A global issue: preservation of digital objects

Hans Hofman
National Archives of the Netherlands

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Introduction

Much has been written and discussed about the preservation of digital information, objects or records. There is a plethora of projects and initiatives in this area trying to find solutions for the problem that digital information is volatile, intangible and mutable. Existing preservation methods as for paper do not longer suffice and new and innovative approaches and methods have to be developed. It is experienced not only in traditional memory organisations as archival institutions, libraries, and museums, but also in broadcasting companies, institutions with audio-visual collections, entertainment industry, business companies such as pharmaceutical or petrochemical industry, research institutions with huge amounts of scientific data and so on. Everybody that produces digital information and has an interest in preserving it for a certain period has to face the issue how this can be achieved and that becomes more difficult the longer this information has to be preserved. In other words the issue of digital preservation is not limited to one organisation, or a certain domain like memory organisations, or a country, it is really a global issue that everybody in this field is trying to deal with.

Although there exist many initiatives in this area, real and enduring solutions are not yet available. There are some interesting strategies being developed to date, which may provide a solution for the short and perhaps mid-term. These strategies may include developing standards for storage formats or preservation metadata, legislation, prescribing standards, or developing reference models for preservation functions or repositories, or defining minimum sets of metadata that allow the ongoing maintenance and access of these information resources.
The natural ally of preservation is accessibility, the one cannot without the other. Therefore any requirements for preservation have to be based on the requirements of accessibility and use of digital information. It is this whole, complicated area, which is being addressed in this paper. The objective is to provide an overview of the main issues and requirements, followed by the main developments to date in the search for solutions with a brief description of the

achievements and the available methods and tools. Additionally I will try to identify some initial steps that could be taken in order to implement proper management of digital records and related preservation strategies, starting with record creating agencies. Finally the main focus will be on electronic records, although I will take sometimes a broader view.

Requirements

The requirements for preserving digital records (or other information resources) are derived as indicated from the use organisations or people want to make of them. Well known reasons are the business process, accountability, research, law suits, and they include also cultural heritage. In order to enable these purposes and activities information resources need to be retrievable, authentic, reliable, understandable and usable. I will explain these requirements briefly.

Accessibility

Accessibility can be seen as one part of what can be called a binovular twin. The counterpart is preservation or longevity. Without accessibility preservation of information does not make sense and similarly the other way around without adequate preservation of information there will be no accessibility.
Accessibility as such is no new requirement, but in the case of digital information it can be considered a real challenge. With paper records one can always walk to a shelf to search physically through the records, digital records can be considered as lost if there is no consistent naming convention for documents or better files, or if search applications as windows explorer cannot be used. Digital information is invisible and intangible even if it is stored somewhere on a hard disk.

Accessibility requires arrangement and description of the records. Records can or better should be structured and organised for instance by applying a classificationscheme. This will not only contribute to the accessibility, but also establishes coherence or more correctly expresses the interrelationships between the documents that are created and received in carrying out a certain business process (filing of the records).

At closer look one could say that accessibility consists of a sequence of three sub-requirements:

1. **Retrievability**. Records have to be retrievable. Instruments to enable that are making them identifyable, arranging or structuring them, and describing them (in a digital

environment mostly metadata). The arrangement and description methods that are chosen for records can be articulated in a structuring scheme, e.g. a business classification scheme. Search results based on these descriptions and structures should be presented to and can subsequently be interpreted by the user, who can make then choices for one or more records or documents.

2. **Readability**. As soon as digital records are retrieved and identified as relevant they have to be reproduced and presented on the screen. This supposes that the appropriate software is available to get the file, to interpret the encoded data and to reproduce and present the record or the information in the correct (=authentic) form and structure.
3. **Interpretability**. If both previous steps have been properly achieved, then the presented record (or document) has to be interpretable. That means the record has to be accompanied with the necessary and explanatory metadata about provenance and documentary context. The user should know why and how the document once has been created, for what purposes it has been used and what the interrrelationships with other documents are, even if this is not always necessary for answering his or her specific question. With this information or metadata the user can assess the value of the document and its content in relation to the research or use.

Authenticity

One of the big issues around digital documents or records is authenticity. Apparently it seems to be a new phenomenon that causes quite a lot of discussion. It is however not a real new thing, because it was already implictly present with paper records. Paper records are physical entities and it is mostly easy to recognise whether it is an original document or authenticated copy. The reason why it has become an issue now is that digital document or records by their very nature are intangible and volatile, and it is therefore not easy to apply the requirement for authenticity. So what does authenticity mean in a digital environment?

A lot of research has been done and described by Luciana Duranti about the notion of authenticity in several projects as for instance the Inter Pares project, using and going back to the old discipline of diplomatics.[1] It does not fit into the framework of my presentation to dive into this subject here, which is worth a conference on its own. I will only mention briefly some of the most relevant aspects and issues. Authenticity refers to our requirement to be able to retrace documents or records to their creation (or origin), so we are able to identify why, when, where, by whom and so on, they were created and used. We need the answers to these questions not only to know the identity of a record, but also to know whether the

presented information is trustworthy or reliable. In other words we need to be able to position a record in the time and context from which it purports to originate. After all, if we know somebody or something (or think we know) we are able to establish whether we can trust him, her or it, or not. In order to enable this judgement or assessment we need information that can answer those questions. That information might not always be used in reality, but it should be there one way or another, so we can fall back on it. Mostly, however, people just trust the information or records as presented without going through the procedure of checking it. This also depends on what organisation or individual is supplying the records. A trusted party as an archival institution is mostly considered more reliable than for instance an arbitrary person providing information on the Web.

In this respect it will be necessary to have not only information about the context of creation (e.g. about organisation or individual, activity or function, time, place, reason), but also information about the relationship with other documents (e.g. in a case file), and information about the management of the records from their capture until the moment of (any) presentation. Evidence should be available to answer questions as e.g. how has the record been maintained, or has the document been tampered with? This contributes also to whether we can trust the presented record or not.

Apart from this reason the digital nature of records requires that information has to be captured about structure and form and sometimes even about the behaviour of a document or record at the moment it was used in a business activity. The level of detail of this description will differ for documents in different business processes, since the authenticity requirements will differ in each of these business processes. More explicitly stated, authenticity requirements are dependent on the nature of the business process and the context in which it is carried out. Criteria are for instance legislative, regulatory, business and juridical aspects. They determine how strict authenticity has to be interpreted. Those that are able to identify best what the essential characteristics of certain types of documents in a specific business proces are, are the people that are responsible for and carrying out that business process.[2]
An instrument to describe the form and structure can be XML (e*Xtensible Markup Language*). The description of the structure can be done by using a document type definition (DTD) or schema, that subsequently also can be used to check whether the created

[1] More information can be found on the website of Luciana Duranti (www.slais.ubc.ca/users/duranti) and of the Inter Pares project (www.interpares.org).
[2] In the CAMiLEON project research is being done to establish the requirements (future) users will have as regards to authenticity of digital objects. The context of the user is the important factor. What is the reason for using a record or object, but it is equally relevant to be aware of the intention of the creator in creating the record or object.

documents comply with the intended structure or not. It is obvious and more cost-effective that a DTD or schema should be made and implemented before creation of documents or records. With the *eXtensible Style Language* (XSL) the form of a record can be described (in a style sheet). In some recent versions of word processing applications these tools are already implemented. Several projects on digital preservation are using this approach, e.g. the NARA project, and the Dutch testbedproject.
Basically the sequence of activities in the process of searching and using information consists of retrieving, interpreting, trusting and using it.

The nature of digital information

One aspect is essential in relation to long term preservation of digital records, and that is the distinction that has to be made between digital records (the conceptual aspect) and the computer files (the technical aspect). I will try to clarify what is meant with this distinction. With paper records it is obvious that the document and the carrier are one. They form one physical entity. Form and structure are physically fixed by paper (or parchment) and do not have to be described as such. With respect to digital records it is very much different. These records are no longer physical entities. Information technology has fragmented them into different components, e.g. software, datafile, medium and hardware. The consequence is that we have to make a distinction between an intellectual or conceptual and a technical presentation. That makes it, more than in a paper world, necessary to identify and describe what needs to be preserved.

At the one hand there is the representation on the computer screen. That is the record that human beings can read. On the other hand there is the physical representation, being one or more computerfiles with encoded data that are stored on a medium (hard disk or CD-ROM or tape). We are dealing here with different things that both need to be managed in order to preserve and to reproduce digital records or other objects. Sometimes there might be a one to one relationship between a document or record and a computerfile, but mostly more than one file will be necessary to reproduce the conceptual record. Or the other way around sometimes one computerfile may even contain data of one or more records, so the relation can be 1:n, n:1 or even n:m. Especially in the case of multimedia and more complex digital documents or objects the latter will be the case. To give a simple, perhaps a little bit technical example, in presenting a MS Word document the wordprocessing application uses not only a file with bytes that contain the text characters in the document, but also a so-called dll-file (dynamic link libraries-file) that is used by the system software (Windows) to present the characters in the font or fonts used by the writer. Though these dll-files are not part of the user created document, they are necessary to reproduce and represent the document

properly and in the way the writer intended it. This goes the same with other types of content such as for instance graphics.

So each time a digital record has to be presented on the screen, it has to be reproduced or reconstituted by software using the digital components as stored on the storage medium. As soon as a document on the screen is 'closed' or saved, it will be stored as encoded data that are only interpretable by the (application) software. In other words that what is stored on the storage medium is not the same as what is presented on the screen. To know whether the document that is presented on the screen is similar to the document that was once received or created in a business process, we need a description of this (conceptual) document. The components that have to be described are content, context, form, structure and in some cases behaviour (e.g. a spreadsheet that contains formulas). To what extent depends on the authenticity requirements.

The awareness of the distinction between these conceptual and technical aspects of digital records is essential to manage them (see diagram). In the Netherlands a Ministerial Regulation has recently been issued that addresses both and establishes requirements and standards for archival records to be implemented in procedures, systems, and software applications used to create, manage and preserve records in government organisations. These applications could be dedicated records management software applications, but also records management functionality integrated in business applications.

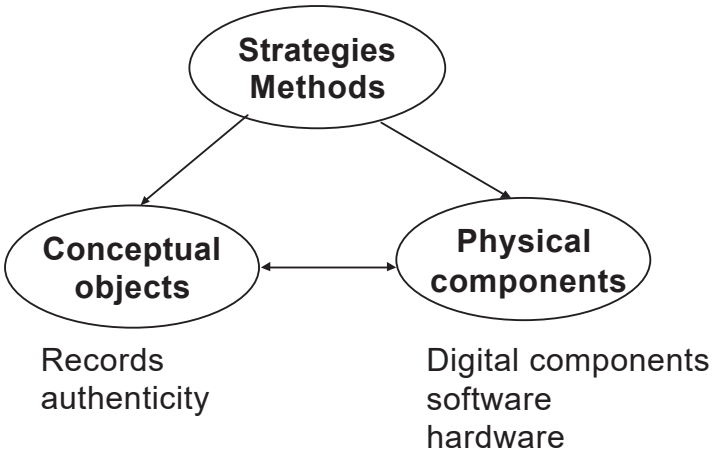

Figure 1 One strategy for two different objects

Issues to be solved and available approaches, concepts, solutions

In the previous sections the main requirements and fundamental issues have been identified. The next step is to develop frameworks, strategies, infrastructures, and methods that enable to deal with them, so proper records management over time can be implemented and achieved. To summarise briefly the issues posed by digital information:

- the increase of control necessary to ensure authenticity and integrity of the digital records
- the awareness of dealing with two types of objects: the intellectual or conceptual objects (=records) and the technical objects (=computerfiles)
- the functionality or processes necessary to achieve that the (archival) requirements are implemented properly
- the organisation of metadata structures required to enable management and preservation, and to ensure accessibility, interpretability, reliability, integrity and authenticity of the records. One of the major issues in this respect is interoperability.
- although out of scope of this paper I could add also the development of user interfaces that enable searching, presenting, and using records and other kinds of digital information. Searching should be enabled across organisations and across domains.

The required strategies and methods have not to be invented by organisations from scratch though, because there are already several strategies, methods and tools available that could help to build a safe and proper environment for preserving and managing digital records.
I will list the following initiatives and projects in this respect and try to position them when discussing implementation:

- First of all there is the recently launched ISO Records Management Standard (15489:2001) upon which I will dwell a little bit more in the next section. Closely related and a good and useful example of guidance for implementing the records management standard is the Australian ‘Manual for Designing and Implementing Record Keeping Systems’ (DIRKS).
- The results of several projects such as the Inter Pares project (with requirements for preserving authentic records), the European NEDLIB project (about long term preservation of digital publications), the NARA project (on preserving digital information using XML), the Dutch Testbed project (on possible preservation strategies and practical guidelines) offer other rich sources for implementation.
- Reference models for a preservation function, such as the Open Archival Information System (OAIS) and the Inter Pares preservation function model for archival records, provide useful overall frameworks with all aspects that have to be taken into account.

- Collaborative initiatives that enable information exchange, discussion of key issues, dissemination of reasearch results, new research projects, trials and so on, such as ERPANET and PADIFORUM.
- Metadata standards, such as the resource discovery metadata set of Dublin Core, and archival description standards as ISAD/G and ISAAR, the preservation metadata report of CEDARS and the recent report of the preservation metadata working group of RLG.[3] In this area much activity is going on, including defining record keeping metadata guidelines based on the ISO records management standard.
- The draft report of RLG/OCLC 'Attributes of a trusted digital repository', that provides an overview of all kinds of aspects relevant for the proper, safe and reliable management and preservation of digital objects.[4] With this report organisations are able to identify to what extent they comply with all the requirements for preserving digital objects in a safe and reliable manner.

It is clear that one is not alone in this area. The point is how to find your way through the results of all these projects and how to assess and to identify what is relevant and useful. The above mentioned reference models offer an initial and useful framework, but they still are not easy to understand and more practical guidance is needed for organisations to develop their strategy, to start a program and to implement methods and infrastructures. Especially the issue of costs and risk analysis is still unclear. There is yet not much experience with preservation of current types of digital records. Most experience has been gathered with preservation of relatively simple databases, not with the kinds of records or objects records managers and archivists or other disciplines are confronted with now. In the following section I will try to discuss these implementation issues a little more in depth.

Implementation issues and approaches

Most people consider requirements, frameworks, and the results of most of the projects as rather theoretical and want more practical guidance. In other words to know what the requirements are and what they really mean is one thing, the implementation of them another. At least two perspectives can be distinguished, that of the record creating organisations and that of the archival institutions, but more important implementation has different aspects that have to be taken care of, e.g organisational, technical, and archival.

[3] The archival description standards are available on www.ica.org/cgi-bin. The CEDARS report on www.leeds.ac.uk/cedars. The RLG metadata report can be found on www.rlg.org or www.oclc.org/research/pmwg.
[4] The final report can be found on www.rlg.org/pr/pr2002-repositories.html or www.rlg.org/longterm/repositories.pdf. .

The latter has been discussed above in the section on requirements, but the other two need further explanation.

One key principle is that preservation does not start at the moment records are transferred to an archival institution, or even at the moment when records will be created, but already in the design stage of information systems. It requires already in that stage, before any record has been created or received, an analysis of the relevance of the business process as such and in relation to other business processes, of the regulatory context, and of the records that will or need to be received and/or created . Based on this first assessment the specific requirements for records and records management can be identified and it will also be clear whether records with archival value will be produced and subsequently whether long term preservation measures have to be taken. This approach will be the most cost-effective.

From the perspective of archival institutions the position taken will be mostly as follows:

1. The responsibility for the accessibility and preservation of archival records lies with the record creating organisations as long as they are not transferred
2. The archival requirements are not something on their own. They need to be embedded in the whole of records management measures, procedures and so on (including the records that do not have archival value), especially in the case of digital records. These records are subject to the rapid developments in IT (as regards to storage media, storage formats, software versions, hardware components and so on) and the subsequent threat of obsolescence. Five years is already a long period. Many records have to be retained and preserved for reasons of carrying out activities or to be accountable during a certain period, although they do not have archival value. That requires for reasons just mentioned that proper attention has to be paid to their management (e.g. procedures, adequate systems, and access control) and technical maintenance, such as refreshing, conversion and even migration of digital files.
3. The current developments in government to realise digital service delivery to citizens (in e-government programs) and in business companies are a good starting point or trigger for implementing and integrating the necessary requirements and record keeping functionality including preservation. For these new online services whole new infrastructures have to be created and developed.
4. The archivist may help and support in these developments with his expertise. This supposes though that that expertise and knowlegde is available within archival institutions and that is not always the case, to say the least.

This is all true, but archival institutions also play a key role in detemining what records have archival value and as such they are involved, as also identified in the ICA ‘Guide for

managing electronic records from an archival perspective'.[5] The other point is that no government organisation (at least in the Netherlands) really has organised its digital records management appropriately if at all. They are still very much in the area of experimenting and pilot projects. In most cases still paper records are being archived, though they may have been created digitally with word processing applications. That goes particularly for certain types of digital records such as e-mail messages that are being printed. Nonetheless theincrease of digital documents (including databases) that should be considered records, but are not managed as such, is huge. Take only the large amount of e-mail messages that is being sent and received, and the many databases and documents made with word processing applications, they all fall under the same category. Records management applications are not yet in place, but even if they are, preservation is not their strength. That touches another issue, the lack of adequate IT-tools. Suppliers or vendors offer a range of software tools, that in their opinion are compliant with all records management requirements, but there are no sufficient assessment tools to certify that, and worse there is not one set of requirements. The DoD 5015.2 standard for instance is only one of many and it has a certification process connected to it. Nonetheless these emerging sets of requirements provide a first basis for developing adequate software tools. In the following section I will briefly descibe the main developments that are taking place to date, starting with the ISO records management standard, a first common and broadly accepted framework.

A Framework for implementing preservation strategies for records

The international *Records Management Standaard*, ISO 15489-1:2001, is one of the recent major achievements in the area of managing a specific group of information resources, called records. [6] It provides an excellent starting point for implementing an appropriate records management regime, that also addresses preservation, though only at a high level.

One important and leading principle in organising records management, including long term preservation for an organisation is that it should be the business process that determines and influences the way how to implement it, and not the point of view of records management itself. That view is taken by the ISO records management standard and has also been translated in a ministerial regulation on accessibility and arrangement of archival records in the Netherlands.
It is the organisation that has to carry out activities and that has to identify the risks if records management does not meet all requirements. That seems to be obvious, but in practice both have grown apart and are not always tuned in an optimal way to say the least. The ISO

[5] Published in 1997. Website: www.ica.org/eng/mb/com/cer/index.htm

standard articulates this principle by offering a framework that identifies the needs of an organisation to have evidence of its activities, to enable accountability and to manage its information resources for as long as needed.
The standard also includes a methodology that supports the integration of records management into business processes. This methodology consists roughly of the following steps:

- A preliminary investigation that identifies the role and objectives of an organisation and her regulatory framework
- An analysis of business activities that should lead to a classification scheme and an overview of the different business processes and transactions.
- Identification of the records requirements in each business activity
- Assessment of the existing records systems based on the requirements evaluation
- Identification of strategies in order to comply with the records requirements
- Design of a records system
- Implementation of a records system
- Post-implementation review of the performance of the records system and if necessary adaptation.

This methodology provides a firm basis for achieving proper records management and implementation of a records system. What a records system should look like is another question. That depends on the requirements derived from the activities of an organisation, its regulatory framework and the risk analysis. The answers to these questions are provided by using this methodology, which is further described in the Technical Report accompanying the ISO standard. It is derived from the Australian methodology called *Designing and Implementing Recordkeeping Systems* (DIRKS).[7] Using this methodology requires a big investment. The standard and its technical report with guidelines offer a good overview of all the issues involved in achieving proper records management and the records processes of which its consist, including preservation. As such it can also be a model for implementing preservation strategies.

With the archival requirements and the framework of the records management standard the following set of initial steps for implementing proper preservation strategies could be carried out:

[6] Available on: www.iso.ch
[7] The manual of DIRKS can be found on www.naa.gov.au/recordkeeping/DIRKS.

1. Identify the ambitions of the organisation in relation to e-government or electronic service delivery
2. Assess the current situation as regards to records management, records systems and use the ISO records management standard as a check list. Determine based on the results of both the approach, objectives and phases or steps for change.
3. Involve senior management by asking them to make policy statements about the value of information as source for creating knowledge, the quality of information management, the use of standards, the necessity of proper accessibility, and about acquiring the necessary skills and competencies, and so forth.
4. Follow the steps for implementation as indicated in the ISO standard. In this phase the above mentioned reference models for preservation can be used.
5. Monitor and review regularly the performance of the implemented systems and procedures.

This is only an example and can be adapted if needed, based on the circumstances in an organisation, and extended. In addition to this framework for getting proper records management in place, reference models for preservation as the OAIS-model or the more records-specific Inter Pares preservation function model can be used.[8] They offer a more in depth insight of the necessary functionality of maintaining, preserving, and reproducing digital objects. Though the models focus on long term preservation the functionality is not fundamentally different for managing current records. The same can be said of the archival requirements that govern the preservation system.

Since almost no organisation will start from scratch one of the issues to be dealt with is that of the already existing information resources (e.g. in legacy systems). First of all has to be identified whether they have archival value or not. Another issue is what relation they have with paper files. Since most organisations are still in a transitory state towards working completely digitally that relationship will exist in most cases. Much of the archiving is still taking place by using paper files. What is being done electronically is communication by using e-mail and storage by using databases of all sorts, as for instance for geo-spatial data. However in most of these cases there has been or will be no proper electronic records management. That means that there is a huge backlog in trying to make these information resources preservable and usable for future generations. Much effort and resources will be needed to take care of those archival records that are created in this situation. It is a separate issue, but no less important and it requires a separate approach. Organisations need to stop this hybrid situation as soon as possible and take the necessary measures that

ensure that appropriate management of digital records is in place. In the case of legacy systems each of them has to be analysed to see whether they contain valuable records and if so, what steps have to be taken to preserve them properly.

Other resources

Useful for building a program for (longterm) preservation are gateways as for instance the PADI website and very soon also the ERPANET website that intends to provide reviewed information on preservation projects, websites and publications.[9] They both are a solid starting point for getting an overview of the field of digital preservation and the latest state of the art.

Some institutions recently started to build their own repositories as for instance the Dutch Royal Library, one of the leading organisations in this area, and the British Library.[10] In the USA the NARA is building a program to develop persistent strategies for preservation and the Library of Congress is leading a so-called '*national digital information infrastructure preservation program*' that should provide a national planning report or schedule for dealing with long-term preservation.[11]

More practical experience is gathered in projects as CAMiLEON and the Dutch testbedproject for longterm preservation. The first tries to identify the applicability of emulation and migration for different kinds of digital objects and analyses the significant properties of these objects. The Testbed project carries out all kinds of experiments in order to identify what preservation strategies can be best applied to what kinds of records.[12] It are these practical guidelines that people help to understand the issues and enable them to implement the proper methods for preservation of valuable information resources.

Collaboration: Building partnerships

The challenge to preserve digital objects in all their forms is huge, just because of their nature and triggers everybody who has an interest in it and what is more, there is a growing

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[8] See for the Inter Pares preservation function model: www.interpares.org/documents. The model itself is not finished yet, but there is a high level description in the final Inter Pares 1 project report.
[9] See www.nla.gov.au/padi and www.erpanet.org.
[10] Information on the joint IBM/KB study on longterm preservation can be found on: www.kb.nl/kb/resources/frameset_kenniscentrum.html
[11] Amy Friedlander, 'The National Digital Information Infrastructure Preservation Program', *D-Lib Magazine* Vol.8 No. 4, April 2002 (www.dlib.org/dlib/april02/friedlander/04friedlander.html). Information on the NARA project can be found on the website of NARA (www.nara.gov) and of the San Diego Super Computer Centre (www.sdsc.edu/nara/publications).

tendency to co-ordinate efforts in developing solutions, strategies and approaches. Examples of collaboration are, apart from the ISO standardisation work, the recent Digital Preservation Coalition in the UK, the international Inter Pares project, the Research Libraries Group (RLG) though that existed already but has taken an important role in it, the already mentioned European ERPANET-project and last but not least the standardisation work around the reference model of the Open Archival Information System (OAIS).
Partners can and should be found within and across domains as is shown for example in the OAIS working group with librarians, archivists, and scientists, and in the Inter Pares project, with archivists, computer scientists, and representatives from the music community and the scientific community.

It is also important to realise that in order to carry digital records through time and deliver them to current and future users, a close relationship is necessary between creators and preservers on the one hand and preservers and users on the other. In the records domain for instance that concerns the record creating organisations, in the library domain that may be the collaboration between publishers and librarians. Sometimes these roles may be united within one organisation, but as time goes by that will hardly be the case. Creators produce digital records for carrying out their business and preservers have the responsibility to maintain them over time and keep them accessible and understandable for other reasons that have a broader, societal scope, e.g. cultural heritage. Understanding (current and future) users and the way they use records or information resources and what is of value to them is another issue preservers have to deal with. It will influence preservation strategies and the management of records. In practice however this is an area that needs much more attention than is is given today, especially in the archival community.

[12] Information about CAMiLEON can be found on www.si.umich.edu/CAMILEON/about.htm; information about the Dutch testbed project: www.digitaleduurzaamheid.nl/index.cfm?paginakeuze=181&categorie=2

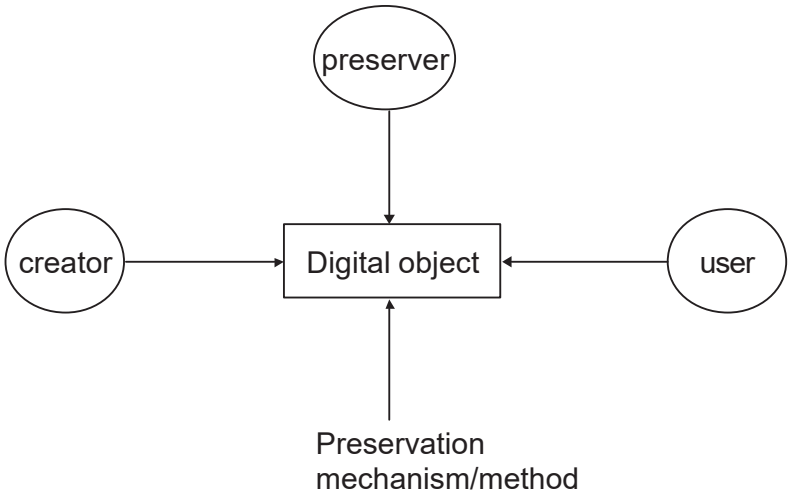

Figure 2 The digital object and relevant actors

In diagram 2 the connection between the different players is shown. Two other types of players can be added here. First there is the IT-industry that provides the technology to produce and maintain digital objects. They should be more involved in developing solutions in longterm preservation and provide tools. As such they should have a connection with the preservation infrastructure and standardised methods. Finally there is a group that plays a role in controlling the quality of the preservation systems and procedures. Quality assurance will be an important factor in longterm preservation.

Conclusion

Preserving digital objects poses unprecedented challenges to all organisations that have a responsibility in this area and many of them are trying to find solutions both within their own domain and together with other partners. The awareness of the issues on digital preservation is now at a point that this can be better achieved and that more progress can be made. In many government agencies that awareness is still insufficient though.
The increasing effort that is going into this area of research is producing more and more valuable results that can be used in building preservation programs and strategies, but also more practical implementation. The situation has reached the stage where theory is being moved into practice. The first digital repositories are being built and projects with experiments and testbeds collect useful practical experience, guidelines and facts. Still, a lot of further work and research has to be done, both in theory and in practice. Preservation technologies as migration and emulation need to be investigated more in depth in relation to different types of records or objects, before they can be applied more succesfully. The increasing complexity of types of electronic records is making that even more necessary. The growing opinion is that not one strategy will be sufficient, but that a combination of strategies will be necessary to be succesful in preservation.
In the records domain measures with respect to longterm preservation have to be taken already in the design stage of new systems in record creating agencies. They have to be integrated in records systems or business systems depending on where the records will be managed. It will be too costly if they will be taken later in the life cycle.
In this respect record creating organisations play an essential role and it will be crucial that senior management expresses its interest and commitment in achieving and maintaining good records management including longterm preservation and make that position clear to all employees in an organisation. Regulations alone will not be sufficient. If people do not see the relevance of these or that they can benefit they will not be obeyed, certainly not if there are no sanctions.
An important trigger in establishing the appropriate environment for managing and preserving electronic records can and should be the current developments around e-government and electronic service delivery. This will require that organisations review their existing infrastructures, both technically and organisationally, and rebuild them completely. This will only be succesful if the information and records management is integrated properly.

There is also an increasing tendency to building partnerships and networks of interested organisations, not only within certain domains, as library or archival communities, but also across domains. Not only the openness of the world wide web invites or perhaps forces

organisations to this, but there are more triggers as the awareness of similar research going on in other domains, and in relation to that the need of interdisciplinary research in order to achieve solutions, the objective to avoid redundancy, the willingness to share results of projects or research and to discuss key issues and so on. In this dynamic field the archival community in general however still has to catch up with the developments going on in otherdomains. Collaborative efforts as the European funded project ERPANET, which is not focusing on records or archives in particular, may help in this respect and will also provide useful platforms for information exchange and for building research agendas.

Some references:

Inter Pares project on authenticity and integrity of records and long term preservation: www.interpares.org

Reference Model for an Open Archival Information System, ccsds 650.0-R-1.2 (draft) July 2001: http://ssdoo.gsfc.nasa.gov/nost/isoas/ref_model.html

ISO Records Management Standard 15489:2001 : www.iso.ch (English)

International standard for Archival Description (ISAD/G) and International Standard for archival authority files (ISAAR): www.ica.org/cgi-bin

Dublin Core, a standard for information resource discovery: http://dublincore.org

NARA project on digital preservation: www.sdsc.edu/nara/publications.html

XML and other related standards: www.w3c.org

NEDLIB project, a collaborative project of several national libraries in Europe: www.kb.nl/coop/nedlib

RLG report 'Attributes of a trusted digital repository' : www.rlg.org/pr/pr2002-repositories.html

PADI, main gateway to information about digital preservation: www.nla.gov.au/padi