A Predictive Model for Attaining Quality in Recordkeeping

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Abstract

Records are a subset of information and recordkeeping requirements demand that a record is managed with maintained authenticity and reliability, i.e. with high quality. Records are evidence of transactions and are used and managed in daily work processes. Records may be preserved for anything from milliseconds to eternity. With computer based information systems the electronic record was born: a record that is born digital. With electronic records problems regarding maintenance of authenticity and reliability have been identified. Electronic records are no longer physical entities as traditional records were. An electronic record is a logical entity that can be spread over different locations in a computer based information system. In this research the aim is to improve the possibility of reaching high quality in recordkeeping systems, i.e. to maintain reliability and authenticity of electronic records, which is necessary if electronic records are to be usable as evidence of transactions. Based on case studies and literature studies, a recordkeeping quality model is presented: a predictive model for attaining quality in recordkeeping. The recordkeeping quality model consists of four major concepts which are interrelated with each other: Electronic records, Records use, Electronic record quality, and Multidimensional perspective. The model is proposed for use when designing and developing computer based information systems which are required to be recordkeeping systems which manage electronic records. In this research two results beside the recordkeeping quality model are emphasized. The first is that quality in recordkeeping must be seen in a multidimensional perspective, and the second is that recordkeeping systems are information systems with a partially unknown purpose.

Keywords: Authenticity, Electronic record, Information systems, Recordkeeping, Reliability, Quality
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# Content

1 INTRODUCTION ................................................................................................................................. 1

1.1 AIM OF THE RESEARCH ................................................................................................................. 4
1.2 THESIS STRUCTURE ........................................................................................................................ 6
1.3 INCLUDED PAPERS .......................................................................................................................... 7

2 METHOD .................................................................................................................................................. 8

2.1 RESEARCH PERSPECTIVE ............................................................................................................... 8
2.2 RESEARCH PROCESS ....................................................................................................................... 10
  2.2.1 Cover paper ................................................................................................................................ 11
  2.2.2 Paper I ........................................................................................................................................ 12
  2.2.3 Paper II ...................................................................................................................................... 12
  2.2.4 Paper III ..................................................................................................................................... 13
  2.2.5 Paper IV ..................................................................................................................................... 13
2.3 QUALITY IN RESEARCH .................................................................................................................. 14

3 RECORDS AND RECORDKEEPING .......................................................................................... 16

3.1 RECORDS ............................................................................................................................................. 16
3.2 RECORDKEEPING AND RECORD SYSTEMS .................................................................................... 21
3.3 RECORDS RELATED CONCEPTS ....................................................................................................... 23

4 INFORMATION- AND INFORMATION SYSTEMS QUALITY ............................................. 25

4.1 QUALITY IN THE IS DOMAIN .......................................................................................................... 26
4.2 ASSESSMENT MODELS ...................................................................................................................... 28
4.3 QUALITY IN RECORDKEEPING SYSTEMS ..................................................................................... 31
4.4 USERS AND THEIR RELATION TO QUALITY ................................................................................ 32

5 RESULTS: THE PAPERS ....................................................................................................................... 34

5.1 PAPER I .............................................................................................................................................. 34
5.2 PAPER II .......................................................................................................................................... 35
5.3 PAPER III ........................................................................................................................................ 37
5.4 PAPER IV ......................................................................................................................................... 39

6 SYNTHESIZED RESULTS OF THE RESEARCH PAPERS ............................................... 42

6.1 ELECTRONIC RECORDS .................................................................................................................... 42
6.2 RECORDS USE .................................................................................................................................. 43
6.3 ELECTRONIC RECORDS QUALITY ................................................................................................. 46
6.4 MULTIDIMENSIONAL PERSPECTIVE ............................................................................................ 46
6.5 SUMMING UP ................................................................................................................................... 47
6.6 APPLIED INTERPRETATION OF THE RECORDKEEPING QUALITY MODEL .................... 48
6.7 A PREDICTIVE MODEL ...................................................................................................................... 50

7 CONCLUSION ....................................................................................................................................... 51

7.1 FINAL REMARKS ............................................................................................................................. 52

REFERENCES ............................................................................................................................................. 53
<table>
<thead>
<tr>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>What are the Characteristics of Records?</td>
<td>63</td>
</tr>
<tr>
<td>Operational use of electronic records in police work</td>
<td>95</td>
</tr>
<tr>
<td>Electronic record quality, necessary inter alia for trustworthy e-government services</td>
<td>115</td>
</tr>
<tr>
<td>Fulfilling electronic record requirements: Good practice from two Swedish organizations</td>
<td>133</td>
</tr>
</tbody>
</table>
1 Introduction

In public and private organizations there exists a subset of information that is used and managed in daily work processes. This specific form of information needs to be kept reliable and authentic for a variety of time, from milliseconds to eternity, information that is going to serve as evidence of transactions. The subset of information is called records, recorded information. Records should not be mixed up with the records used in database theory (e.g. Connolly & Begg, 2005; Teorey, 1999). The international standard on record management defines records as:

“Information created, received, and maintained as evidence and information by an organization or person, in pursuance of legal obligations or in transaction of business.” (International Standards Organization, 2001a, p.3)

In public organizations recordkeeping is essential when records are evidence of public organizations’ activities and decisions. Recordkeeping is necessary for transparency and democratic accountability in governments’ actions (c.f. Krisberedskapsmyndigheteten, 2005; National Archives of Australia, 2001; Reed, 2005). Records have unique characteristics in relation to information. Records are the result of transactions and to maintain reliable and authentic evidence of the particular transaction, the record can never be changed or altered. One of the characteristics of records is their requirement for preservation, where the record must be kept reliable and authentic. For hundreds of years information has been recorded on paper, and the paper based records have been quite easy to preserve if the environment conditions have been right. Today almost all records are born digital, i.e. created within a computer based information system, which gave birth to what are called electronic records (see e.g. Reed, 2005). When records have become electronic they are no longer bounded to a physical form, they are more of a logical entity which parts can be spread on e.g. different databases, on different servers. With electronic records preservation has been one of the major problems to solve, since the two pioneers Charles Dollar (1992) together with David Bearman (1993, 1994) began to address the need for new methodologies and techniques to enable long term preservation of electronic records. In 1999 David Bearman (1999) noted there still was no magic bullet solving the problem with preservation, which also was noted by Kimberly Barata five years later (Barata, 2004).
Preservation of electronic records is problematic because it is difficult to maintain the authenticity and reliability of electronic records both on short term and on long term (Duranti, 2001a, 2001b). Authenticity and reliability are necessary requirements for electronic records of high quality, which can be used in daily work processes as evidence of the transaction of its creation (e.g. Duranti, 2001a, 2001b; Reed, 2005). According to Chen (2001) there is a paradox in digital preservation:

"This situation creates a fundamental paradox for digital preservation: On the one hand, we want to maintain digital information intact as it was created; on the other, we want to access this information dynamically and with the most advanced tools." (Chen, 2001, p.25)

Research which has aimed to contribute to the problem of preservation of electronic records can be divided in two different perspectives or traditions. The first is more of a technical approach, treating problems concerning how electronic records can remain understandable throughout their existence. Computers, computer based information systems, file formats, storage media, operating systems, are all examples of technical artifacts in continuing change and development, making preservation of records difficult. You would probably not, for example, like to rebuild a 30 year old mainframe computer just to be able to access a 30 year old record. Information in old file formats stored on old storage devices as for example 5\(\frac{1}{4}\) diskettes, and even 3\(\frac{1}{2}\) diskettes are difficult to use today, even if they are no more than 10-20 years old.

The other research perspective aims to contribute on the methodological and theoretical level of recordkeeping, including electronic records. Such research is for example the Records Continuum Model\(^1\) (Mckemmish et al., 2005a; Upward, 2000, 2004, 2005) which is the basis of the Australian school of recordkeeping, a theoretical perspective about recordkeeping adopted in this research and further described in section 3. According to Chen (2001), the Records Continuum Model is a good example of a contribution to what is important in digital preservation, to minimize the tension between creation and use of digital information.

\(^1\) The record continuum model is based upon Anthony Giddens work on theory of structuration
Around the world several research projects have been initiated dealing with the two problem areas. InterPARES² is an international research project at University of British Columbia, with an aim to develop both theoretical and methodological knowledge of how to preserve records in the long-term while keeping the authenticity of the record. LDB³ (Long-Term digital preservation project) has a similar aim, which is cooperation between Luleå University of Technology and the Swedish National Archives. LDB partners both do research on methods for long-term preservation while they are developing a working electronic archive environment. A more practical research project ended in 2003 and was named David⁴. It was a national project in Flanders with the purpose of developing guidelines and manuals for electronic archives. Emulation was the technical solution for long-time preservation of digital material for the CAMiLEON⁵ project. The DLM⁶ forum has served as a place where solutions and techniques to solve electronic record-related problems can be discussed and presented within the European Union. They have focused on the more technical part of electronic records problems. Technical should here be interpreted as problems concerning e.g. file formats, storage media and generations of operative systems. The projects mentioned above all have similarities in their purpose: they aim to develop methods and techniques for long term preservation of records created electronically. The exception is the DLM forum which is not a research project, more of an interest organization for exchange of ideas.

There are also examples of methodological tools that have been raised to help organizations in their management of information and records. One such is the DIRKS⁷ manual, an eight step method aimed to support government agencies in Australia to be able to manage information and records structured and in a way that corresponds with Australian standards. Another good example is MoReq (Model Requirements for the Management

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² http://www.interpares.org/
³ http://ldb.project.ltu.se/~Projekt_LDB
⁴ http://www.antwerpen.be/david/website/eng/index2.htm
⁵ http://www.si.umich.edu/CAMILEON/
⁶ http://europa.eu.int/comm/secretariat_general/edoc_management/dlm_forum/
A Predictive Model for Attaining Quality in Recordkeeping

Erik Borglund

of Electronic Records) which is a product from the DLM forum where the European Commission have tried to develop a common European basis for functional requirements for management of electronic records in electronic record management systems (European Commission, 2002).

Research in recordkeeping and on electronic records has to a large extent been performed by researchers solely from archival science. Preservation of information is not a new topic in information system research. For example databases, data warehouses, are two examples of research areas that deals with preservation of information and which seldom is cited in scientific publications about electronic records and recordkeeping (Cox, 2000). Authenticity and reliability, which were stated above to be requirements for records, are also used in information systems research: for example in information- and data quality research (c.f. Ivanov, 1972; Knight & Burn, 2005; Wang & Strong, 1996). Another example is accountability, presented in section 3 as a characteristic of records. In information system research accountability has been presented as a design issue (see e.g. Eriksen, 2002). In this thesis preservation of records (information), reliability, authenticity, and evidence are dealt with from a recordkeeping perspective.

The overall research question which guided this research is:

What should be done to improve the possibility of preserving information created in computer based information systems for future use in both the short and the long term?

1.1 Aim of the research

The introduction points out that no magic bullet for electronic recordkeeping has yet been found, and continuing research is needed. This research is based on a belief that a proactive approach is necessary when dealing with electronic records and electronic recordkeeping, i.e. if an electronic record can not be authentic and reliable at creation it can not be so later on. This belief is supported and influenced by both Bearman (1993, 1994) and Barata (2004) and almost embedded in the Records Continuum Model (c.f. Upward, 2000, 2004, 2005). This belief makes it impossible to exclude computer based information systems from this research, because in those systems electronic records are born. The requirements for making an electronic record reliable and authentic and usable for evidential purposes must be captured when the record is created, because they most likely are very difficult to reach afterwards. One question that has been an underlying
motivator for this research is: How can information systems managing records and recordkeeping systems be designed to fulfill the requirements for maintaining authenticity and reliability of electronic records, i.e. electronic records with high quality? In information systems research, different approaches to quality have been used as a means to attain user satisfaction, fulfill requirements, and achieve a valuable impact of the information system. Ancient Greek philosophers would probably have agreed that a recordkeeping system’s (an artifact) quality can be judged by how well it has succeeded in fulfilling its purpose (c.f. Dahlbom & Mathiassen, 1993). Quality can be defined as “an entity’s set of attributes that are characteristic of its ability to satisfy established and implied needs” (Chirinos et al., 2004, p. 18). The concept of quality is theoretically described in section 4.

One way to evaluate whether information systems managing records, recordkeeping systems, and electronic records have reached their purpose, i.e. fulfilled their requirements, is to use quality assessment measures. Assessment of quality has been used in information systems research to assess success in information systems (see e.g. DeLone & McLean, 1992, 2002, 2003; Wilkin & Hewett, 1999). When reliability and authenticity affect a record’s possibility to serve as evidence, it is also important to be able to assess whether the recordkeeping system is maintaining those requirements for records. In this research, quality from an information systems research perspective has been used as the approach to understand how to validate and assess whether a recordkeeping system or an electronic record has fulfilled these requirements.

The aim of this research is to improve the possibility of reaching high quality in recordkeeping systems, i.e. to maintain reliability and authenticity of electronic records.

In the process of achieving the aim the following research question have been used:

- What are the characteristics of records?
- How are electronic records used operationally?
- What electronic record quality is needed to maintain trustworthiness in electronic records?
- What can be improved to ensure high electronic record quality in recordkeeping systems?
The expected result of this thesis is a recordkeeping quality model that would support development and assessment of computer based information systems, systems that manage electronic records and are part of recordkeeping.

In the development of computer based information systems (IS) the recordkeeping quality model aims to be usable as a basis for forming the knowledge of what affects the quality of the recordkeeping system. The recordkeeping quality model aims to be able to support assessment of recordkeeping systems that are already in existence. The model is not a finished assessment model, but by presenting a set of concepts and their relationship, the model can serve as basis for design of assessment.

The quality model is a conceptual model, which also to some extent can be visualized.

1.2 Thesis structure

This thesis is divided into two separate parts: first a cover paper and then four peer reviewed research papers. The purpose of the cover paper is to introduce the main purpose of the research, give the reader needed theoretical background and to present the overall findings of this research. The second part consists of four peer-reviewed research papers: two journal publications and two conference publications. The research papers have been formatted to fit the thesis. One of the papers has been co-authored together with Lena-Maria Öberg, in which both authors have contributed equally.

Part one of this thesis is set out as follows. In section 2 the overall research method for this thesis is outlined and described on a meta-level. The section also contains the underlying methodological and scientific approaches, which have influenced the research. The overall research process is briefly described with the purpose of relating each separate study and research paper in relation to each other, and also to give a basis for understanding how the presented results have evolved during the research process. Sections 3 and 4 are two theoretical sections, which serve as frames
of reference. The former is about records and recordkeeping. The latter is about the information and system quality in information systems research. The frames of reference together with the results of each paper, in section 5, are then used as the basis for the synthesized results presented in section 6, where the quality model is described. Section 7 includes the conclusion and a summary of the contributions and proposals for future research.

1.3 Included papers

The following research papers are included in the thesis and are found in part 2.


2 Method

In this section the overall research method is described. The section begins with a general description of the research perspective used, followed by a more detailed description of the research process. The section ends with a discussion about quality in the research.

2.1 Research perspective

Information system development (ISD) and methods, techniques supporting ISD have been the focus in what is called the Scandinavian School of IS research (see e.g. Bansler, 1989; Iivari & Lyttinen, 1998).

This research conforms to the Scandinavian approach of IS research, in which the thesis results are supposed to contribute to information system development, in this case to the development of systems that manage electronic records and are part of recordkeeping.

The research is a result of a research project, one of the purposes of which is to increase knowledge of how to be able to develop information systems that enable long term preservation of electronic records. This research has been performed within an informatics perspective, and has adopted the following definition of informatics:

“...a theory and design oriented study of information technology use, an artificial science with the intertwined complex of people and information technology as its subject matter” (Dahlbom, 1996, p. 29).

The first Informatics PhD thesis in Sweden was on the topic of information quality (Ivanov, 1972), and this thesis follows the same Swedish informatics tradition.

The unit of analysis in this research is electronic records. An electronic record is a record born digital i.e. within a computer based information system. Development of information systems that manage electronic records are therefore within the scope of Scandinavian IS research tradition. Records

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9 Archives of the Future: Electronic Record Management in Swedish Public Organizations and Companies

8
A Predictive Model for Attaining Quality in Recordkeeping

Erik Borglund

are by tradition also a concept of interest within archival science (see e.g. Bearman, 1993; Cox, 2001; Duranti, 2001a; Reed, 2005; Thomassen, 2001) which makes the unit of analysis of interest in two scientific domains, fig 1. This research has been performed with an informatics perspective in a domain that by tradition have been dedicated to archival science.

But how does this thesis apply informatics as Dahlbom (1996) defines it? There are two elements in Dahlbom’s definition that need some explanation. The first is “Information technology use”. Information technology is not only computers, which of course is one sort of information technology. According to Lee (2003), text is the oldest example of information technology. Text has enabled the existence of many organizations, for example archival institutions, in which business is based on information technology in the form of text. If text and computers are two realizations of information technology, electronic records, records, and recordkeeping systems are also information technology. They are either based on text, computers or a combination of both. The second element from Dahlbom’s definition of informatics is a “design oriented approach”. Design can, as Simon (1981) described it, be a process that changes an existing situation to a desired situation (fig 2).

Figure 1. Research area

Figure 2 "design as an artificial science" (Ljungberg, 1999, p.95)
A Predictive Model for Attaining Quality in Recordkeeping

Erik Borglund

A desired situation can be anything from a small artifact as a model or framework to a large information system. Design is about a goal to improve information technology and its use (Dahlbom, 1996) and in this research the goal is to be part of the improvement of information technology in the form of electronic records, records, and recordkeeping systems. Electronic records, records, and recordkeeping systems are all types of artifacts i.e. man made, which therefore also makes them designed (c.f. Dahlbom, 1996; Löwgren & Stolterman, 2004). When one is aiming to improve artifacts in some way design is therefore a natural part of that process.

2.2 Research process

The results presented in this thesis are from a two year research process. This research is founded on an explorative approach in its mean to fulfill the aim of this thesis. The research has followed the tradition of interpretative case studies (c.f. M. Myers, 1997; M. D. Myers & Avison, 2002). In this research electronic records, recordkeeping systems, and records use have been studied and observed from an outsider’s perspective, using the term ‘outsider’ in two senses. First, the research is done with an informatics perspective in an archival science domain. Second, each study has been performed with the eyes of an outsider, where the studied organizations are unfamiliar to the researcher. There is one exception, and that is paper II, where the data was collected as an insider familiar with the organization and its structure.

For elaborated details of the research methods applied see each individual research paper in part 2.

The following is first a presentation of the research process for the cover paper and the synthesizing of the recordkeeping quality model, and then a chronological description of each research paper. Figure 3 presents the way each paper, the overall research question, the thesis aim, and the presented results are related to each other. A more detailed description of this is found in sections 5 and 6.
2.2.1 Cover paper

This research has been stepped and iterative at the same time. As each step or phase in this research has been based on a research question and has resulted in a research paper. Each phase has also given more knowledge based on empirical data; knowledge which increased the insight into the previous phase. To bring together these four phases into a united result a final phase was needed, a phase where the theoretical frames of reference
together with results from each research paper were united into a recordkeeping quality model. The synthesizing process can be described as an analytical and logical process where each result from every research paper was related to each other and brought into one piece. This process is described in section 6.

This cover paper therefore contributes to the aim of this thesis by bringing all papers together with a frame of references into one piece, the synthesized result of this research.

2.2.2 Paper I

When entering a new and unknown scientific domain as researcher the first and maybe most important issue was to identify and understand the phenomenon or concept aimed to be studied, which here was the concept of records. Theoretically it was possible to understand the concept of a record, but when this research aimed to collect empirical data in real life environments where records existed and were managed, the concept of a record had first to be understood in such an environment. Paper I is based on a qualitative case study carried out in three public organizations and one private organization. Group interviews, interviews, observation and use of written documents were data collection methods. The empirical data was analyzed in two steps: first different types of records were identified, followed by an analysis of the characteristics of records. Finally the empirically grounded characteristics were compared and analyzed in relation to records and archival theory.

2.2.3 Paper II

Paper I focused on identifying the characteristics of the records. Paper I also raised questions of how electronic records were used in organizations. The next phase in the work with this thesis was therefore to study and investigate how records were used. Archival science divides records use in relation to its purpose. There is a primary and a secondary purpose for records. The primary purpose for records is to serve as evidence of business activity, i.e. a rather operational use (Sprehe, 2000; Thomassen, 2001). The secondary purpose is to support research. Paper II aimed to

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10 See section 3.2 for a further discussion on this.
understand how records were used in an operational environment. The chosen organization was the Swedish police, which is a public organization with many information systems in which content should be preserved forever, i.e. many electronic records. Paper II is based on empirical data from three previously performed studies for which the collected data were reanalyzed. The empirical data were drawn from twenty seven semi structured interviews, 50 hours of observation. During reanalysis of the empirical data, two complementing interviews were held. The result of paper II was the presentation of operational records use, and how that use supported police work and in some cases also changed work practice.

2.2.4 Paper III

Paper I & II, represent the basis for the understanding of records, electronic records, and recordkeeping systems and the use of those in this research. In paper III the quality of electronic records was of interest, quality which should enable maintenance of reliability and authenticity in electronic records. The concept electronic record quality had not been an issue of major interest in the recordkeeping context, but there are exceptions (e.g. Laudon, 1986). Paper III is based on a case study in one Swedish public organization. The duration of the case study was seven months. Data collection techniques were semi structured interviews, observations and use of written materials (documents and archival material). In paper III electronic record quality is introduced as a concept. The empirically grounded electronic record dimensions were compared with sets of well-established and accepted information quality dimensions. The result of paper III is a set of electronic record quality dimensions.

2.2.5 Paper IV

In paper III electronic record quality dimensions were identified, dimensions that are needed to fulfill the requirements of reliability and authenticity of electronic records. In paper IV the research shifted focus, to study what good practice can be found in two different electronic recordkeeping systems that enable high quality i.e. fulfilling the requirements of reliability and authenticity. Paper IV is based on two case studies from two Swedish public organizations. One was the same used for paper III. The data collection methods are the same as those described for paper III. The duration for second case study was 3 months. In paper IV a set of good practice is presented, demonstrating how it is possible to reach
high quality by maintaining authenticity and reliability in recordkeeping systems.

2.3 Quality in research

Criticisms put forward against qualitative research methods are those methodologies’ lack of validity and reliability. Validity and reliability are applicable when doing quantitative research where the results most often aim to be generalized. The results of this research are not claimed to be generalizable, because the data have been collected in a limited number of organizations in relation to the full population.

In quantitative research with a positivistic approach three quality terms are often used: external validity, reliability, and objectivity. If the results are general and possible to apply to larger populations they are of high external validity. Reliability is about the chosen instrument or approach of the study’s ability to present the same result if the research is replicated. Reliability validates or judges whether the researcher has chosen the appropriate research instrument or research approach. The goal is to choose an instrument that really studies what was intended. Objectivity is about the importance that research and the research findings are free of bias and prejudices. Validity, reliability and objectivity are described by many (see e.g. Bell, 2000; Guba & Lincoln, 1989; Wallén, 1996). In qualitative research those terms are not appropriate and the quality of research must be described in other ways.

Guba & Lincoln (1989) have introduced an alternative way to ensure high quality in qualitative research without using external validity, reliability, and objectivity. It is possible to use transferability instead of External Validity or generalizability. Transferability is about the possibility to use some or all of a qualitative research project’s results in another setting. To achieve transferability the researcher must describe the research settings in detail to ensure others to understand context, culture and other factors which affected the research or found in the research setting. Dependability is Guba & Lincoln’s response to reliability. Here the researcher must describe the process of the research so that a reader can understand every step in the process and follow changes in the original research method. Conformability is the last alternative dimension which is the qualitative substitute for objectivity. In qualitative research the importance is that the result is grounded in the data and that this relationship is possible to track back to its
source. The whole idea with these three alternative dimensions is to ensure that an outsider should be able to find the source of the data and judge the result from that.

In this research transformability of the results and dependability of the method i.e. appropriateness of the method for the purpose of the research, are the two dimensions that have been used as a guide to increase the quality of this research. Every research paper has aimed to describe the research settings and research context as descriptively as possible in order to make the results transferable to other organizations and settings. The researcher has also aimed to describe the research process clearly in each research paper. However, this thesis consists of different research papers and full descriptions of research settings and research process can be difficult to achieve because of limitations on the length of each research paper. For example, papers III & IV are conference proceedings and can not fulfill this goal to the most desirable extent. Conformability has at some extent been reached especially in paper II, where excerpts from the empirical material have been used.
3 Records and recordkeeping

This section together with the following serves as a frame of reference, in which the perception and interpretation of central concepts and theoretical approaches within the scope for this thesis is presented. This section takes its starting point in concepts which originate in archival science. Wherever there are concepts that serve as bridges between the two disciplines (information system and archival science) that bridge is described.

In this thesis as mentioned in the introduction, the Australian school of recordkeeping has been adopted.

3.1 Records

This section is about records, which not should be mixed up with the term used in database theory, where record is a tuple in a table (e.g. Connolly & Begg, 2005; Teorey, 1999). According to Thomassen (2001) are records and archives the two concepts which make archival science. Research on recordkeeping and archival science address different aspects of what are characteristics of records. Samples of the variety of those characteristics are presented below:

- Records are physical, have a content, a structure/form and are created in a context (Hofman, 1998)
- Records are evidence of actions and transactions (Reed, 2005; Thomassen, 2001)
- Records are process-bound information, i.e. “information that is generated by and linked to work processes” (Thomassen, 2001, p 374)
- Records should support accountability, a “principle that individuals, organizations, and the community are responsible for their actions and may be required to explain them to others” (International Standards Organization, 2001a, p.2) (c.f. Meijer, 2001)
- Records must be preserved, some for a very short time and some permanently (see e.g. McKemmish et al., 2005a)
A Predictive Model for Attaining Quality in Recordkeeping
Erik Borglund

- Records are part of the organisational memory and are used to support operational management (Cox, 2001; National Archives of Australia, 2001)

In traditional recordkeeping theory records have different values, one primary and one secondary (c.f. Schellenberg, 1998). The different values are about different purposes of using records. The primary value is to serve as evidence and support business activities (e.g. Sprehe, 2000; e.g. Thomassen, 2001). The secondary value is evidence supporting research. Records serve as evidence over the past (e.g. Thomassen, 2001). In this thesis that adopt the Australian school of recordkeeping based on the Record Continuum Model the dividing up in different values are of secondary importance when a record has a value as long as it exist in the continuum of its existence (McKemmish et al., 2005a)

In this research the definition of records from the ISO 15489 has been adopted, which is one of the components in the Australian school of record keeping and was based on the Australian Standard AS 4390-1996: Records Management.

“Information created, received, and maintained as evidence and information by an organization or person, in pursuance of legal obligations or in transaction of business.” (International Standards Organization, 2001a, p.3)

Records are always transactional bounded and should be able to be used as evidence, which is central in recordkeeping. For example if a record can not be used as evidence, accountability is not assured (e.g. Reed, 2005). Records have been used since early times to support legal and governmental issues and in some cases to solve legal disputes (e.g. Hänström, 2005; Livelton, 1996). The term record is today also used in combination with other words to strength the evidential touch of the combined word, for example “criminal records”, and “medical records”. Those two are examples of record types which are used as evidence over transactions and also processes. Several transactions can form a process. The relation between transactions within a process must be linked together to be usable as evidence of processes. According to Cox (2001) the evidential value of a record can only exist if the content, structure, and context are preserved. The context is the link between different records that belong together and also to the process where the record was created. Records’ relation to transactions is both what makes records different from information and enables the
A Predictive Model for Attaining Quality in Recordkeeping

Erik Borglund

evidential functionality of records (Reed, 2005). When records are recorded information product of some sort of transaction, they also play a key role in evidence and understanding of the transaction. A record can only be evidence of a transaction if a record is reliable and authentic (e.g. Duranti, 2001a). It is important to notice that a record does not need to consist of true information to be used as evidence. When records are used as evidence, the record itself must be authentic and its content must be reliable. But even false or untrue information which has been recorded can be reliable. For example in a police investigation a suspect person is interrogated. The police officer doing the interrogation puts up some aggravating circumstances for the suspect. The suspect on the other hand is telling a remarkable story that at no single point is true. The interrogation is recorded on tape, and then transcribed into an interrogation protocol. That protocol is a record of the interrogation of the suspected person. The content of the record is reliable and the record itself is authentic, but the information that is part of the record is untrue, which in this example was the untrue story told the interrogating police officer. ISO 15489-1 defines authenticity and reliability as: “

An authentic record is one that can be proven

a) to be what it purports to be,

b) to have been created or sent by the person purported to have created or sent it, and

c) to have been created or sent at the time purported

To ensure the authenticity of records, organizations should implement and document policies and procedures which control the creation, receipt, transmission, maintenance and disposition of records to ensure that records creators are authorized and identified and that records are protected against unauthorized addition, deletion, alteration, use and concealment.

/…/

A reliable record is one whose content can be trusted as a full and accurate representation of the transactions, activities or facts to which they attest and can be dependent upon in the course of subsequent transactions or activities. Records should be created at the time of the transaction or incident to which they relate, or soon afterwards, by individuals who have direct knowledge of the facts or by instruments routinely used within the business to conduct the transaction” (International Standards Organization, 2001a, p.7)
These definitions of authenticity and reliability are those that are used in this thesis.

A relevant question is whether a record can be authentic and not reliable? According to Reed (2005) must one make a differ between evidence in a legal perspective and in a recordkeeping perspective. Legal evidence requires authenticity of records that can be accepted as evidence in a court, which may differ between countries. Evidence in a recordkeeping perspective is dependent on how the record has been managed. For example, is the record managed in a way that no one can have changed it? Theoretically a record can be authentic i.e. it is managed correctly and it is what it purports to be, but there are some major mistakes made when the record was created so that the record is not reliable. But this is probably a very rare situation, and based on all the studies within this research reliability and authenticity follow each other. If one of them is low, the other is often low as well.

The adopted definition of records used in this research is that used in the ISO 15489 standard (International Standards Organization, 2001a). The definition is normative and how it has been applied in this thesis needs some explanation.

The standard ISO 15489 states that reliability and authenticity are characteristics of records. In this research that is not questioned. They are in this research also interpreted as requirements for records, requirements that need to be fulfilled in order to enable records to serve as evidence of transactions. Derived from the aim of this thesis one assumptions is made, not all records can be used as evidence. The basis for this assumption is that there exist records, which are ‘good’ i.e. records that fulfill record requirements, and can be used as evidence. But there exist also ‘bad’ records which do not fulfill the record requirements at full extent, and are therefore not usable as evidence. According to Reed (2005) there exist records that either not are evidential when they are created, or either have lost their evidentially during retention.

There is no difference in expected functions between records and electronic records, but there are differences in structure and form. The majority of traditional records are paper-based. A traditional record is a physical entity, often a document (e.g. Reed, 2005; Thomassen, 2001) even if Reed (2005) gives the example that even the Unabomber’s cabin was kept as a record at the FBI. The electronic record is more of a logical entity, of which
integral parts can be managed at different places within an information system, or even in different information systems (Dollar, 1992). The electronic record can be:

- Entity like, i.e. one file which eventually has the possibility to appear as a digital document on a computer screen.
- Composed by data from different locations and different systems that together forms a record, data that both can be derived and filtered from other data sources.

In Sweden composed electronic records are named potential records (not a verified translation of ‘potentiell handling’). A potential record is a record that can be derived by automated routine tasks and brought into one piece. A potential record can for example be results from SQL queries in different databases, which are united into one piece of record. A very close concept is aggregated documents. Aggregated documents raise the question of whether you should interpret a set of related documents as many records or interpret them as one record (Reed, 2005). According to Reed this is an important issue to solve, and it relates to how the record boundaries are defined. But in this research record are treated both as single entities and as results of aggregation or composition.

There are some differences between practice and theory in what is definable as an electronic record. Theoretically an electronic record is a record that is born digital in a computer-based information system. Such a record is electronic in the original and a print-out is a copy of the original. Many organizations develop and do investigations in computer-based document management systems, workflow systems, and electronic record management systems. Such systems support administrative tasks in organizations. To get full effect of the system all records handled by the systems need to be in electronic form, and paper based records and document are often transformed to electronic form by scanning. Organizations want to manage all their records and documents within one system.

In Sweden organizations that scan records still need to preserve the paper-based original because of legislation. But one of the organizations studied in this research has made efforts to change the Swedish legal system to give them the right to treat the scanned paper-based record as a substitute for the original, with the same legal value. From a practitioner’s perspective
it should therefore be good if electronic records were defined to cover both
records that are born digital and those that are transformed to electronic
form. The theoretical standpoint in this research is that an electronic record
is defined as a record made or received in electronic form. In the
organizations studied in this research that treat all electronic records as
equals the definition by Duranti had to be applied; “an electronic record is a
record made or received and set aside in electronic form.” (Duranti, 2001a,
p.272).

3.2 Recordkeeping and record systems

The Australian School on recordkeeping is based upon the Record
Continuum Model (e.g. Upward, 2000, 2004, 2005). The continuum model is
developed by Frank Upward. The aim of the model is to support archivists
in their concern with the relationship between recordkeeping and
accountability (Upward, 2005). According to Upward (2005) a characteristic
of the model is the view of records as unstable. A recordkeeping model
should consider both an object oriented approach and a system-based
approach. There are no end products in an archival institution so there is a
need for continuing addition of process metadata meanwhile they change
during space-time. The model is four-dimensional see figure 4. According to
Upward (2005) traditional archival methods are creating one-dimensional
documents and two-dimensional records, or three-dimensional archive but
technologies enable a four-dimensional approach. Upward (2000) writes that
records can have multiple lives in space-time, and a record are never
finished in its creation, it is continuously in change. McKemmish (2001,
p.336) is of the opinion that by use of the model will lead to “accessibility of
meaningful records for as long as there are of value to people, organizations,
and societies – whether that is for a nanosecond or millennia.”
Recordkeeping is an organized and structured way of managing records from creation of records through the records continuum. Recordkeeping systems are information systems which are involved in the management of records. An archival system is similar, a system which “focuses on the processes needed to ensure that records are accessible and that their meaning is available over time.” (McKemmish et al., 2005b, p.160). ISO standard 15489 defines a record system in almost the same terms: “Information system which captures, manages and provides access to records through time” (International Standards Organization, 2001a, p.3). In this research the ISO standard 15489’s definition is adopted. A record system implicit is a system that meet record requirements.

A record system can consist of both manual and computer supported parts.
3.3 **Records related concepts**

In the proposed research area and in relation to records there are related concepts, which are briefly presented here. This thesis does not aim to present and discuss every aspect of those concepts. The presented references have to some extent influenced this work.

Information is such a concept, and is most often described as an interpretation of data, an interpretation which is done by a human (e.g. Sundgren & Steneskog, 2003). Information can also be described to differ from data in a sense where information has functionality and is useful, which data not can be (Ackoff, 1996). Today data and information are used as synonymous terms and there is no distinct border between the concepts in many areas, a situation Sundgren & Steneskog (2003) criticize and name it “terminological inflation” (Sundgren & Steneskog, 2003, p.12).

According to Buckland (1991a) information as a term or concept is quite unclear. And he is critical of the imprecise use of the term information as a concept. E.g. an information retrieval system is designed to retrieve information, but is it information they retrieve or is it documents or data? Information as thing is one of Buckland’s (1991a, 1991b) categorization of information. Information as thing is central when dealing with information systems. An information system is dealing with information that is tangible and can be seen as an entity, e.g. data, documents, records etc (Buckland, 1991b). Data, text and documents, and objects are all parts of the classification of information as things that Buckland (1991a, 1991b) presents. He called them information resources. He derives these concepts from the assumption that information is about being informed. He also states a possibility to view information-as-thing as evidence, something that has changed a person’s knowledge.

This variety in what is definable as information as thing also gives examples of a variety of possible records, when records are recorded information. Even if electronic records not are tangible in the physical sense, electronic- and paper based records are in this research interpreted as what Buckland (1991a, 1991b) define as “information as thing”.

Information can also be described as “reduction of uncertainty” (Langefors, 1995, p.107) and this fulfills when someone gets informed, i.e. getting knowledge. All knowledge is not information, but information is knowledge in a form possible to communicate. Data can be described as the
A Predictive Model for Attaining Quality in Recordkeeping
Erik Borglund

unit used to represent information. Börje Langefors\textsuperscript{11} also introduces a concept he called elementary-message (e-message), which is the smallest possible element needed to inform and distribute knowledge (Langefors, 1995).

Maybe Börje Langefors’ most famous contribution is the infological equation $I=i(D,S,t)$ “$I$ is the information (or knowledge) produced from the data $D$ and the pre-knowledge $S$, by the interpretation process $i$, during the time $t$.” (Langefors, 1995, p.144). The infological equation is about the dependency between a person’s pre-understanding and the information that person gets from data. The idea is that the interpretation process is tightly connected to individuals and therefore to a person’s ability to interpret and understand the data.

Information systems are another record and recordkeeping related concept. By analyzing the infological equation you realize that people are involved in information systems. Information systems are commonly described as an integrated set of components for collecting, storing, processing, and communicating information. In this research an information system involves people and organizations (e.g. Checkland & Holwell, 1998; Checkland & Scholes, 1999; Palmius, 2005). Based on both the definition above and the position taken about the concept information technology in section 2.2 the following definition is applied in this research:

“an information system consists of an organization and an information technology that so enable each other that neither could usefully function or even exist without the other.” (A. S. Lee, 2003, p.315)

\textsuperscript{11} Börje Langefors is a pioneer of Information System research in Sweden as well as in Scandinavia. He was the first professor, at the Royal Institute of Technology (KTH) 1967-1980, of the academic discipline, which now is called informatics.
4 Information- and Information Systems quality

In this section quality is in focus, a concept used in many different ways in information systems research. In the following section quality in the information systems domain is presented followed by a section where different information systems quality assessment models and techniques are presented. This section serves to create a frame of reference for the results section.

Quality can find its origin in early skilled craftsmen and tradesmen, who won their reputation with products of high quality (Flood, 1993). During industrialization the mass production of products led to a more manual quality control of each product based on Taylorism (Bergman & Klefsjö, 2002; Flood, 1993). Manual quality control was time-consuming, which lead to a toolbox for possible management of quality that today most often has a goal to satisfy customers (Flood, 1993).

Quality is a quite widespread concept and there are many definitions and interpretations of what quality really is. Several attempts to strengthen the impact Quality has on business as whole, and not only products, has resulted in both an ISO standard, and Total Quality Management (TQM). ISO9000 is a standard for quality management and TQM is an approach striving to continuously improve quality, and quality management is seen almost holistic (see e.g. Bergman & Klefsjö, 2002; Eklund & Fernlund, 1998; Flood, 1993). Flood (1993) has listed seven different ways of defining quality which he captures into one statement about quality:

“Quality means meeting customers’ (agreed) requirements, formal and informal, at lowest cost, first time every time. (Flood, 1993, p. 42)”

Another possible definition of quality is the one that Chirinos et al. (2004) have adopted from the ISO 14598-3 standard, where quality refers to

“an entity’s set of attributes that are characteristic of its ability to satisfy established and implied needs” (Chirinos et al., 2004, p.18).

This definition is the one adopted in this research and the definition is also corresponding to what Eklund & Fernlund (1998) present. Dahlbom & Mathiassen (1993) discuss quality in terms of good vs. bad, where good is synonymous with high quality. To evaluate or measure if something is good the functionality must be understood and well defined. Many of the ways of
dealing with quality in software engineering, information system design, and information system development focus on the artefact, and the actual use of the artefacts in some context are of less interest. The differences in quality interpretations are dependent on who uses the artefact. (Dahlbom & Mathiassen, 1993).

4.1 Quality in the IS domain

According to Nilsson (2005) quality in IS research has mostly focussed on attributes and use of information systems and its components, information and system.

In information system research there are many areas where quality is involved. This section does not aim to categorize those, rather to give a brief overview of existing research trends and their differences. The Swedish branch of the Scandinavian school of IS research has also been contributing to Quality by for example the first PhD Thesis in informatics\textsuperscript{12} by Kristo Ivanov (Ivanov, 1972) which was about “Quality control of information”. More detailed was quality about accuracy in “data banks” and Management Information Systems. Ivanov listed 36 attributes that was related to Quality, a list that are almost identical to quality criteria/attributes presented by e.g. Wang & Strong (1996).

One large research area on quality in IS research is information- and data quality. In this area the interest is the product or the entity that is processed within a computer based information system. Data quality is often described as the quality connected to the entities that are stored in databases, and in storage solutions. In such databases data had too many errors, resulting in costs (see e.g., 1989; Laudon, 1986; Strong \textit{et al.}, 1997). Problems can occur when data from different databases are combined into new data. There are some uncertain difference between data-, and information quality. Wang & Strong (1996) do not distinguish between those concepts, but Neumann & Rolker (2000) relate information quality to the output of a system, and data quality is related to that processed within a computer based information system. The aim with both information- and data quality research is to measure the quality of interest i.e. to reduce errors (e.g. Y. W. Lee \textit{et al.}, 2002; \textit{ADAB (Allmän Data Behandling)}

\textsuperscript{12} What previous was called ADB (Allmän Data Behandling)
In this thesis no distinction is made between data quality and information quality.

According to Wang & Strong (1996) data- and information quality dimensions in literature identified are either based on intuitive, theoretical or empirical approaches, and there are no agreed list of dimensions for data- and information quality (Wand & Wang, 1996). The dimensions or criteria are used when quality is assessed or measured. The intuitive defined dimensions are according to Wang & Strong (1996) more or less based on assumptions from different studies, and environmental settings. Theoretical based dimensions are logically derived from other research and literature studies. The empirical based dimensions are defined after analysis of collected empirical data. The empirical approach is less used in relation to the intuitive where the researchers by intuition define quality dimensions. Wang & Strong (1996) made an empirically based definition of many quality dimensions. They defined their dimensions after a large quantitative study, which has made the dimensions by Wang & Strong (1996) almost a standard of acceptable data and information quality dimensions (see e.g. Bobrowski et al., 1999; Kahn et al., 2002; Knight & Burn, 2005; Pipino et al., 2002; Strong et al., 1997; Wand & Wang, 1996; Wang & Strong, 1996). The work with data- and information quality is to ensure that the product going to be processed is of high quality (data) and the product out of an information system is of high quality (information). Information- and data quality influence both social and economic aspects in organizations (Wang & Strong, 1996) and have also been identified as one of the most important parts of e-business (Hu & Korinos, 2004).

Another area of quality in information system research is about the information system as entity. Information systems quality has become the means to protect the strategic value of information in both organizations as well in information systems (Dedeke, 2000). When developing an information system a natural purpose is to build a successful system.

Information-, system-, service-quality, and user satisfaction are by many proposed as the dimensions, which could assess such success (see e.g. DeLone & McLean, 1992, 2002; Wang & Strong, 1996; Wilkin & Hewett, 1999). Information quality together with system quality is the key components in the DeLone and McLean Information System Success Model (DeLone & McLean, 1992, 2003) where user satisfaction and quality as
dimensions are described as a whole (see next section for an extended description).

Quality is dependent on the users of the information system and must be defined and understood in relation to the users and their needs. If the users change, the needs must be redefined and perceived information quality also changes (Klischewski & Scholl, 2006). The quality of an information system can be measured by the satisfaction of the user of the system (see e.g. Bailey & Pearson, 1983; Doll & Torkzadeh, 1988; Ives et al., 1983). User satisfaction is not in a static term. It covers a variety of criteria used in assessment of satisfaction, from friendly to use to how reliable and accurate the information produced in the system are. In information system quality research the information system is seen as an entity that also must give service to users. Measurement of service quality can be part of the validation of the success of an information system (see e.g. Jiang et al., 2002; Pitt et al., 1995; Watson & Pitt, 1998).

The World Wide Web, the growth of internet use, and different e-services has also made impacts on the research into information system quality. Some of this new research approaches is found in; information quality during information retrieval (Knight & Burn, 2005), about the information quality the web sites produces (Katerattanakul & Siau, 1999), how to detect information quality problems on the Internet (Klein, 2002), and judgment of information quality on the web (Rieh, 2002).

Common to information quality, data quality, and information system quality is some vision to measure if the artifact (here data, information or information system) has fulfilled its stated and implied needs and requirements. Categorizations of different quality dimensions (e.g. Kahn et al., 2002; Wang & Strong, 1996) are needed when quality needs to be assessed. Information and data quality is in research often identified by some sort of perception of quality by users. Information and data quality research have aimed to make quality measurable and to reduce the fact that quality most often is a result of user perception.

4.2 Assessment models

As described in previous section data-, information-, and information system quality in information system research have been categorized to be measurable, categories that have been used in different assessment methods and technologies.
A Predictive Model for Attaining Quality in Recordkeeping

Erik Bormlund

That the majority of all information systems development projects want to satisfy the user of the system and fulfill all stated and implied requirements is not an overstatement. Fulfilling requirements and user satisfaction are two components that make quality in information systems. But how does one assess if an information system has high quality, and if the information system is successful? According to Dahlbom & Mathiassen (1993) there are roughly two ways that information systems are evaluated. One is to use metrics to measure and assess the information system, the other is based on people’s experience in use of the information system. In information systems research, assessment of information system success has resulted in different models giving help in this assessment work.

The DeLone and McLean Information System Success Model (D&M IS Success Model) was first presented in 1992 (DeLone & McLean, 1992) and aimed to support the assessment of efficacy in information system management and its action, the model was an attempt to describe how information system success could be structured in information system research. The model is presented in figure 5.

Figure 5. DeLone and McLean IS Success Model (DeLone & McLean, 1992, p.87)

The model is based on the ambition to find and identify “dependent variables” (DeLone & McLean, 1992, p.61) in management information system (MIS) research. Variables, which could measure the outcomes of MIS research i.e. the efficiency and success in information systems. By an extensive literature study of more than 100 empirical studies they identified a set of categories of information system success:

- System quality
- Information Quality
- Use
- User Satisfaction
Individual Impact
Organizational Impact

DeLone & McLean found that the success of an information system cannot be seen from only one or few of the above categories. Success of an information system must be understood in a holistic perspective where all these categories affect the information system success. They presented their DeLone & McLean IS Success Model (DeLone & McLean, 1992) which proposed that measurement of information system success must be done by taking several success dependencies into consideration. In 2003 they presented an updated version (DeLone & McLean, 2003). Based on empirical studies where the model has been tested, a common critique against the model was that the assessment of success focused on the outcome from the information system, information and data. The service quality the information system is giving was kept out in the first model. This forced them to revise their model (DeLone & McLean, 2003) to include service quality. In the revised model they have merged the impact dimensions into one dimension named net benefits. The updated model is presented in figure 6.

Figure 6. Updated D&M IS Success Model (DeLone & McLean, 2003, p.24)

The DeLone & McLean IS Success model (DeLone & McLean, 1992, 2002, 2003) have not been fully accepted. Wilkin & Hewett (1999) have made a re-specification of the model and their main difference is that they have quality as the central component in the model instead of use, and user satisfaction. Quality is by Wilkin & Hewett (1999) a function of the users expectations and perceptions. The IS Success Model model is described in three zones (fig 5) and it was these three zones that were basis for Seddon’s (1997) critique. Seddon (1997) propose that the DeLone & McLean IS Success Model actually
A Predictive Model for Attaining Quality in Recordkeeping
Erik Borglund

consist of three separate models. The first, which deals with measurement of information & system quality, the second that is measurement of use and user satisfaction, and the third that is about measuring the benefits of the system.

The dependent variable or dimension use and user satisfaction in the DeLone and McLean IS Success Model must be consider the nature of the information system the model is going to be used upon. For example in a recordkeeping system user satisfaction should be about whether the user is satisfied with the authenticity and reliability of the records and not primary how well the graphical interface were designed.

4.3 Quality in recordkeeping systems

How can recordkeeping systems be related to data-, information-, and information systems quality? When dealing with electronic records both the terms data- and information quality are applicable, when the record is recorded information stored as data in for example databases. Information systems quality is theoretically also applicable to recordkeeping systems, which per definition are information systems. The assessment models presented above should also be applicable when we deal with recordkeeping systems.

Quality in information systems research has focused on different ways to measure quality by using categories, criteria, or dimensions which enable such measurement. Categories, criteria, and dimensions have been identified for data-, information-, and information systems quality. With records, electronic records, and recordkeeping systems no dimensions have been identified with a specified purpose to measure record-, electronic record-, and recordkeeping system-quality.

But there are probably dimensions that recordkeeping researchers agree upon. For example according to Duranti (2001a) authenticity is a quality of records, which MoReq also declares (European Commission, 2002). Thomassen (2001) means that it is important that an archivist is capable of understanding how quality of archives and records can be ensured and assessed. According to Thomassen (2001, p. 382) the formal quality of records is maintained if “availability, readability, completeness, relevance, representativeness, topicality, authenticity and reliability.” are maintained. Service quality has been used in research where users of records have been studied (Sexton et al., 2004). Grimson (2001) presents problems related to
electronic health care records where data quality is one of the major issues to solve. Iacovino (2004) presents results from a study on an electronic health record system, in which data- and information quality dimensions such as validity, completeness, and data integrity are discussed.

Quality, as presented above, is not a new phenomenon in recordkeeping, but archival science has not worked with identification of different quality criteria as IS research has. Assessment of quality in recordkeeping is also something not found in literature. In recordkeeping literature quality criteria are most likely possible to find, doing a deep analysis, which is out of the scope for this thesis. In paper II three electronic record quality criteria presented which all was derived from recordkeeping literature: evidence, authenticity, and accountability (Borglund, 2005b).

The whole idea of recordkeeping is implicitly related to quality. If a record should be usable as evidence it must have certain qualities.

4.4 **Users and their relation to Quality**

The term ‘user’ is central when talking about quality. In this section some theoretical perspectives of ‘user’ in information system research is presented and how these are applicable in the relation to the concept of quality.

The term user is also a central concept in the Scandinavian School of IS research the term user is central in the Scandinavian tradition of user participation in the information system development process. Something which positively impact the success and impact of the information system (see e.g. Bjerknes & Bratteteig, 1995; Nielsen & Relsted, 1994; Saarinen & Sääksjärvi, 1990). Use of information technology is part of the applied definition of informatics in this thesis (Dahlbom, 1996).

Users are in Information System development literature implicit defined as those persons that are physically going to use or interact with the information system (e.g. Pressman & Ince, 2000). Use cases are used in object oriented design to identify how a user would interact with the information system, which is important in information system which is successful and have the expected impact (e.g. Mathiassen *et al.*, 2001).

But there is also some criticism against the concept of user. The term ‘user’ is imprecise and is everyone interacting with a information system a user or are they something else? According to Lamb & Kling (2003) the term
‘user’ can be someone using an information technology artifact (information system) on daily basis. But the modern information technology as mobile telephones, internet based services, e-services and similar open up for a different type of user, a user that not is a primary user of information technology. This kind of user is better described as a social actor.

In the IS Success Model presented by DeLone and McLean (DeLone & McLean, 1992, 2002, 2003) user satisfaction is one of the of the dimensions affecting the success of an information system. According to DeLone and McLean (1992) use is some interaction with a information system, and the user is the person interacting. Some of the critique for the DeLone and McLean IS Success Model was whether ‘use’ can cause impact or if use or just precede impact on individuals and on organizations (DeLone & McLean, 2003).

In this research a ‘user’ is the one that either interact with the information system on daily basis or only interact with the information system occasionally. Any differentiation is not made between those two sorts users, no statement whether some users should be described as for example social actors. A ‘user’ is also the one that use the output of the information system, and more precise some one using records, which have been retrieved from the information system. The users are important because of their influence on quality. The users defines the need and implicit some of the requirements on both the information system and the output. Changes the users new needs and requirements may occur, which affect interpretation of the level of quality (Klischewski & Scholl, 2006).

A user of an electronic record does not necessarily have to be aware that it is a record he/she is using. A user in this research can also be an organization or some other information system using the electronic records.
5 Results: The papers

In this section each paper is summarized and described under the following headings:

- Problem definition in the paper
- Research question and purpose of the paper
- Summary of the results
- The paper’s contribution to the aim of this thesis in the work to synthesize the results

5.1 Paper I

What are the characteristics of records? (Öberg & Borglund, 2006)

Problem definition in the paper

Electronic records have been more and more common in organizations as the majority of organizations have computerized their administration. Electronic records as well as paper-based records must be reliable and authentic to be able to serve as evidence. The issue of preservation is not trivial. In theory, records are a subset of information and the definitions of records available are rather abstract and difficult to use as help in identification of records. The descriptions of records often consist of the functionality records must achieve. Identification of what are the characteristics of records is for example necessary if one aims to formalize records, which is necessary to enable processing in a computer-based information system.

Research question and purpose of the paper

The aim of the paper was to describe the characteristics of records based on both archival theory and empirical data. The research question within the paper was:

- What is defined as a record in organizations?
- What are the characteristics of these records?
- Are there any differences between the empirically grounded characteristics of records and the characteristics described by recordkeeping and archival theory?
Summary of the results

The paper presents a list of several different characteristics found in four organizations. There is a large variety in what organizations define as records. The paper also presents context, type of content, organizing, structure and version/copy as characteristics of records. Based on an extensive literature study, all characteristics other than type of content are found in archival science and recordkeeping literature.

The paper shows the existence of some discrepancies between theories and empirically identified records, when penetrating each characteristic in detail. Legislation, other organization-dependent regulations, archival tradition, and different recordkeeping traditions between countries are possible reasons for these discrepancies. This paper also presents examples of a large variation in recordkeeping maturity between organizations, which greatly affects what an organization defines as records. There are examples of good correspondence to standards and recommendations of recordkeeping and also the opposite.

The results of the paper are applicable when developing computer based information systems that manage electronic records. Electronic records should be formalized to some extent before it is possible to manage and process them in computer based information systems. The variety of identified records in organizations should together with the widespread unawareness of what a record is, motivate a proactive approach when dealing with electronic records. Organizations should carefully identify both general and organization-specific electronic records before they start a development project of a computer based information system managing electronic records.

The paper’s contribution to the synthesis of the results

Paper I aimed to identify characteristics on records to be better able to manage electronic records, therefore the characteristics of electronic records are the contribution of this paper to the quality model.

5.2 Paper II

Operational use of electronic records in police work. (Borglund, 2005b)

Problem definition in the paper

When electronic records became more widespread the archival science community became almost desperate to find a solution to solve problems
related to preservation of electronic records. The majority of the research on electronic records has focused on how to solve problems and less has been focusing on the possible benefits when electronic records have become common in organizations.

Research question and purpose of the paper

The purpose of the paper was to study use of electronic records in operational work by answering the following research question:

- How are electronic records used within operational work, and how does the use of electronic records affect that work?

Summary of the results

In the studied operational environment of the Swedish police, electronic records were a widespread type of information. Several information systems consisted of records and five information systems containing electronic records were identified, all of which were obliged to preserve their content forever.

The research found that electronic records were used in operational work:

- Information retrieval processes
- Information communication processes
- Decision making
- Valuation of information
- More accessibility

Police officers were found to be using electronic records on a daily basis and electronic records were identified as an important source of trustworthy information, i.e. reliable and authentic information.

The operational use of electronic records could be summarized in two dimensions:

- Decision making for situated action
- Decision making for planned action

Police officers used electronic records either to plan some action or they used them once in an operational situation. In the latter, they could either retrieve information derived from electronic records by using the dispatch central, or they could already have gathered the information they used previously.
Use of electronic records was also identified as a natural component in police officers’ ability to increase their police knowledge by easy access and searchability in the information systems containing electronic records. The possibilities for police officers to search and access reliable and authentic information aimed for both tactical and legal decisions increase the officers’ ability to make correct decisions within operational work. Police officers can be better prepared for the unexpected when working.

If searchability and access to information systems containing electronic records became more mobile, the role electronic records play in operational police work would increase.

The paper’s contribution to the synthesis of the results

The contribution of this paper to the quality model is concerned with use of electronic records. It is not fully possible to predetermine the extent to which electronic records will be used. The police officers used electronic records simply because of their reliability and authenticity, or at least their experienced quality of the electronic records. The paper demonstrates what for example can be found in the DIRKS manual (National Archives of Australia, 2001): that electronic records play an important role in organizations for business decisions. In order to continue to be an important component in operational police work electronic records must be reliable and authentic.

5.3 Paper III

Electronic record quality, necessary inter alia for trustworthy e-government services. (Borglund, 2005a)

Problem definition in the paper

In e-government services the whole idea is that all communication and interaction between citizens and public organizations should be done electronically by using the Internet. E-services are therefore a service which produce electronic records, when every record is born digital. Electronic records have been proven to be difficult to preserve and the Swedish Agency for Public Management (Statskontoret, 2003) have stated that the preservation and management of electronic records is a problem that must be solved to be able to fully develop the idea of 24/7 agencies in Sweden. There are several examples of electronic records that have lost their reliability and authenticity, which makes them almost useless as evidence.
An electronic record must be of high quality to be usable in e-services i.e. be authentic and reliable throughout its period of existence.

Research question and purpose of the paper

The paper has adopted the idea of information quality as a basis for understanding what qualities electronic records must have to be reliable and authentic. The aim of the paper was to present a set of electronic records quality dimensions.

The results were also compared with well established information- and data quality dimensions presented by leading researchers in information- and data quality.

Summary of the results

The paper presents sixteen quality dimensions that were found to affect the reliability and authenticity of electronic records. The results have been compared in two steps with established information quality dimensions (Kahn et al., 2002; Pipino et al., 2002). Table 1 summarizes the identified electronic record quality dimensions.

Table 1 Electronic record quality dimensions

<table>
<thead>
<tr>
<th>Dimension</th>
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<tbody>
<tr>
<td>Accessibility</td>
</tr>
<tr>
<td>Accuracy</td>
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<tr>
<td>Appropriate amount of data</td>
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<tr>
<td>Believability</td>
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<tr>
<td>Completeness</td>
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<tr>
<td>Free-of-error</td>
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<tr>
<td>Interpretability</td>
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<tr>
<td>Moveability</td>
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<tr>
<td>Original look</td>
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<tr>
<td>Portability</td>
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<tr>
<td>Relevancy</td>
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<tr>
<td>Representational Consistency</td>
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<td>Searchability</td>
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<tr>
<td>Security</td>
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<tr>
<td>Timeliness</td>
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<tr>
<td>Traceability</td>
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Accuracy and Traceability are two dimension not used by Kahn et al (2002) and Pipino et al (2002), but found in other information quality literature (e.g. Wang & Strong, 1996). Moveability, original look, portability and searchability were quality dimensions found to be unique for electronic records. The results indicate a correspondence between information quality dimensions and electronic records dimensions, which prove that records are
A Predictive Model for Attaining Quality in Recordkeeping
Erik Borglund

a subset of information. Further, the results indicate the existence of unique electronic records quality dimensions not applicable to all kinds of information. Some information quality dimensions found in the literature are not desirable for electronic records, for example ‘ease of manipulation’ (Kahn et al., 2002; Pipino et al., 2002).

The identified electronic records quality dimension was implemented as functionality in the studied electronic archive systems, which makes it difficult to make a clear demarcation between the electronic record and the information system managing them.

The paper’s contribution to the synthesis of the results

The contribution from this paper to the quality model is electronic records quality, which is very similar to information quality but has certain unique features. Implicitly, this paper identifies the possibility of using information quality research methods for electronic records quality research. Quality of an electronic record is also difficult to separate from the quality of the system, when electronic records and hosting systems are interdependent upon each other.

5.4 Paper IV

Fulfilling Electronic Record Requirements: Good Practice from two Swedish organizations (Borglund, 2006)

Problem definition in the paper

Electronic records have become a natural occurrence in modern administration, when the office became paperless through the use of computer based information systems. Electronic recordkeeping is not trivial and reliability and authenticity are requirements if a record is to be used as evidence. There are few good examples of how to maintain electronic record quality in computer based information systems. There are some recommendations for example the ISO 15489 standard (International Standards Organization, 2001a, 2001b), and MoReq (European Commission, 2002) but there are no guidelines based on implemented recordkeeping systems.
Research question and purpose of the paper

The aim for this paper was to identify a set of good practice for achieving reliable and authentic records in recordkeeping systems.

The research question for the paper was:

What can be improved to ensure high electronic record quality in a recordkeeping system?

Summary of the results

The paper presents results from two larger case studies in organizations that have implemented recordkeeping systems. From the empirical material three different levels of quality dependencies have been identified: quality dependencies affecting reliability and authenticity of electronic records. Each level contains different categories affecting record quality.

- **Strategic level (quality dependencies on an overall and general structure of activities)**
  - Recordkeeping system approach
  - Underlying motivators
- **IS level (quality dependencies on a computer based information system level)**
  - Technical Solutions
  - Standards
- **Entity level (quality dependencies related to electronic records as entities)**
  - File formats
  - Metadata
  - Security

Not all of the above were found to be good practice solutions for achieving reliable and authentic records in recordkeeping systems. The identified good practice solutions were:

- Use of metadata, to preserve context
- Use of added security, e.g. electronic signatures
- Use of OAIS as the reference model in development process
- Use of approved file formats, and use of a minimum of file formats
A Predictive Model for Attaining Quality in Recordkeeping
Erik Borglund

- Use of storage and database products, which are possible to change/upgrade independently of the recordkeeping system's functionality

The results in this paper were presented in three levels, which motivate that quality in recordkeeping systems should be interpreted and understood in a holistic or multidimensional perspective. The ‘good practice’ presented in the paper does not cover all possible forms of electronic records. In both studied organizations they treated electronic records as a single entity, as an electronic document, a computerized clone of paper-based records.

The paper’s contribution to the synthesis of the results

This paper provides a multidimensional perspective to the quality model. The ‘good practice’ and the quality dependencies were found in different levels in the recordkeeping system. The work of achieving reliable and authentic records cannot be done solely on one level, for example on the electronic record as entity. The work must be done on several levels which include both strategic decisions in organizations, information systems solutions as well as work on the entity level.
6 Synthesized results of the research papers

In this section the results from the papers and the frames of reference are synthesized and form a recordkeeping quality model, consisting of four related major concepts or components, which all are derived from papers I-IV. The synthesized result is the expected outcome of this thesis, which was introduced in section 1.1. The recordkeeping quality model is part of the aim of this thesis, which was to improve the possibility of achieving high quality in recordkeeping systems, i.e. to maintain reliability and authenticity of electronic records.

Four major concepts serve as the basis for the proposed model, which all are grounded in papers I-IV. These concepts are further described and developed in this section, together with frames of reference. Beside the four major concepts, the recordkeeping quality model is presented in what is named here ‘applied interpretation’. The recordkeeping quality model is thus put in recordkeeping context and discussed from that point of view.

In the following discussion each of the four major concepts is further described and explained using the frames of reference. This section ends with a summary and the applied interpretation of the recordkeeping quality model, where the model is also visualized graphically.

6.1 Electronic records

Records are in their simplest definition described as recorded information, and have much in common with just information. An electronic record is a record born digital, but the requirements of what a record should be able to serve as, does not differ between paper-based and electronic records. In paper I the aim was to identify the characteristics of records in order to make it possible to formalize records, i.e. making it possible to process them in a computer based information system. Thus the characteristics of records identified in paper I are applicable to electronic records (i.e. records that created, captured and used within a computer-based system.

Based on the findings in paper I and the frame of reference in section 3, records as well as electronic records can take very different forms and identities. Electronic records are almost as difficult as information to define in detail. It is possible to define an electronic on an abstract level i.e.
electronic- “information created, received, and maintained as evidence and information by an organization or person, in pursuance of legal obligations or in transaction of business.” (International Standards Organization, 2001a, p.3). But this definition does not for example enable an automated identification of electronic records.

The major purpose of an electronic record is to serve as evidence of transactions (e.g. Reed, 2005; Shepherd & Yeo, 2003). To be able to serve as evidence the electronic records must be authentic and reliable (e.g. International Standards Organization, 2001a; Reed, 2005). When maintaining authenticity and reliability of electronic records it is important to take into account the characteristics of records identified in paper I.

The research that was the basis for this paper indicated that electronic records as well as records were preserved in organizations without any awareness by employees that they were records with certain requirements and characteristics.

This lack of awareness affects the possibility to work proactively to implement and fulfill records requirements in a computer based information system environment.

When working with electronic records i.e. those born digital, requirements and characteristics must be captured when the record is created. Awareness of what constitutes electronic records in an organization is a prerequisite for ensuring reliable and authentic records.

6.2 Records use

Information systems are designed for someone to use them and implicitly the aim is for information to be used by users. In the infological equation (Langefors, 1995) it is implicit that data is interpreted by a user. Use is also central in IS Success assessment models (c.f. DeLone & McLean, 1992, 2003; Seddon, 1997; Wilkin & Hewett, 1999).

According to Sundgren (1995) there are information systems with partially unknown purpose. Sundgren (1995) bases his statement on two axioms in information system design:

- “An information system to be designed has a relatively well defined set of potential users, whose needs as regards the planned information system we can, at least in principle, find out by means of discussions with the users.
A Predictive Model for Attaining Quality in Recordkeeping
Erik Borglund

- Once the needs of the users have been identified, they may be recorded and transformed into a reasonably complete statement of explicitly defined external requirements upon the planned information system, as regards upon the planned information system, as regards its information contents and functionality. (Sundgren, 1995, p.120)

Sundgren (1995) argues that information systems fulfilling above axioms also have a known purpose. The opposite is of course information systems that do not fulfill those axioms, and although they are information systems, they have an unknown or ill-defined purpose. The term ‘partially’ is added because information systems with completely unknown purpose are probably never developed. It is possible to define recordkeeping systems as systems with partially unknown purpose, something which is motivated below.

Records are created with a primary purpose of supporting some operational business or activity (Sprehe, 2000; Thomassen, 2001) but by archival tradition records are also used to support research, where records are used as evidence of the past (Thomassen, 2001). Both these sorts of use can be difficult to predetermine, i.e. a record and a recordkeeping system has partial unknown purpose. Paper II addressed a widespread use of electronic records in an operational environment, a use not always corresponding to the records’ primary purpose. Police officers use records operationally in a way for which the recordkeeping system was not designed. The evidential values of records are an important factor for this use. Police officers have access to many records in police information systems, and they automatically trust those records, i.e. assume that they are reliable and authentic. The easy access of records and retrieval of records makes records suitable for operational decision support in police work. Such use is not the original purpose of the records, which is to serve as evidence of transactions where the record is the final product. One example is when police officers search the command and control system STORM for information to support their decision making. But STORM is basically designed to record police work, and not to support record retrieval. Holgersson (2001, 2005) describes several situations where police information systems are used in situations which was not predetermined, which had a negative effect. For example an information system was used for retrieval of information for decision making, but the information systems
filtered the information and gave a poor quality basis for decisions. Although paper II was about operational use of electronic records, the chosen recordkeeping model concept is use of records. Records use includes operational use, but does not need to clearly define when some use is operational or not.

Following from the discussion above, it can be seen that the use of records in general is difficult to predict and define at 100%. There are at least two reasons for this uncertainty in records use:

- The evidential value of records.
- Records preservation.

Records have an evidential value, which opens up possibilities for a use of records other than that which was meant at the creation stage of the record. In paper II the police officers use records in many situations just because the record is reliable, authentic and is evidence of some activity, action, or transaction. Preservation of records is another aspect that affects the uncertainty in records use. Records can be preserved for a range of periods, from a short time to permanent retention as an archival record. In Swedish public organizations normal medium term preservation time is about 10 years. 10 years seems like a quite short period of time, but the possibility to predict how records are going to be used is not easy even if the period is only ten years. For records that have to be preserved for a longer period, the usage gets even more difficult to predict. One must also have in mind that records have both a primary and a secondary purpose which complicate this even further. Within the primary purpose where records serve as evidence of some activity, the use of records have been found to mainly be within the organization that created the record. It is also difficult to predict who the users of the records will be. With the secondary purpose where records are used for cultural and historical research purpose, the use and the user are probably extremely difficult to predict. Whether or not it is even desirable to attempt to identify secondary users is very doubtful.

In all organizations studied in this thesis, the majority of records users have been found or defined by the organization from some of these categories.

- Organizational internal users
- Well defined users from other organizations
- Researchers
To sum up this section, records are used because they are reliable and authentic, and thus it is possible to use them as evidence. The use of records is also partially unknown.

6.3 **Electronic records quality**

In this thesis electronic records are a subset of information. If electronic records are to serve as evidence of transactions and be reliable and authentic i.e. fulfilling record requirements, the electronic record as an entity must have certain qualities. In information quality research different quality dimensions have been identified which enable measurement of information quality (e.g. Pipino et al., 2002; Wand & Wang, 1996; Wang & Strong, 1996). Even if there are some significant differences between information and records, information quality as a concept can be used as a basis for understanding electronic records quality.

In paper III a set of electronic records quality dimensions was identified, which to some extent corresponded with well established information quality dimensions (e.g. Pipino et al., 2002; Wand & Wang, 1996; Wang & Strong, 1996). A number of quality dimensions not desirable for an electronic record were also identified. The idea with electronic records quality is to enable assessment of electronic records. The contribution of paper III to this research was the identification of dimensions for electronic record quality. These dimensions are integral to the recordkeeping quality model concept.

6.4 **Multidimensional perspective**

Paper IV presents a set of good practice for developing recordkeeping systems to maintain reliability and authenticity in electronic records. The quality dependencies that were identified in paper IV as affecting reliability and authenticity of electronic records were found in these three levels:

- Strategic level
- Computer based Information System Level
- Entity level (record level)

The set of good practice presented in paper IV was found in the latter two levels. Paper IV indicates that success in maintaining reliability and authenticity can be positioned in several levels or dimensions. The multidimensional perspective of the recordkeeping quality model concept
was part of the results presented in paper IV, although identification of good practice was the aim of the paper.

In the work with assessment of success in information systems, a multidimensional approach was proposed in the DeLone & McLean IS Success Model (DeLone & McLean, 1992). In the DeLone & McLean IS success model, both information quality and system quality have been identified as affecting the success of an information system. The different levels presented in paper IV all affect the possibility of satisfying users of electronic records, recordkeeping systems and information systems managing records; ie users that want to use reliable and authentic records.

The strategic dimension is interesting. That dimension in paper IV is defined as approaches and underlying motivators for recordkeeping systems. In the two organizations in paper IV the underlying motivators and their approach affected how they developed the recordkeeping system, which implicitly affected the quality of the recordkeeping system. What is noticeable is that the approach and underlying motivators are dependent on what the organizations define as user and records use.

### 6.5 Summing up

The proposed recordkeeping quality model consists of four major concepts or components:

- Electronic records
- Records use
- Electronic record quality
- Multidimensional perspective

The whole idea with this quality model is to enable a deeper understanding of how to ensure high quality in recordkeeping systems, i.e. fulfilling recordkeeping requirements, represented here by authenticity and reliability.

The concept of the electronic record is necessary, because it is the unit of analysis in this research. The electronic record is also the entity that the recordkeeping system must manage, and without knowledge of requirements and characteristics of the entity, such management can be difficult.
A Predictive Model for Attaining Quality in Recordkeeping

Erik Borglund

The second concept is records use. It is important because it affects specific electronic records requirements apart from the overall requirements of authenticity and reliability. Use is also related to the user, when it is implicit that a user is the one that uses either a recordkeeping system or an electronic record. A recordkeeping system in this research has been defined as an information system with partially unknown purpose, which results in unknown users and unknown use. The unknown use within the concept of records use is important because when unknown use exists, unknown users exist as well, which implicitly gives unknown requirements which affect quality that is dependent on user needs.

Electronic records quality is quality on an entity level and includes dimensions and criteria for assessment of electronic records and whether they fulfill their requirements. It relates to the previous two levels in the following ways. Related to electronic records it is the quality that satisfies stated and implied needs of electronic records i.e. the requirements. The requirements of primary interest are of course those that enable an electronic record to be used as evidence. Electronic record quality relates to records use by the fact that the user states requirements.

The multidimensional perspective is also crucial to quality in recordkeeping i.e. fulfilling electronic record requirements must be seen in a multidimensional perspective. Quality in recordkeeping must be seen both on an entity level, i.e. electronic record quality, and on a system level, i.e. information system quality. Those two qualities are difficult to separate. Beside those two are, for example, organizational strategic approaches and underlying motivators affecting quality.

6.6 Applied interpretation of the recordkeeping quality model

In this section the major concepts of the recordkeeping model identified above and their interrelationship between each other are described. The description is based on figure 7.
The figure should be understood as follows. In the large container (within the dotted line) a record is born digital in a transaction resulting in an electronic record. An electronic record fulfilling record requirements can be used as evidence. As mentioned above the proactive approach recommends that the requirements should be captured at creation of an electronic record, in this case before the transaction. Users are using electronic records and the users are also affecting the records requirements, by their needs. Record requirements such as reliability and authenticity are rather abstract and must be broken down into more understandable components. Quality is a detailed description of the record requirements.

Outside the large container, what is named here organizational dependencies on a strategic level affects both record requirements and quality. Organizational dependencies on the strategic level are what paper IV presents as the underlying motivation and recordkeeping approach.

The large container as one unit represents a very simplified picture of some early stages in recordkeeping. Quality per definition used in this thesis is “an entity’s set of attributes that are characteristic of its ability to satisfy established and implied needs” (Chirinos et al., 2004, p.18).
the set of attributes that are characteristic to satisfy the process within the large container.

Quality is also directly affected by the user of electronic records. According to quality research in the IS domain as presented in section 4, this is fully natural. The user does of course implicitly affect and influence quality by their relationship with record requirements, but this direct affecting is not about record requirements. For example if a user finds it difficult to access and retrieve electronic records, the user is not satisfied, which results in low user satisfaction and implicitly, low quality. According to the record requirements the recordkeeping system could be of high quality but the user is not satisfied and may even dislike using the system.

Representing quality in a single container provides a visualisation that quality must be seen as a combination of both system quality and electronic record quality. It is difficult to make a separation between them as for example in DeLone & McLean IS Success Model (DeLone & McLean, 1992, 2003). Papers I, III and IV all present results that confirm the entity level and the system level are difficult to separate.

Figure 6 should only be seen as one possible way to integrate the four components in the recordkeeping quality model in a larger context. Figure 6 is not a suggestion of how a fully designed recordkeeping model can/should look like. The recordkeeping model is by itself only conceptual.

6.7 A predicative model

A recordkeeping quality model has been proposed above. The model is of a predicative nature, and is intended to be used to support development, and assessment of computer based systems that manage electronic records and are part of recordkeeping systems. At the level of maturity the recordkeeping quality model holds in this thesis, the model is best used as a basis upon which to increase and attain quality in development and management of information systems involved in recordkeeping. The recordkeeping quality model supports the idea of a proactive approach.
Conclusion

This section presents the conclusion, summarizes the contributions and outlines ideas on further research.

The aim of this research was to improve the possibility of achieving high quality in recordkeeping systems, i.e. to maintain reliability and authenticity of electronic records.

In the process of reaching the aim the following research questions have been used:

- What are the characteristics of records?
- How are electronic records used operationally?
- What electronic record quality is needed to maintain trustworthiness in electronic records?
- What can be improved to ensure high electronic record quality in recordkeeping systems?

The recordkeeping quality model presented consists of four major concepts which all have been derived from the four research papers (I-IV).

The aim of the thesis has been reached in two steps, first by each research paper and then the synthesized results in the form of the recordkeeping quality model.

The recordkeeping model is predictive in its nature and can be used in the design of information systems that must fulfill the recordkeeping requirements of reliability and authenticity, i.e. to attain high quality. The model is also a first step towards the assessment of recordkeeping systems. Within a recordkeeping system each record must fulfill those requirements to be able to serve as evidence over transaction (Reed, 2005). There is a need for further research on each of the four concepts of the recordkeeping quality model to better understand their nature and the relationships between them.

Beside the main result of this thesis, two other findings are worth highlighting. The first is the concept of the unknown use/user which forms part of the records use concept. When use of records is partially unknown this affects the possibility of capturing all requirements on both a recordkeeping system level and on the electronic records level, so that they can satisfy stated and implied needs. The ideal situation would of course be a situation where all sorts of use and potential users are known.
Further research on how to identify or at least minimize the unknown use/user is of interest and can be applied for example in development of e-services.

The second finding is the multidimensional perspective. The need and advantage of using a multidimensional perspective is not unique, it is the core idea in information system assessment models (e.g. DeLone & McLean, 1992, 2003; Seddon, 1997; Wilkin & Hewett, 1999). The idea behind the multidimensional perspective is that quality in recordkeeping is not solely something that can be reached on an electronic record level. The multidimensional perspective opens up the possibility of incorporating recordkeeping, and especially recordkeeping systems, into the domain of information system quality assessment.

Some of the concepts and dimensions affecting quality in a recordkeeping system have been presented in this thesis. How is it possible to assess those concepts? And how should measurement of recordkeeping systems quality be performed are also areas for further research.

The recordkeeping quality model is an empirically and theoretical grounded model, which has been validated only on a logical level. The most natural continuation of this thesis is to develop the model further and bring it to test in either an experimental environment or in a real life setting.

7.1 Final remarks

This thesis is the result of a larger research process that aims to culminate in a PhD thesis. The results of this thesis will be the foundation for continuing research which aims to further contribute to the overall research question presented in section 1 in this thesis.
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A Predictive Model for Attaining Quality in Recordkeeping

Erik Borglund


A Predictive Model for Attaining Quality in Recordkeeping

Erik Borglund


56
A Predictive Model for Attaining Quality in Recordkeeping
Erik Borglund


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A Predictive Model for Attaining Quality in Recordkeeping
Erik Borglund


A Predictive Model for Attaining Quality in Recordkeeping
Erik Borglund


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