

A Structured Link Document as a New Means for Composing and Publishing Technical Customer Documentation in Extranets and Intranets

Anneli Heimbürger

University of Jyväskylä

Department of Computer Science and Information Systems/Digital Media

P.O Box 35 FIN - 40351 Jyväskylä

Tel.+358 14 603 294, Gsm+358 50 330 3945, Fax+358 14 603 068

E-mail anneli@infoma.jyu.fi Home page <http://www.infotech.jyu.fi/~anneli/>

ABSTRACT

Internet technology together with the SGML based XML language family provide means to develop technical customer document management in inter-organisational industrial projects. The purpose of this exploratory study is to describe the characteristics of an inter-organisational industrial project, the problems related to the management of technical customer documentation and the possibilities of the new information technology to solve some of the problems. The model for technical customer document management in an inter-organisational network is presented. The model indicates that more precise investigation is needed and that future research should concentrate on developing systematic extranet and intranet design methodology which focuses on link management.

1. INTRODUCTION

In an industrial project, such as delivering a paper machine, a digital telephone exchange, a base station for mobile phones or a mill, there are several actors. They have different roles in producing, updating, composing, managing, delivering and using the technical customer documentation of the technical object concerned. Although all the actors in an industrial project will not adopt totally compatible systems for electronic publishing, particularly in the case where some of the actors change project by project, some common rules may be sought and agreed upon. The need for flexible solutions is obvious in a heterogeneous project environment of this kind.

Technical customer documentation is seen as an important part of the technical product itself, and plays a crucial role in the international competition. Systematic approach to technical customer document management is an issue of vital importance for industry. The modern information technology provides interesting means, such as extranets, intranets and XML (eXtensible Markup Language) language family, which may solve some of the problems related to the management of technical customer documentation in an inter-organisational industrial project. The XML with its XLink and XPointer languages give interesting possibilities to develop new management procedures for customer documentation in network environments, which are based on an external hypertext link management architecture. In this paper, a link refers to what the linking application software has to manage and present to end users.

The purpose of this exploratory study is to

- a) indicate the problems and needs related to technical customer document management in an inter-organisational industrial project,

- b) to suggest a model for technical customer document management in network environments
- c) to identify problems related to the suggested model for more precise investigation.

The remainder of this paper is structured as follows. Section 2 describes an inter-organisational industrial project with its actors and characteristics of technical customer documentation together with problems and needs related to. Technological developments, such as extranets, intranets and XLink language are presented in section 3. Advantages of the new information technology are discussed in Section 4. Section 5 introduces a concept of a structured link document and a model for technical customer document management. A scenario for a structured link document is also presented. Related work is discussed in section 6. Section 7 concludes.

2. TECHNICAL CUSTOMER DOCUMENTATION OF AN INTER-ORGANISATIONAL INDUSTRIAL PROJECT

2.1 An inter-organisational industrial project

The typical life-cycle of an industrial project consists of a number of phases leading up to the start-up and commercial operations of the technical object. When the project starts, a vast number of actors enter the project. An actor is an organisation or a person (Salminen 1999b). In addition to a customer and an information broker, there will be involved a constructor, large number of suppliers and subcontractors. Various official bodies are also involved in the project.

An information broker is usually a consulting or engineering company, which co-ordinates the project. The information broker has the best knowledge of the project as a whole and the needs of the customer. It has a crucial role in composing the technical customer documentation. A constructor with subcontractors build the technical object. Suppliers are responsible for the different components needed during the construction. Official bodies produce rules and regulations related to environmental, legal or security aspects.

Because an industrial project has a complex project organisation with several actors in different roles, it seems reasonable to separate the content production from the composition, management and delivery of the customer documentation. The natural role of the information broker is to act as the composer of the customer documentation. The different actors of the industrial project and their tasks in technical customer document management are summarised in Table 1.

Table 1. The main actors of an industrial project and their tasks in technical customer document management.

	<i>Production</i>	<i>Update</i>	<i>Composition</i>	<i>Management</i>	<i>Delivery</i>	<i>Use</i>
<i>Information broker</i>	X	X	X	X	X	X
<i>Constructor</i>	X	X				X
<i>Subcontractors</i>	X	X				
<i>Suppliers</i>	X	X				
<i>Official bodies</i>	X	X				
<i>Customer</i>						X

From the viewpoint of technical customer document management, the different actors form a complex inter-organisational network. They produce, compose, manage, deliver, update and use the customer documentation or parts of it according to their tasks in the project.

2.2 Technical customer documentation

Technical customer documentation describes the structure and function of a specific technical object such as a paper machine, a digital telephone exchange or a base station for mobile phones. Traditionally, customer documentation consists of the following components: installation, operation, commissioning, maintenance and training. Documentation is used in various environments, such as inside, outside, and in warm and cold weather conditions. There are many different user groups including technicians, maintenance personnel, vendors and trainers. All user groups have their own particular needs in searching for information. Moreover, the level of experience concerning a technical object will vary widely among the people in any user group. Group specialism and level of expertise will also affect the way people use the information and how customer documentation is taken advantage of.

Technical customer documentation contain text, tables, graphics, such as CAD drawings and figures, and possibly animation, sound and video sequences. Generally, customer documentation is organised in chapters and subchapters. Pieces of information in that documentation can have many internal relationships, for example a specific subchapter or a drawing of the Installation chapter may also have an important role in the Maintenance chapter. Documentation can include references to external information resources, such as standards and legal documents. Documentation will need to be updated either often or now and then depending on the technical object it is related to. Possible components of technical customer documentation are presented in Table 2 (Heimbürger and Lanas 1994).

Table 2. Components of technical customer documentation.

Component	Examples of the contents
User guide	Guidelines for using electronic customer documentation.
Project independent general information	Links to home pages of an information broker.
Project dependent general information	Project description and identifier, actors in the project.
Notes, cautions, warnings	Remarks related to security, such as cautions and warnings related to the technical object and individuals.
Structure of the technical object	A figure of the technical object.
Functions of the technical object	Descriptions of the main functions of the technical object; may include links to trouble-shooting situations.
Task and/or user group specific components <ul style="list-style-type: none"> • Installation • Operation • Commissioning • Maintenance • Training 	Step by step procedures for installation, operation, commissioning and maintenance of the technical object, list of links between these procedures, user group specific training materials etc.
Processes	Descriptions of the main processes of the technical object; may include links to trouble-shooting situations.
Trouble-shooting situations	List of links to different trouble-shooting situations and step by step instructions on how to solve them.
Component catalogue	Access to external relational database consisting information about the components of the technical object.
Transportation	Matters or rules concerning transportation of the technical object or parts of it.
Storage	Matters or rules concerning storage of the technical object or parts of it.
Environmental aspects	Matters or rules concerning environmental aspects of the technical object or parts of it.
Indexes and lists <ul style="list-style-type: none"> • Technical terms • Abbreviations • Tables • Figures and drawings • Animation, video and sound sequences • Standards related to the technical object • Other manuals related to the technical object 	Lists of links to technical terms, abbreviations, tables, figures and drawings, animation, video and sound sequences, standards related to the technical object, other manuals related to the technical object etc.
Users' notes	The user can make hers of his comments of a new trouble-shooting situation or a part of the technical object to be maintained.

2.3 Problems and needs

Nowadays, technical customer documentation is seen as a part of the technical product itself, and it plays an important role in international competition in various commercial fields. Customer documentation is more and more delivered, used and managed in electronic form. The main problem of technical customer document management in an inter-organisational project is unsystematised working procedures and heterogeneous information systems between different organisations. These often cause unnecessary overlapping and manual work, and makes technical communication between different actors in the project difficult. From a customer's point of view, this is time consuming and expensive.

It is typical for an inter-organisational industrial project that the organisation changes partly or in whole project by project. The information broker, who is responsible for composing the technical customer documentation is willing to use systematised, consistent and flexible ways for doing that. In addition, the information broker is interested in developing new customised information services and products related to customer documentation, for example support for task, situation and user group specific information needs. Production of training materials for different purposes is also an important issue.

3. TECHNOLOGICAL DEVELOPMENTS

3.1 Extranet and intranet

An extranet is a private network that uses Internet protocols and the public telecommunication system to securely share part of a business's information or operations with suppliers, vendors, partners, customers, or other businesses. An extranet demands security and privacy. These require firewall server management, the issuance and use of digital certificates or similar means of user authentication, encryption of messages, and the use of virtual private networks that tunnel through the public network. Companies can use an extranet to provide or access services provided by one company to another or to a group of other companies. (Lawton 1997; Sharp 1998)

An intranet means implementation of Internet technologies within an organisation over enterprise network inside a firewall. An intranet is a corporate wide area network that spans a whole organisation regardless of the actual geographical boundaries. The aim is to reduce the need for duplication in work activities through access to shared information. An intranet is used within and across different workgroups and departments in the organisation. (Bouguettaya, Benatallah and Elmagarmid 1998; Lovatt 1997)

An extranet can be viewed as part of a company's intranet that is extended to users outside the company. The life cycle of an extranet can be either project specific or a more permanent solution.

3.2 XML Linking Language

Standard Generalized Markup Language (SGML) is an international standard for defining markup languages, and it is designed to promote text interchange (ISO 8879; Goldfarb 1993; Coleman and Willis 1997). Markup languages define the markup rules which add meaning to the structure and content of documents. They are the grammar and the syntax which specify how a language should be "spoken". SGML documents have their grammar definition with them in the form of the Document Type Definition (DTD). An SGML DTD specifies what components are allowed, what components are required, how the markup itself is to be distinguished from text, and what the markup means.

The Extensible Markup Language (XML) is a subset of the SGML, and it is usable over the Internet (Extensible Markup Language 1998). XML is specially developed for network publishing in the World Wide Web (WWW). An XML document consists of marked up data using tags. As in SGML, each start-tag/end-tag pair, with data that may lie between them constitutes an element:

```
<techdoc>Customer documentation of the Project 2002</techdoc>
```

Each XML document contains one or more elements. The names in the start and end tags for an element must be the same. Elements can have attributes. Each attribute has a name and a value:

```
<techdoc attribute="value"> . . . </techdoc>
```

XML documents can have document type definition, but it is not necessary.

The XML Linking Language (XLink) is part of the XML language family (Boumphrey et al. 1998; XML Linking Language 1998; XML Pointer Language 1998). XLink specifies how separate documents should link into one another, and how structures within XML documents should be addressed.

A link identifies a relationship between two documents or pieces of information. A linking element is an element that tells the existence and describes the characteristics of a link. A linking element can have any name, but a way to inform the XLink conforming browser that this element should be treated as a link is done by using the XML reserved and designated attribute `xml:link`. A linking element can have other attributes too. The attribute `xml:link` can have the following values:

simple extended group locator document

An extended link differs from a simple link in that it can connect any number of resources, not just for example one local resource and one remote resource. It is a link whose traversal can be initiated from more than one of its participating resources. A linking element for an extended link contains a series of child elements that serve as locators. A locator is a string provided as part of a link, which identifies a resource.

As simple links, extended links can be inline or out-of-line. An inline link is a link where the content of the linking element serves as a participating resource. In an inline link there is always something that can be displayed to the user for clicking, for example, a text string or a hot spot. HTML links are examples of inline links.

Extended links can contain extended links as well, which makes nested tables of contents possible. With inline extended links it is possible to hide list of links behind a text string, and when the user clicks the string a drop-down box may appear on a screen. This is one way to save space on the screen. The appearance on the screen depends totally on how the XLink conforming browser treats the inline extended links.

It is possible for the links to reside in a completely different document. An out-of-line link is a link whose content does not serve as one of the link's participating resources. A key issue with an out-of-line extended link is how a linking application software can manage and find it, when it is stored separately from its participating resources. By itself an out-of-line extended link seems to be useless. However, when it is combined with an XLink conforming linking

application software it provides interesting possibilities to implement link databases with functions for maintaining, filtering, sorting, analysing and processing of link collections.

An extended link **group** element is a specialised form of the extended link, which can be used, for example, to group lists of links together according to some criteria. To prevent lost in hyperspace phenomena **group** element can have the attribute **steps**, which tells the XLink conforming browser how many levels to go in its exploration of links. A link author can also use attributes **show**, **actuate** and **behavior** to describe the traversal behaviour of the link.

4. ADVANTAGES OF THE NEW TECHNOLOGICAL DEVELOPMENTS

The XML and XLink specifications provide interesting possibilities to manage technical customer documentation in extranet and intranet environments, specially for a heterogeneous industrial project organisation. Producing, updating, composing, managing, testing, delivering and using the customer documentation can be done in a common network. Task, situation and user group specific information needs can be supported. Link management based on the XML and XLink languages makes it possible for same information to be relinked automatically. Various sets of links can be associated with the same content to create for example user group oriented views to information. XLink's ability to define more structure for links makes them easier to control. This leads to easier maintenance and, as with XML, to greater possibilities for automated processing. It is possible to treat collections of links as independent databases that may lead to new categories of marketable information.

SGML based document management solutions are application independent, consistent, flexible, and support reuse of information. The data can then be used and re-used across different platforms and in different applications.

The external link database supports the development of new information products and services related to technical custom documentation. For example, collections of customised link sets related to a specific project or a specific technical object could be sold as separate products. XLink provides nested information hierarchies, many-to-one and one-to-many relationships between documents. The XLink specification includes also the notion of a central link repository. Link databases, with filtering, sorting, analysing, and processing capabilities can be implemented by suitable linking application software.

In the future, an information broker will be able to play an entirely new role in the business domain. It can act as a link broker, who develops new general and customised information services and products which are based on the management of link collections.

5. A MODEL FOR TECHNICAL CUSTOMER DOCUMENT MANAGEMENT

5.1 Structured link documents

In this paper, a structured link document refers to an XML link document, where links have structures. In the case of technical customer documentation a structured link document can be defined as a structured metadocument of documents and/or parts of them produced by different actors in an inter-organisational industrial project. The basic structures of the link document can be used in every industrial project for composing customer documentation.

Generally speaking, a structured link document can be used by authors to design and compose publications for network publishing as well as by end users to read the publications and search related information, especially when there are several organisations responsible for content

production and one organisation composing the whole.

5.2 Actors and tasks

The different actors in the industrial project produce documents that they are responsible for according to a common set of rules and in agreed file formats. The organisations are working in the extranet, which includes all actors in the project. There are three possibilities how to store the components of the customer documentation in the extranet. They can be transferred through the extranet to the information broker's server, or they can be stored in one or more servers in the extranet.

The information broker composes the customer documentation by means of the structured link document designed, implemented and customised for the project. The structured link document can contain

- project independent links, for example a link to a guide how to use the documentation in the customer's intranet
- project dependent links, for example a link to a drawing of the technical object
- task or user group specific links, for example links to installation, operation, maintenance and training manuals
- situation specific links, for example a link to a trouble-shooting situation
- customised links, for example links to animation and video sequences describing an installation process step by step
- links to external resources, for example a link to a relational database such as a component catalogue.

Technical customer documentation consists of:

- a structured link document
- resources and sub-resources; examples of resources are documents, drawings, images, files, programs, databases, query results, sound, animation and video sequences
- links that point to resources and/or sub-resources.

After composing procedure the customer documentation can be tested by the actors who will use it. It is a great opportunity for a customer to take part in the testing phase. The information broker must also archive a copy of the documentation. Once the composing, testing and archiving procedures are completed the information broker delivers the customer documentation via the extranet to the customer's intranet, where it will be published for the end users. The transformation process from extranet to intranet requires the values of the attribute href to be converted from the project's extranet address space to the customer's intranet address space.

The structured link document has two roles in the customer documentation. Firstly, it defines the components and structure for a specific customer documentation. Secondly, a structured link document is the user interface of the customer documentation.

The model for technical customer document management is presented in Figure 1.

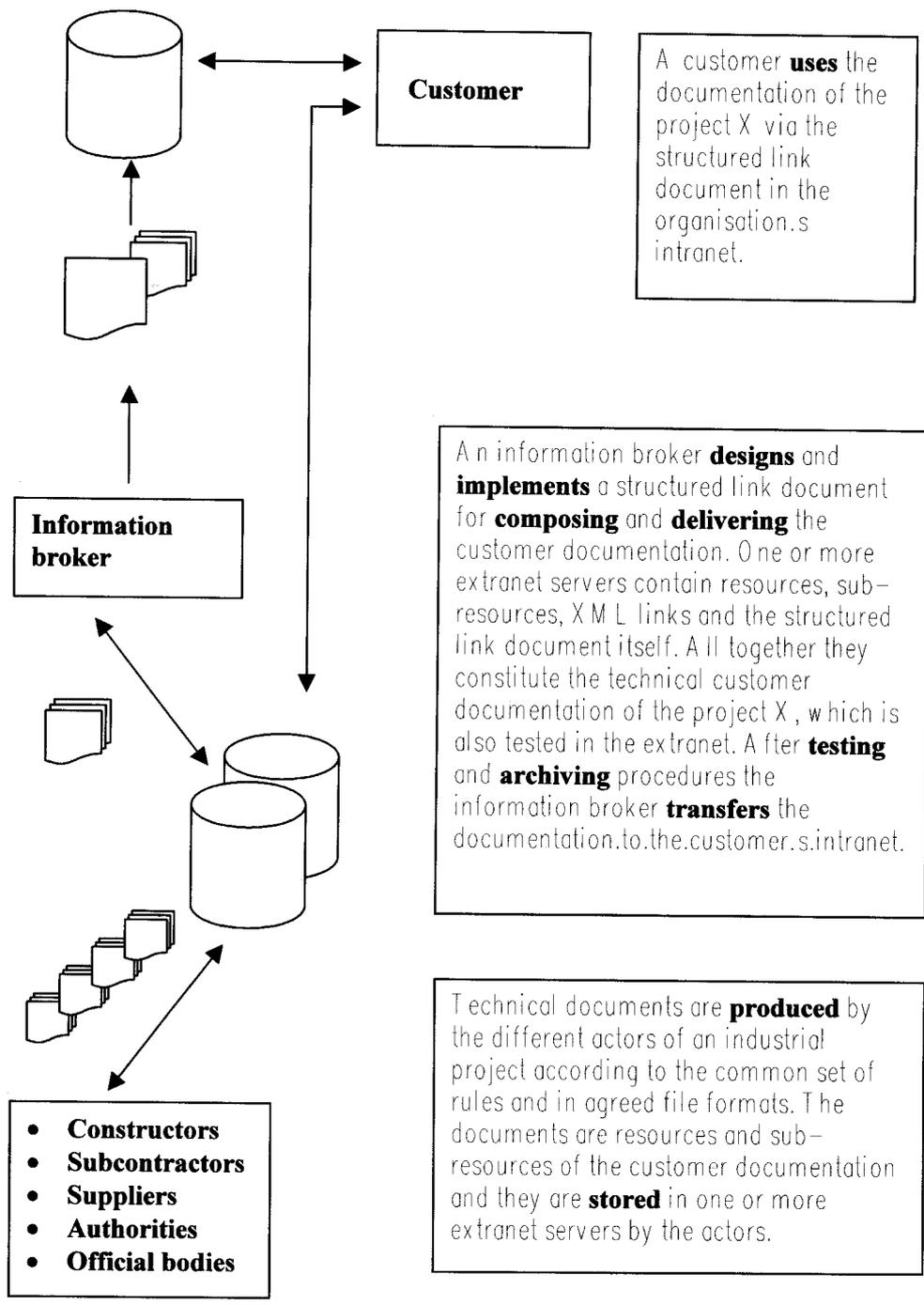


Figure 1. The model for technical customer document management for inter-organisational industrial project.

5.3 A scenario for the structured link document

The idea of the structured link document is not tied up to the XLink language, although it provides an interesting possibility to test the idea in practise as soon as there will be conforming software available. The structured link document can contain the components or some of them presented in the Table 2. Customer documentation may be composed by using out-of-line extended link structures according to the XLink specification. The example is shown in Figure 2.

```
<?XML version="1.0"?>
<project2002>
<para>
This is the
<techdoc xml:link="simple" href="http://www.extranet.com/links.xml">
Technical customer documentation of the Project 2002</techdoc>
</para>
</project2002>

<linkdoc xml:link="extended" inline="false">
<section xml:link="locator" href="http://www.extranet.com/links.xml" title="Project
2002"/>
<section xml:link="locator" href="http://www.extranet.com/doc1.xml"
title="Installation"/>
<section xml:link="locator" href="http://www.extranet.com/doc2.xml" title="Operation"/>
<section xml:link="locator" href="http://www.extranet.com/doc3.xml"
title="Commissioning"/>
<section xml:link="locator" href="http://www.extranet.com/doc4.xml"
title="Maintenance"/>
<section xml:link="locator" href="http://www.extranet.com/doc5.xml" title="Training"/>
</linkdoc>
```

Figure 2. An example of a simple and an out-of-line extended link as defined by the XLink language.

When a user clicks the text “Technical customer documentation of the Project 2002”, he or she may be presented with a drop down box for further selections. The box contains a list of links to different resources, in this case “Installation”, “Operation”, “Commissioning”, “Maintenance”, and “Training” documents. It is entirely up to the XLink conforming linking application software and browser how the links are managed and shown to the user.

6. RELATED WORK

Hypertext research indicates that the solution to many link management issues is to separate the links from the content. The idea of a link service has existed since the days of Intermedia (Bieber et al. 1997; Nielsen 1995; Yankelovich et al. 1988). From a user’s point of view the need for distributed link services has grown with the development of the World Wide Web. Hyper-G and Microcosm’s Distributed Link Service are two projects where support for non-embedded links to WWW pages have been developed (Andrews, Kappe and Maurer 1995; Carr, Hall and Hitchcock 1998). In Microcosm SGML markup is used in the link databases and now some parts of the system have been modified to support some of the XLink based linking facilities, such as controlling link behaviour and its presentation (Carr, Hall and Hitchcock 1998).

Grönbæk, Bouvin and Sloth (1997) have described the Dexter model (Halasz and Schwartz 1994) based distributed link service mechanism in which the links are maintained by a separate server, but combined with the text document by a Java applet embedded in the users browser. Another distributed link service has been produced for the Aquarelle project (Rizk and Sutcliffe 1997).

Nürnberg, Leggett and Wiil (1998) have described the development of conceptual architectures of hypermedia systems, demonstrating various stages from monolithic systems to open hypermedia systems.

Balasubramanian and Bashian (1998) have reported an architecture for a component-based authoring and publishing in the area of financial management and advisory services. In their architecture information about products were separated into components.

The IETF Working Group is defining standards for a distributed authoring and versioning protocol for the WWW (Whitehead and Wiggins 1998).

The study presented here is a part of the document management project currently in progress at the University of Jyväskylä. The project aims to develop, test and customise methods for the SGML standardisation process especially for industrial purposes (Salminen 1999a). The main goal of the whole project is to find means for optimising the multipurpose use of structured documents and for minimising manual and overlapping tasks in document management.

7. CONCLUSIONS

Internet technology together with the SGML based XML language family provide means to develop technical customer document management in the inter-organisational network environments. This exploratory study described

- a) the characteristics of an inter-organisational industrial project
- b) the problems and needs related to the management of technical customer documentation
- c) the possibilities of the new information technology to solve some of the problems
- d) the model for composing and publishing technical customer documentation by means of a structured link document.

In this study following issues for further research were indentified:

- a more precise understanding and definition of the structured link document as a concept; its meaning for software developers and for end users
- hypertext linking and document identification principles in inter- and intra-organisational networks so that the links could be transferred from the inter-organisational network to the intra-organisational network and vice versa automatically
- precise analysis of link record information so that the link database will support maintaining, processing, sorting, filtering and analysing link collections
- a more precise understanding of how does the XLink language support an external hypertext link management architecture
- electronic archiving principles of technical customer documentation
- a DTD for structured link documents should be considered.

These issues motivate future research to concentrate on developing systematic extranet and intranet design methodology which focuses on link management.

REFERENCES

- Andrews, K., Kappe, F. and Maurer, H. 1995. Serving information on the Web with Hyper-G. *Computer Networks and ISDN Systems*, Vol. 27, No.6, pp. 919 – 926.
- Balasubramanian, V. and Bashian, A. 1998. Document management and Web technologies: Alice marries the Mad Hatter. *Communications of the ACM*, Vol. 41, No. 7, pp. 107 – 115.
- Bieber, M., Vitali, F., Ashman, H., Balasubramanian, V. and Oinas-Kukkonen, H. 1997. Fourth generation hypermedia: some missing links for the World Wide Web. *International Journal of Human-Computer Studies*, Vol. 47, No. 1, pp. 31 - 65.
- Bouguettaya, A., Benatallah, B. and Elmagarmid, A. 1998. *Interconnecting heterogeneous information systems*. Massachusetts, MA, Boston: Kluwer Academic Publishers. 218 p.
- Boumphrey, F., Drenzo, O., Duckett, J., Graf, J., Hollander, D., Houle, P., Jenkins, T., Jones, P., Kingsley-Hughes, A., Kingsley-Hughes, K., McQueen, C. and Mohr, S. 1998. *XML applications*. Alabama, AL, Birmingham: Wrox Press Ltd. 648 p.
- Carr, L. A., Hall, W. and Hitchcock, S. 1998. Link services or link agents? In: Grønbaek, K., Mylonas, E. and Shipman, F. M. (eds.) *Proceedings of the Ninth ACM Conference on Hypertext and Hypermedia*, Pittsburgh, PA 20 – 24 June 1998, USA. The Association for Computing Machinery. Pp.113 – 122.
- Coleman, J. and Willis, D. 1997. SGML as a framework for digital preservation and access. *The Commission on Preservation and Access*. 47 p.
- Extensible Markup Language 1998 (XML) 1.0., (referred 3.2.1999). <URL: <http://www.W3.org/TR/1998/REC-xml-19980210>>.
- Goldfarb, C. F. 1993. *The SGML handbook*. Oxford: Clarendon Press. 664 p.
- Grønbaek, K., Bouvin, N. O. and Sloth, L. 1997. Designing Dexter-based hypermedia services for the World Wide Web. In: Bernstein, M., Carr, L. and Østerbye, K. (eds.) *Proceedings of the Eight ACM Conference on Hypertext*, Southampton, UK. New York, NY: The Association for Computing Machinery, Inc. (ACM). Pp. 146 – 156.
- Halasz, F. and Schwartz, M. 1994. The Dexter hypertext reference model. *Communications of the ACM*, Vol. 37, No. 2, pp. 30 – 39.
- Heimbürger, A. and Lanas, T. 1994. A practical model for computer-aided reading supports (CARS) for technical documents – The user's point of view. *Microcomputers for Information Management. An International Journal for Library and Information Services*, Vol. 11, No. 2, pp. 99 – 110.
- ISO 8879. 1986. *Information processing – Text and office systems – Standard generalized markup language (SGML)*. Geneva: International Organization for Standardization. 155 p.
- Lawton, G. 1997. Extranets: next step for the Internet. *IEEE Computer*, Vol. 30, No. 5, p. 17.
- Lovatt, M. 1997. Herding cats: a case study on the development of Internet and Intranet strategies within an engineering organisation. In: *The Proceedings of the SIGCPR 97*, San Francisco, CA, USA. New York, NY: The Association for Computing Machinery, Inc. (ACM). Pp. 104 – 109.
- Nielsen, J. 1995. *Multimedia and hypertext*. Massachusetts, MA, Cambridge: AP Professional. 480 p.
- Nürnberg, P. J., Leggett, J. J. and Wiil, U. K. 1998. An agenda for open hypermedia research. In: Grønbaek, K., Mylonas, E. and Shipman, F. M. (eds.) *Proceedings of the Ninth ACM Conference on Hypertext and Hypermedia*, Pittsburgh, PA 20 – 24 June 1998, USA. The Association for Computing Machinery. Pp.198 – 206.

Rizk, A. and Sutcliffe, D. 1997. Distributed link service in the Aquarelle project. In: Bernstein, M., Carr, L. and Østerbye, K. (eds.) Proceedings of the Eight ACM Conference on Hypertext, Southampton, UK. New York, NY: The Association for Computing Machinery, Inc. (ACM). Pp. 208 - 227.

Salminen, A. 1999a. Document management, (referred 15.2.1999). <URL: <http://www.cs.jyu.fi/~airi/docman.html>>.

Salminen, A. 1999b. Methodology for document analysis. To appear in the Encyclopaedia of Library and Information Science.

Sharp, D. E. 1998. Extranets: borderless Internet/Intranet networking. Information Systems Management, Summer 1998, pp. 31 – 35.

Whitehead, J. and Wiggins, M. 1998. WEBDAV: IETF standard for collaborative authoring on the Web. IEEE Internet Computing, September/October, pp. 34-40.

XML Linking Language 1998 (XLink), (referred 15.2.1999). <URL: <http://www.w3.org/TR/1998/WD-xlink-19980303/>>

XML Pointer Language 1998 (XPointer), (referred 15.2.1999). <URL: <http://www.w3.org/TR/1998/WD-xptr-19980303/>>

Yankelovich, N., Haan, B. J., Meyrowitz, N. K. and Drucker, S. M. 1988. Intermedia: the concept and construction of a seamless information environment. IEEE Computer, Vol. 21, No. 1, pp. 81 – 96.