research results about the applicability of the standards, it is opportune underlining the necessity of specializing quality evaluation plan by selecting the characteristics to be measured taking also in consideration the organizational limits and constraints.

The procedure customized for the audio-visual preservation has been positively accepted inside the Presto4U project that, for the first time, faces the problems of the applicability of international standards for software quality assessment. Different stakeholders have considered the proposed procedure, the encountered problems and the practical proposed solutions a good reference to replicate the experience in software engineering contexts different from audio-visual preservation one.

Besides, the proposed quality evaluation plan is part of the future work of assessment of the audio-visual preservation tools. Similarly to what has been done for the definition of the quality evaluation plan, the set of measures will be also specialized and adapted to the audio-visual preservation context. For this a wide range of different quality aspects would be taken into account such as: properties of source code, test-related properties such as coverage, or architecture-related properties, such as data access constraints or communication directives. The specific information needs of the different involved in Software Quality Assessment (SQA) holders are another essential dimension.

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