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**Improving enterprise document management by a quality
system: a case study**

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IMPROVING ENTERPRISE DOCUMENT MANAGEMENT BY A QUALITY SYSTEM: A CASE STUDY

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ABSTRACT

Much of the collective knowledge of organisations is scattered in different types of document archives and in incompatible electronic documents within unintegrated applications. Along with technological challenges, organisational challenges caused by increasingly ubiquitous information technologies in everyday working need to be taken into account in the design of enterprise document management (EDM). The paper describes a case study in starting and organising continuous EDM improvement. The project took place in a power plant where an ISO 9002 quality system had previously been implemented. In the project, continuous EDM improvement was organised as an extension of the quality system. The paper describes document management in the plant before the project, the phases of the project, and analyses its results. The study shows that the adoption of the new EDM technologies required the organisation to rethink its documents, document management systems, work processes and the roles of human actors. The methods earlier adopted in the quality system for process improvement, however, offered a good basis both for performing the necessary reengineering tasks and organising continuous improvement.

1. INTRODUCTION

In contemporary organisations many working processes are connected with *documents*, i.e. recorded information structured and represented for human consumption. Sharing the collective knowledge stored in documents is, however, often impaired by the lack of a common technological and organisational infrastructure for *enterprise document management (EDM)* (Sutton 1996). Sprague (1995) defines document management as:

"creation, storage, organization, transmission, retrieval, manipulation, update, and eventual disposition of documents to fulfill an organizational purpose".

The design and implementation of the document management functions above is only a subset of the challenges to be met in establishing successful EDM. To achieve high quality EDM, a lot of organisational support is needed (Meier & Sprague 1996). In managing process change initiatives, *reengineering* seeks to achieve radical changes in processes within a bounded time frame, whereas *quality management* or *continuous improvement* emphasises improvement over an open-ended period of time (Davenport & Beers 1995).

Quality assurance activities in organisations and their processes have traditionally been widely organised by *quality systems*. The ISO 9000 series of standards offers a well-known model to demonstrate the quality of products or services (e.g. ISO 9001, ISO 9002). ISO 9000 standards have, however, been criticised for their limitations (Braa & Øgrim 1994, Reimann & Hertz 1993). In some companies the external auditing of quality has been the most important motivation for the implementation of ISO 9000 standards. Quality award criteria (e.g. Malcom Baldrige Award Criteria 1995) instead explicitly address customer focus, benchmarking, organisational learning and continuous improvement, and require organisations to be able to prove that they actually use specific methods for these purposes. In some companies, continuous improvement of processes has been implemented by a quality system where the

minimum quality assurance activities required by ISO 9000 standards have been augmented by activities typical in quality award criteria. We will show that quality systems can be extended to facilitate continuous EDM improvement as well.

Although the importance of computer-supported EDM has been identified for many years (Culnan 1980), there continues to be a dearth of empirical studies on the topic (Gordon 1997). The paper describes a case study in starting and organising continuous EDM improvement as an extension of a quality system. The EDM project took place in a power plant maintenance organisation where an ISO 9002 quality system had previously been implemented. A power plant is an interesting case study environment for two reasons. First, a rich collection of different kinds of documents is needed in power plant maintenance and support activities. Second, the limited number of different user roles in a medium-size power plant allows an in-depth study with moderate research resources. The organisation in question – Rauhalahhti power plant – was also interesting as a pioneer among Finnish power plants in the implementation of a quality system.

The study shows that the methods for process improvement earlier implemented in the quality system offered a good basis for organising the reengineering and continuous improvement of the plant's EDM. The EDM project had effects on documents and information structures, document management systems, work processes and human actors. These components have to be taken holistically into account in research concerning EDM methods and technologies, as well as in practical EDM improvement.

The paper is organised as follows. After a discussion on research methods in Section 2, the case is described. First, the pre-project situation in the organisation is introduced in Section 3. In Section 4 the four EDM project phases are described. The outcomes of the project are analysed in Section 5. Section 6 then discusses the lessons learned. The paper concludes with some suggestions for further research.

2. RESEARCH METHODS

The research data was gathered in three phases. During the first phase, two researchers spent two months (November 1995 – January 1996) familiarising themselves with power plant operation and maintenance work in general, and the EDM situation in the target organisation. They had access to documented material about the organisation including reports concerning the implementation of the quality system (Aro 1993, Repo 1996) and contemporary manuals for the quality system and for paper document management (Rauhalahhti 1, Rauhalahhti 2). In addition, the researchers made notes about the discussions they had with the quality manager and the secretary responsible for archive development. At the end of the phase, a plan for an EDM project was drawn up by the researchers and the above-mentioned personnel. The goal of the project was to define the quality criteria-based requirements for the future EDM development.

During the second phase, the researchers participated in the initiated EDM project. Their main task was to facilitate the definition of quality criteria for EDM. The researchers separately interviewed 19 of the plant's employees by collaboratively filling in a questionnaire about the utilisation of documented information (Appendix). They also participated in a development group which was set up to carry through the EDM project as a whole. The group members produced a documented report in a computer-supported meeting about the most desired features for the future EDM system and overall EDM development. The researchers continued to make notes about their occasional discussions with the plant personnel and on the observations they made during the time they spent in the plant. The researchers left the organisation in June 1996.

The third phase consisted of gathering follow-up data a year after the project to find out what actions had been taken towards continuous EDM improvement. The follow-up data was gathered by a tape-recorded discussion and complementary phone conversations with the participants of the first phase (the quality manager had now been promoted to plant manager and the secretary held the responsibility for EDM development as a whole). The researchers also had access to an up-to-date EDM manual (Rauhalahhti 3).

Phases one and three followed a case study methodology (Yin 1989), whereas the second phase was a type of action research (e.g. Checkland 1981) as the researchers actually participated in the EDM project to test their idea of defining explicit quality criteria to guide overall EDM development in the organisation. The third author's role was to hold an outsider's view of the study. An outsider would have more distance (Nandhakumar & Jones 1997) from which to generate general patterns out of the data and to cluster and analyse it further. In particular, she contributed to the pattern used to analyse the changes

which occurred in EDM in the power plant (see Section 5), while the two researchers were more bound to the context of the specific case. The case is reported chronologically to illustrate the changes and improvements which took place in the organisation.

3. PRE-PROJECT SITUATION

Rauhalahti power plant is operated and maintained by a business unit of IVO Generation Services Ltd., a subsidiary of the IVO Group, an international energy corporation offering a wide range of products and services in the energy sector. The plant started energy production in 1985. The primary business of the organisation is to operate and maintain Rauhalahti plant and some other minor power and heating plants in Central Finland.

The implementation of a quality system started in 1992 (Aro 1993). In 1994, the organisation was the first power plant maintenance unit in Finland to be awarded the ISO 9002 quality certificate (Repo 1996). The fulfilment of the ISO 9002 requirements was seen by the management as a starting point towards the continuous improvement of processes. The following means of process improvement were implemented in the quality system (Aro 1993, Rauhalahti 1):

- Defining responsibilities for process improvement.
- Systematic analysis and description of the processes and gathering suggestions for future development needs.
- Setting up of development groups to resolve organisational problems and to promote new initiatives, for example, to adopt new technologies, to benchmark best practices of other organisations, or to implement new ways to organise work.
- Creation of a feedback system in which every employee can identify problems or development initiatives and report them to the persons responsible for the area. The identified problems are expected to be reacted to and resolved immediately, but where this is not possible, the managers may set up a development group for the purpose.
- Developing criteria and metrics to analyse the performance of processes.
- Documenting guidelines for processes.

From the beginning, the quality system was a success (Aro 1993, Repo 1996). The resource savings gained from process optimisation were redirected to new business instead of shedding personnel. The organisation nowadays provides small-scale power plant engineering, remote operation, maintenance and fuel procurement services to other plants in the region instead of simply maintaining one plant (Repo 1996). Several discussions with employees (during the interviews in the EDM project phase) indicated that the changes in working brought about by the quality system were, excluding two or three dissenting opinions, widely accepted among the personnel.

Many types and a great number of documents are needed in the secure and effective maintenance of power plants. The documentation consists of about 12400 technical drawings (Aro 1993) and many other technical, administrative and juridical documents used by more than 60 workers. Documents are needed in operation and maintenance tasks as well as in administrative processes.

Before the quality system, document management had not been generally identified as carrying great importance. Documents were archived in paper and other non-digital forms. The attitude towards document management among the personnel, including the management, was described as follows (Aro 1993, English translation):

"As long as our plant is functioning and producing energy, everything is all right."

An archivist was responsible for the most critical – mainly legal and technical – documents. No documented guidelines existed for enterprise-wide document management. The technical documentation was, however, organised according to the standardised document categorisation offered by the plant vendor. The original, manual versions of technical documents were archived by the vendor in a centralised archive at another site. The reference data for the most critical documents were stored in a mainframe database used by the archivist. The mainframe application together with manual archives was not an effective solution in supporting document utilisation. Hence the employees had many personal, unofficial documents on which they relied at work (Aro 1993).

From the beginning of the implementation of the quality system, improvements in document management were regarded as an essential aspect of efforts to achieve quality (Aro 1993). The first version of the document management manual (Rauhalahti 2) was created together with the main quality manual (Rauhalahti 1). It covered the management of non-digitally archived documents, including

technical documentation, legal and other administrative documentation, quality documentation, and the plant library. The official version of any document was supposed to be archived and distributed in paper form. Responsibilities and means for EDM improvement were not determined in the first version of the manual.

In 1995, the mainframe application for the reference data was regarded as obsolete, and transfer to enterprise-wide electronic document management was suggested; e.g. in the feedback collected within the quality system. Because it was defined as obligatory for the managers to react to feedback, it was decided to set up an EDM project. Two researchers were invited to participate in the first phases of the project as outside facilitators.

4. THE EDM PROJECT

The EDM project took place in four phases:

1. Creation of the EDM development group
2. Identification of the actors with interests in EDM
3. Definition of EDM quality criteria
4. Organising continuous improvement in EDM

4.1 Creation of the EDM development group

In EDM development, the creation of a council representing different interest groups has been found important (Sprague 1995, Salminen *et al.* 1997). In the organisation in question, the use of development groups was initially regarded as an important means for obtaining continuous process improvement. Hence launching a development initiative by a development group was a familiar approach.

Five persons formed the EDM development group. Each subunit of the organisation had a representative in the group. Also among the group members were those responsible in the plant for the information technology (IT) budget, IT support, and paper archives. The organisation did not have an IT department, so the persons responsible for the IT budget and IT support took care of the computerised information systems in addition to their primary duties. In addition to the members from the organisation, two researchers participated in the group as outside facilitators.

4.2 Identification of the actors with interests in EDM

To identify EDM-related needs, problems and ideas, the group determined who the relevant types of actors were. Document *users* were prioritised as the most important actor type and defined as "persons who need documents in their work". The users were classified further into 19 different user roles according to the existing organisation chart. The main emphasis of EDM development was placed on analysing and fulfilling user needs. Other actors with interests in EDM were identified as follows: *managers of the organisation* (concerned with EDM costs and security), the *parent company IVO Generation Services Ltd.* (concerned with the generalisability of the new solutions), and *quality system auditors* (concerned with the quality system and its conformity with ISO 9002 specifications).

4.3 Definition of EDM quality criteria

In the quality system approach, explicit quality criteria are an important means of improvement (Juran 1988). Here, the quality criteria for EDM were defined in two phases. First, the problems, needs and ideas of document users were studied and reported. Second, the development group transformed the observed user needs to commonly agreed criteria, which were then prioritised.

To determine user needs, the development group selected 19 interviewees representing the range of user roles. The interviews were performed by the researchers as structured conversations, where the questionnaire shown in the Appendix was filled in by the researcher together with the interviewee. The questionnaire was derived from a questionnaire previously used to determine user needs in the case of legislative documents (Salminen *et al.* 1997). The interviews were based on the following principles:

- Information needs should be tied to use cases where the user needed documents (Dervin 1992).
- Users should express their problems, needs and ideas using their own language, so avoiding misleading and false interpretations on the part of the researchers.

The interviewees seemed mostly motivated to contribute to EDM development. The researchers wrote a report for the development group describing the use cases, document types used, and problems and needs observed in the interviews. The problems, ideas and development needs were classified into 21 organisation-level preliminary criteria. For each criterion, some examples of the user expressions in the actual interviews were given in order to reach a common understanding of the meaning of the criterion.

The second phase included the formulation and prioritisation of the EDM quality criteria. The development group, including one researcher, participated in a computer supported (GroupSystems™) meeting where they discussed the preliminary criteria, defined each criterion more precisely, and prioritised the criteria. They also defined three additional criteria. For instance, the definition of the criterion 'Ease of use' after discussions in the development group was documented as follows (English translation):

Ease of use: "The electronic document management system should be easy to learn. System commands should be easily memorable. The vendor should support and train the use and update of the system. Documentation structure should be clearly defined and easy to learn by everyone. Documents should be usable with appropriate access rights via every work station in the plant. Access to the document server thus should be easy for every user."

Each development group member voted on the most important criteria. The criteria considered most important by the group are listed in Table 1.

The specified criteria were immediately utilised to define the requirements for an electronic archiving system. The list of requirements was attached to an invitation for bids. The details regarding system delivery and training were agreed on the basis of the criteria. The management regarded the criteria as particularly important for obtaining agreement about the requirements of the archiving system and for tailoring training in the system with the vendor. The vendor thus acquired exact information about customer needs, which was considered valuable for subsequent product development. The quality criteria-based requirements specification thus benefited both the organisation and the vendor.

4.4 Organising continuous improvement in EDM

The feedback system implemented in the quality system had initially revealed the needs for improvement concerning EDM. Before the EDM project there had been no defined responsibilities for EDM as a whole. Now EDM was identified as an important area of continuous improvement by the development group.

Document management was no longer the responsibility of the archivist but the responsibility of every actor working in their different roles of producing and utilising documents as well as developing EDM systems and collaborating together. An important basis for operational collaboration was the new EDM manual. The manual was available to all users in electronic form. It was organised according to the defined document categories: technical documentation, quality documentation, other administrative documentation, project documentation, the plant library, and quality records (Rauhalahti 3). Document types in each category were named and listed. The manual stated the document management systems to be used for each category, and the instructions for use of the systems in processing documents in that category. Especially for the categories technical and quality documentation, the roles and responsibilities of different users were made explicit.

Table 1. The highest prioritised criteria for EDM

CRITERION	VOTES
Ease of use	6
Searchability of documents	6
Shared use of documents	6
Response time	4
Flexibility of systems	4
Currency of information	3
Utilisability of systems	3
Ease of checking and approving documents	3
Information security	2
Availability of documents	2
Clarity of documentation structure	2

The development group assigned an EDM quality manager to be responsible for the continuous improvement of EDM. The tasks of the EDM quality manager included updating the EDM manual, the active analysis of user needs, and the collection of feedback and suggestions regarding new EDM initiatives.

5. OUTCOMES OF THE PROJECT

The follow-up of the project was based on data collected out of discussions with the plant manager (earlier the quality manager) and the EDM quality manager a year after the researchers left the organisation. The latest version of the EDM manual was also examined (Rauhalhti 3). No data about the effects of the technological implementations were collected outside of opinions of the management. Hence we do not discuss EDM from the viewpoint of end users here. However, it was possible to observe some organisational outcomes.

The project was considered successful. According to the plant manager, the extensive user interviews during the requirements analysis had encouraged the use of the new archiving system and also provoked new ideas for developing EDM. Both persons emphasised in particular the importance of the quality criteria in specifying the services needed from the system vendor, and in planning user training during the implementation of the archiving system. The EDM quality manager considered the criteria as defined very helpful for understanding both the technological and organisational needs for improvement in EDM as a whole. However, she did not regard the criteria as very helpful in planning or estimating more detailed development initiatives apart from the requirement analysis for the archiving system.

In our opinion, the most important result was that the case organisation proceeded from a trial-and-error approach to document management towards a more systematic and holistic improvement in EDM. As the EDM quality manager put it (English translation):

“It was precisely that improvement aspect, ... we had not debated it in our minds [before the project], we had done everything [concerning document management] in the same way for ten years”.

By analysing the data we found that the observable changes concerned four components of EDM: documents, document management systems, work processes, and human actors (Figure 1). Below, the changes identified are briefly discussed.

5.1 Documents

Document types and organisation-wide documentation structures were clarified and a new documentation category was defined for the plant’s project documentation (e.g. business projects outside the plant and significant projects concerning the renewal of plant equipment). The document management manual was restructured (Rauhalhti 2, Rauhalhti 3). The quality documents, the technical documents in active use, and the most important incoming paper documents had been digitised.

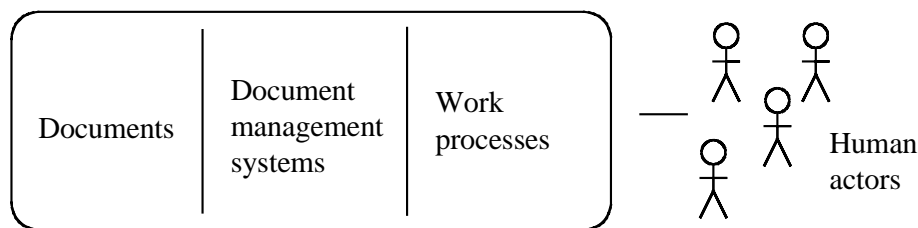


Figure 1. The components of enterprise document management

5.2 Document management systems

The electronic archiving system had been installed, tested by pilot users, and its wider utilisation was starting. The reference data for all archived documents was stored in the new system. Incoming paper documents were stored in the system in digital form after scanning. After the project, a new CAD system had also been installed for the engineers, and more personal computers (PCs) had been provided for workers on the shopfloor. Previously PCs had been mainly in the hands of administrative personnel, managers and engineers. The implementation of the archiving system was expected to reduce the need for personal document archives. As the plant manager put it (English translation):

"At least I do not hoard up information any more because I know the information generally is available and within a reasonable time."

The new systems had already resulted in resource savings: the work of the archivist was no longer needed. Also plant projects, often involving more than one organisation, were more efficient because the electronic archiving system was utilised in the processing and distribution of project documents. The inspection and approval of quality documents was easier and faster in the electronic archiving system than previously in the circulation of paper documents.

5.3 Work processes

Work processes were improved to utilise the opportunities of the new archiving and CAD systems. The EDM manual - especially the guidelines concerning technical, legal and quality documentation - had been redefined to support document handling in digital form instead of the paper form used earlier (Rauhalahti 3). For example, the inspection and approval of updates in quality documents or technical drawings no longer required the manual circulation of papers and collection of signatures. The workers were able to search for documents they needed in the course of their day-to-day work by themselves without the help of the archivist. One of the most evident changes in work processes was the reduction in paper document distribution as more documents were archived on the server.

5.4 Human actors

People were trained to use the new systems and to utilise documents in electronic form. The EDM quality manager was an important new actor in the organisation and the role of the archivist had disappeared. During the year, the responsibilities of the EDM quality manager regarding overall EDM improvement had been clarified. In the future, the role of the EDM quality manager was to be integrated with the job of the person responsible for IT development.

6. DISCUSSION

Contemporary work practices increasingly include the utilisation of digital documents. Compared to earlier practices, computerised systems require new skills and more standardised ways of working with documents. Document management functions are now embedded in the activities of every worker instead of being assigned as specific work roles. The shift from paper-based document management to enterprise-wide electronic document management clearly requires major reengineering efforts. In viewing the fact that IT is continually advancing, organisations have to recognise the need for continuous improvement. Hence organisations need methods by which to manage both radical changes and continuous improvement in EDM.

The quality system approach already adopted for process improvement also promoted the continuous improvement and reengineering of EDM in the organisation studied. Improvements in EDM were identified as a necessary component of efforts at achieving quality. All the methods described above for process improvement – a feedback system, influential development groups to launch an important initiative, systematic analysis of the current situation and future needs, explicit quality criteria, explicit responsibilities, and documented guidelines – contributed to the improvement in EDM. The existing feedback system had established an organisational culture where the expression of problems, needs and development ideas was openly encouraged. This meant that the organisation was able collectively to notice and agree that the defined responsibilities for EDM improvement were lacking. The organisation was familiar with the use of influential and representative development groups, which could thus also be

applied to the EDM improvement process. The extensive user interviews conducted to define the EDM quality criteria were used to systematically analyse current problems, to collect new ideas for development, and to involve users in the resulting EDM improvements. Documented guidelines for EDM were an important means in securing adequate collaboration.

The EDM quality criteria helped the EDM quality manager to identify areas ripe for improvement and assisted the organisation to act as an active client for the new archiving system. The original intent of the researchers was to specify general quality criteria to cover different EDM components and to be applied in different future EDM initiatives. The criteria specified were, however, too general to be usable in new types of development initiatives, for example, in the selection and implementation of the CAD system, user training, or the digitisation of manual documents. One explanation for this could be that users have different needs for different kinds of documents. Different quality criteria thus might be needed to observe improvements needed concerning the production, use, processing and storage of different document types.

The case confirms the need for a holistic EDM approach instead of a system-based, functional approach. During the study we developed a framework in which EDM was divided into four components: documents, document management systems, work processes concerning documents, and human actors (Figure 1). High quality EDM demands high quality documents, high quality document management systems, high quality work processes, and skilled human actors aware of their necessary roles and responsibilities. In EDM improvement, all the components are intertwined with each other and thus have to be planned and improved together. A holistic approach to EDM improvement, which covers all of the EDM components, is essential both in research concerning EDM methods and tools, and in practical development initiatives.

Although the present paper describes an in-depth study of one case, the methods presented for organising continuous EDM improvement may be useful in other organisations as well. These ideas can most directly be applied in cases where an organisation already has a quality system which is actively used for improvement. The specific EDM quality criteria defined in the context of the case organisation are probably not applicable as such in other situations.

7. CONCLUSION

Computerised document processing is a part of day-to-day work. To achieve effective electronic EDM, major reengineering efforts are required. In addition to radical IT implementations, systematic EDM should also include techniques for continuous improvement. Defined responsibilities and shared organisational guidelines compatible with contemporary IT capabilities are needed. Organisations familiar with methods originating in the quality system approach already have a good foundation on which to promote systematic EDM improvement, thereby enhancing their competitiveness.

Although enterprise-level quality criteria for EDM were useful in the described situation, they were not used in subsequent EDM development initiatives. Methods of analysing requirements for different genres of document information in a more detailed way is clearly an area to further research. We have also commenced the development of quality criteria focusing on special EDM components and environments, for example, criteria for electronic document management systems, and criteria for document type definitions of SGML documents.

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APPENDIX. USER INTERVIEW QUESTIONNAIRE (TRANS. FROM FINNISH)

(to be filled in together with the interviewee)

Date and time:

1. BACKGROUND OF THE INTERVIEWEE

- 1.1 Name: 1.2 Organisational group: 1.3 Position:
 1.4 The short description of work duties: 1.5 What information systems do you use in your work?
 1.6 How do you define a 'document'?
 1.7 How familiar are you with other information systems, either in your work or outside the work?

2. USE CASES OF DOCUMENTS

2.1 In what situations or processes do you utilise recorded information or documents (regularly or irregularly)?

2.2 What information and/or documents do you need in those situations?

USE CASE DESCRIPTION	DOCUMENTS USED
(free space to write answers down)	

2.3 What problems do you have in these use cases? What positive features do you see in these use cases?

PROBLEM	POSITIVE FEATURES

2.4 How do you solve problems? How could problems be avoided?

THE CURRENT SOLUTION MODEL	IDEAS

2.5 What are your expectations concerning new document management systems?

3. USE OF DOCUMENTS (From the table 2.2)

3.1 What needs do you have for the document? How often do you use the document? How important is it in your work (1=not at all .. 5 =indispensable)?

DOCUMENT	NEEDS	USE FREQUENCY	IMPORTANCE

3.2 What information do you need from the document?

DOCUMENT	INFORMATION NEEDED

3.3 Do you use different versions of the document? If so, why?

3.4 How do you access the document? How do you utilise it?

DOCUMENT	UTILISATION MEDIA	DISTRIBUTION

3.6 What are your ideas, expectations and needs concerning the better utilisation of documents?

4. OTHER COMMENTS

4.1 Do you utilise classified information, if so, who should have access to it?

4.2 Free comments on the topic:

4.3 Comments on the interviewee and the situation (the interviewer should make notes about the interview immediately after the situation):