Open and Secure Office Communication - EDI is not enough

Thomas Abdallah, Ralph Holbein, Patrick Scheidegger, Dr. Stephanie Teufel

University of Zurich

Department of Computer Science

Winterthurerstrasse 190

CH-8057 Zurich

Switzerland

{abdallah, holbein, scheideg, teufel}@ifi.unizh.ch

Abstract

Information is becoming an important production factor. Businesses are being forced to communicate and exchange information with each other because of market pressures such as increased competition, the internationalization of markets, and specialization of production processes. To survive, businesses must streamline both in-house and external communications while at the same time ensuring the quality, timeliness, and availability of information. Information Technology (IT), in the form of open office communication systems, provides a means for supporting this exchange of information. These systems provide a means for hardware- and software-independent communications within the organization as well as communication between organizations. Organization depend on both the availability of information and the use of IT system. Together called as the electronic information interchange (EII). Since information is primarily represented in the form of documents, open office communication relies on the use of document standards. This paper examines document standards focusing on the difference between loosely and highly structured information exchange and also the role of security which is an important issue for organizations depending on open electronic information exchange.

1 Introduction

The aim of this paper is to identify and describe the relevant prerequisites for open electronic information exchange in organization and consequently the requirements necessary to achieve security. Therefore, we show how the technology can be used for the realization of competitive advantages and economic benefits. We introduce the relevant international document standards, but we do not examine the underlying technical communication infrastructure. These standards together with a standardized communication infrastructure are necessary to realize open and secure electronic information exchange within and between organizations.

In chapter 2 we discuss the importance of information in organizations. Chapter 3 describes how electronic communication systems can guarantee the availability of information (e.g. without transportation delay). In chapter 4 we present documents as the major information carriers. Further on, we introduce document standards required for the exchange of these operational basic units assigned to a certain context. Finally, we show in chapter 5 the scope of document-based electronic information exchange, the role of security, and the basic security requirements.

2 The Importance of Information

Information is becoming an important production factor in organizations. It binds together all other production factors (e.g. labor, capital, and equipment). Therefore, information must be managed and used effectively, strategically, and efficiently [PICO 90].

One of the most important prerequisites for an adequate reaction to changing market conditions is the timely and flexible availability of information. This holds true for information used within the organization as well as information exchanged between organizations. The introduction of highly specialized information and communication technologies into organizations is necessary in

order to manage information in a manner that will enable the organization to react to increasing competition and internationalization of markets and take advantage of specialized production processes [BUMB 92]. The quality of the information and communication resources which an organization has control over affects the competitiveness of the organization [PFEI 90]. An increase in productivity, timeliness, and quality of information can therefore only be realized when the required information is made available to the right persons at the right time and place, in the right quantity and format, and for a minimal cost, i.e. information exchange must take place. Information (implicitly also the exchange of information) is the factor which ties together the influences of cost, quality, and time (see Figure 1).
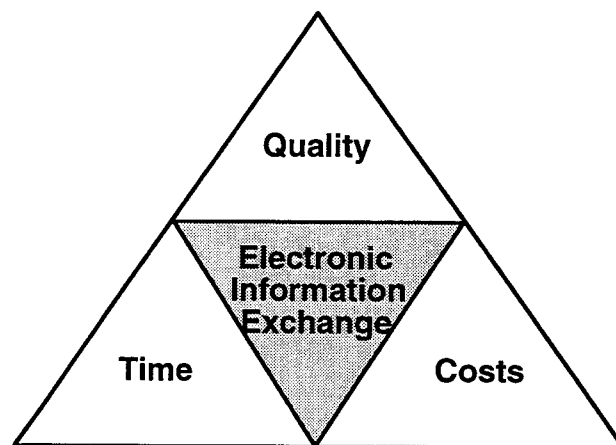
Figure 1 - Electronic Information Exchange's place in Organizations

According to Picot, the introduction of information and communication technologies must orient itself towards the organization's strategies and critical success factors. The use of IT-systems for information exchange facilitates the advantages and improvements described above. This can lead to varied courses of action affecting the value producing activities of an organization and the organization's relationships with its pre- and post-position market partners. The savings in productivity, quality, and timeliness previously alluded to can only be realized through a suitable restructuring process which takes into

consideration the following effects of the information and communication paradigm [PICO 90]: (1) information related costs are reduced through stream-lined information processing; (2) the organization's process oriented approach is strengthened; and (3) organizational activities are better synchronized with the pre- and post-position activities of other organizations.

3   Information Exchange

One of the prerequisites for using information is being able to exchange it with business partners. These partners include both external trading partners as well as internal resources. The electronic exchange of information supports a new orientation in organizations. It can be viewed as an essential part of the electronic communication structure of an organization that allows organizational resources such as personnel and equipment to be freed up. In addition to freeing up resources, potential benefits of electronic information exchange also include more productive use of personnel, reduced error rates, shortened processing and lag times, reduced administrative costs, and support of the Just-in-Time (JIT) concept for production and administration [FUCH 90].
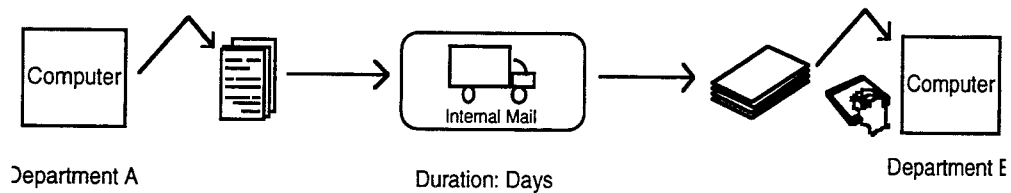
Electronic information exchange also offers a potential for savings and development. Most documents are currently generated, printed, and transferred by mail. These documents must then be manually processed by the receiver. This processing can take the form of transcription into other computer systems, archiving on other media such as microfiche and microfilm, or simply filing the documents for later reference. Seventy percent (70%) of all computer output is used as input for other computers. At least fifty percent (50%) of all transcribed documents contain at least one error.

Oppelt's studies into the order processing and accounting divisions show potential for the use of information exchange within organizations. These studies showed that processing within business units can be divided as follows

(all times are averages): fifty percent (50%) transport time, forty-five percent (45%) lag time, and less than five percent (<5%) actual processing time. Therefore, ninety-five percent (95%) of the time spent on order processing and accounting was unproductive. Concrete examples demonstrated that an introduction of IT communication systems can reduce these times by twenty-five percent (25%). Together with organizational changes, savings of up to fifty percent (50%) were possible. Oppelt goes on to mention that during the fourteen day study only seventeen percent (17%) of the examined orders and order forms did not warrant complaints [OPPE 92].

The effect of introducing electronic information exchange is often best represented as a time saving. As Figures 2 and 3 demonstrate, the time needed for documents to move from one department to another (or one organization to another) are dramatically reduced by the introduction of IT technology. Additionally, transcription of documents is eliminated and reliability is enhanced.

Information Exchange within the Organization

Department A   Duration: Days   Department E

Information Exchange between Organizations

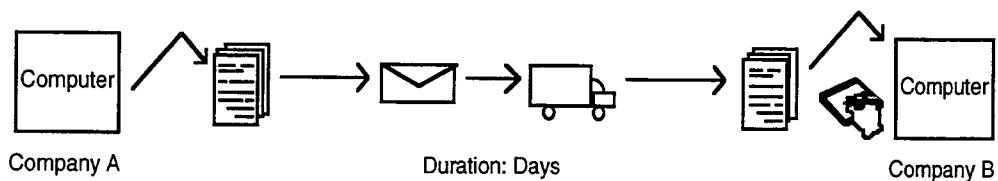Company A   Duration: Days   Company B

Figure 2 - Current Model of Information Exchange

Electronic Information Exchange within and between Organizations
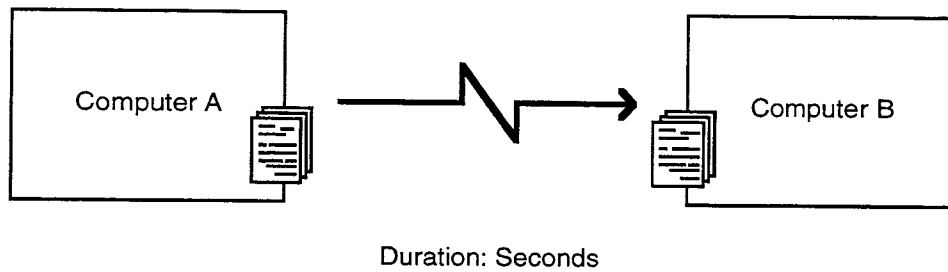

Duration: Seconds

Figure 3 - Desired Model of Electronic Information Exchange

Document-based Information

Information exchange within and between organizations is, for the most part, document based. Documents contain the information that is required in order to combine the classical production factors (labor, capital, equipment) to achieve the smooth and effective operation of a business.

Due to the increasing use of IT, the number of documents produced (e.g. reports, calculations, notes, and sketches) is increasing rapidly. For example, in Swiss commerce, approximately one million documents are processed per day [ANNE 90]. According to their use, i.e. is the amount of automatic or/and intellectual processing of the document content, these documents contain varied structures (e.g. memos, letters, invoices, financial statements) and utilize various media (e.g. text, graphics, sound). The various types of documents can be classified into one of two general categories: either highly structured information (e.g. purchase orders, invoices, airline reservations) or more loosely structured information (e.g. letters, notes, reports).

Current office communications systems which, for the most part, grew out of specific applications, require converters for processing and exchanging documents between different systems. As the communication needs between organizations increase, more conversions will be required. The increasing number of conversions have a negative influence on the performance of the business [BUCH 90].

Electronic Information Interchange (EII) encompasses both document types (highly structured and loosely structured). For automatic processing the Electronic Data Interchange addresses the exchange of highly structured information and is well known as EDI. Information as needed for human processing e.g. within planning and decision making is usually exchanged by documents which are loosely structured (s. Figure 4).

Electronic
Information
Interchange
(EII)

Highly-
Structured
Information
(Electronic Data Interchange:EDI)

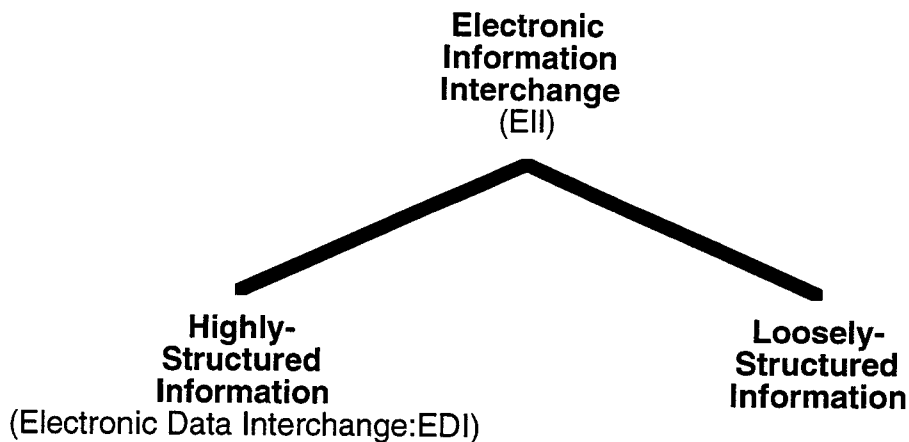**Loosely-**
Structured
Information

Figure 4 - Information/Document Exchange Hierarchy

EDI describes the electronic exchange of highly-structured documents, with minimal manual intervention, between two or more partners across various operating environments. Oppelt describes a scenario for EDI as follows [OPPE 92]: Businesses are involved in a network of relationships with numerous interfaces (see Figure 5). Along with the co-ordination between consumers, suppliers, insurers, transporters, and banks there exists an hierarchical relationship with other organizations (e.g. parent firms) as well as governmental institutions (e.g. customs and taxation). This network is distinguished by a flow of materials, a reciprocal capital flow, and a bi-directional flow of information.

The job of an electronic data interchange system is to provide a bridge or medium over which these processes can be realized. The pressures that drive the use of EDI comes in the most cases from external market pressure (e.g.

JIT production in the automobile industry) that force internal cost reductions (especially in an office environment) and permit higher productivity (e.g. by optimizing the delivery process) [OPPE 92].
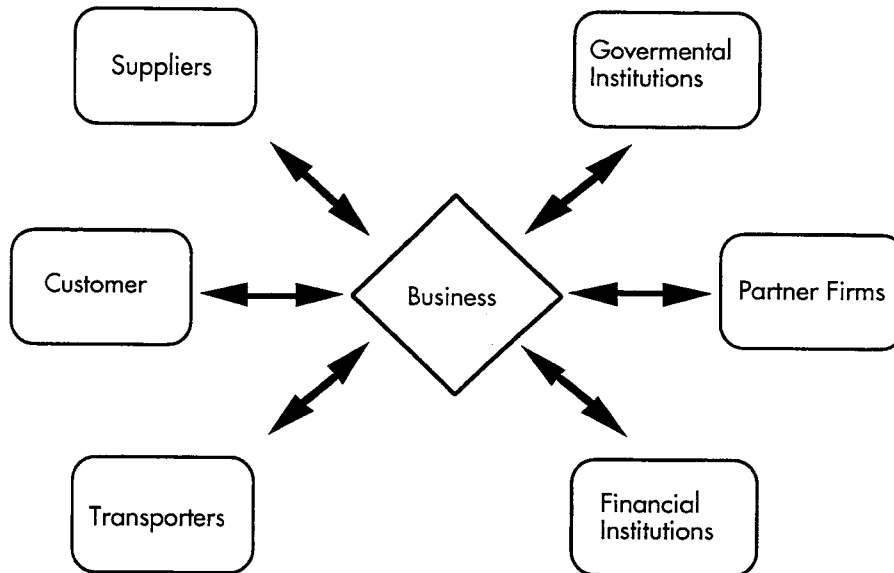

Figure 5 - Relationship Network

A pioneer in the field of EDI has been the automobile industry. British automobile manufacturers realized a cost reduction from £9.50 to £0.30 per transaction by using EDI. In the United States, by using EDI and JIT, the amount of capital equipment in inventory was reduced by one billion dollars [PICO 92]. Anner predicts that the potential gain that can be realized by implementing EDI in world markets is between seven and twelve percent. Furthermore, Anner sees EDI having the same sort of impact that the introduction of data processing had thirty or forty years ago [ANNE 90].

EII also encompasses the exchange of loosely structured information in the form of documents (e.g. reports, papers, notes, etc.) in addition to the highly structured documents of EDI. This type of information exchange includes those areas currently covered under Office Automation such as document management, archiving, and document processing. Loosely structured information is usually not exchanged in the same manner as EDI exchanges.

Various office communication systems like word processors, email, groupware systems are usually used for the internal exchange of text documents, graphics, etc.. The increasing complexity and dynamics of processes in organizations need a comprehensive co-ordination by electronic information exchange. This can only be achieved by an integration of highly and loosely structured information processing.

4   International Standards for Document Architectures

Document standards provide the foundation for document-based information exchange. They bridge the gap between the numerous components that exist within a heterogeneous work environment.

For this reason, standards for the exchange of documents have become the focus of interest. These standards allow communication, through vendor independent processing and transmission systems, between senders and receivers such that the receivers understand the information, can interpret it, and can use it to fulfil their business tasks.

Electronic communication within enterprises is based on documents. Those documents should be exchangeable within and between organizations, independent of the vendor and system used to exchange them.

Two areas are prime candidates for standardization in open information processing; office systems and publishing. The following internationally recognized standards exist for these areas :

Table 1 - Classification of Document Standards

Highly Structured Documents	ANSI X12	EDI in the United States
	UN/EDIFACT	EDI in Europe
Loosely Structured Documents	ODA/ODIF	Office Documents
	SGML/SDIF	Electronic Publishing

ANSI X12 and UN/EDIFACT

The ANSI X12 standard was developed in 1978 by the American National Standards Institute to address the data exchange needs of several American industrial groups. The X12 standard addresses the following areas: communications, education and implementation, product data, finance, government, material management, transportation, technical assessment, purchasing, and industry standard transition [ABDA 93]. In 1986 work was begun to bring X12 in line with the EDIFACT standard. The advantage of X12 is that it is very mature and is gathering momentum in the United States. "... the trend seems to be emerging that in North America the plethora of domestic standards and their supervising bodies will converge upon ANSI X12 as the national domestic standard while conforming to EDIFACT for international trade" [KIMB 91].

The United Nations Economic Commission for Europe (UN/ECE) worked to bring together the American and European standards committees to develop the Electronic Document Interchange for Administration, Commerce, and Transportation (UN/EDIFACT) standard which was published as ISO 9735 in 1988. The UN/EDIFACT standard is also broken down into nine Message Development groups which cover trade, transport, customs, finance, construction, statistics, insurance, travel/tourism/leisure, and health/pharmacy [ABDA 93].

Both the X12 and UN/EDIFACT standards provide a mechanism for packaging and delivering a highly structured document such as an invoice or purchase order. Documents are grouped according to their function. Invoices, for example, can be bundled together into one 'functional group' and transmitted from one business to another. This standard is directed towards the automated processing of information.

Parallel to the international standards development for the exchange of trade information (highly structured documents) various branches of industry have

developed their own specific EDI-implementations such as CEFIC (Chemical Industry), ODETTE (Automobile Manufacturers), and EANCOM (Retailers). At the moment the different industry groups are engaged in the migration from their defacto standards to UN/EDIFACT.

ODA/ODIF

In 1989, after many years of development, the ISO 8613 standard for Office Document Architecture (ODA) and the related ODA Document Interchange Format (ODIF) were agreed upon. This standard allows the system independent transfer and manipulation (reading, printing, editing, and use in business processes) of loosely structured documents. The ISO 8613 standard covers a wide range from simple text editors to document classification-based integrated systems used for the manipulation of multi-media documents [KRÖN 90].

The document architecture of ODA is based on a descriptive object-oriented model [APPE 90]. The content of a document is structured around two basic units: on one side it is represented by a logical structure which divides the document into parts such as chapters, sections, sentences, etc.; on the other side a layout structure defines the document in terms of regions on a page. This structure allows the document to be described not only by its content, but also by its internal structure.

SGML/SDIF

A further standard in the area of open information processing is SGML (Standard Generalized Markup Language). This standard was defined by the ISO to meet the requirements of the publishing industry [ISO 86]. The standard mainly addresses a text-oriented syntax for the exchange of document structures [BORM 90]. This has the advantage of providing a 'layout free' exchange of documents between authors and publishers, where the document

is assigned a specific layout structure by the publisher. This standard divides the document only into logical structures (chapters, sections, etc.) but has no effect on the presentation of the document on paper or the screen.

SGML specifies the syntax of a document but not the semantics of that document. The markup process breaks-up the logical elements of a document and specifies what functions should be performed on those elements. It focuses on the logical structure of the document and not the presentation form on a two-dimensional medium. The related interchange format is SDIF.

The document standards mentioned above are used for the creation and transmission of documents in electronic form. EDIFACT controls the exchange of highly structured documents by defining a set of message structures. The automatic processing of documents by applications is the focus of the EDIFACT standard. ODA and SGML function on a similar basis: they differentiate between the logical and layout structure of a document. The main difference between ODA and SGML is that ODA puts more emphasis on the automated formatting capabilities that can be associated with a document, whereas SGML provides a more general means for describing the syntax of a document in a readable form.

5   Security

In this chapter we illustrate the role of security by introducing the following example (Figure 6). It demonstrates how highly and loosely structured information can be exchanged within and between organizations with the help of standards such as those discussed in this paper. Within Company X, various departments can exchange highly structured information (Data) with the help of an in-house EDI system. Loosely structured information (Notes and Reports) can be exchanged between departments by means of an in-house SGML application. The company's information exchange needs with its Supplier are handled by an EDIFACT application that permits the exchange of

highly structured information (Orders and Invoices). Finally, the company communicates with a Marketing Firm, sending loosely structured information (Sample Brochures) by means of an ODA application. It receives both loosely and highly structured information (Finished Brochures and Invoices) from the Marketing Firm by means of ODA and EDIFACT applications.
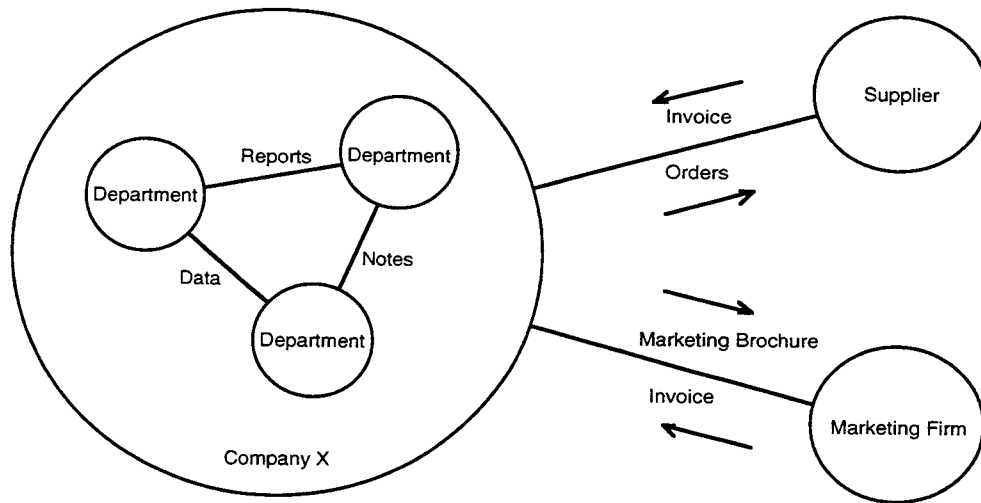

Figure 6 - Electronic Information Exchange Example

The increased use of open networks and electronic information exchange necessary to realize the described scenario also increases vulnerabilities. Risks for loss of confidentiality, integrity, and availability [ZSI 89] arise by higher amounts of data, greater number of users, lower ethic barriers, lack of legal regulations, technical and human failures, etc..

Security is a central quality issue as a means of protecting an organization from such risks. As more documents are being electronically exchanged within and between enterprises, enterprises are increasingly reliant on access to 'correct' information (i.e. information which maintains its integrity and confidentiality). Therefore, the introduction of electronic information exchange is not possible without a comprehensive security management scheme [SCHM 92]. To this end, methods for modeling the goals of an organization, for describing threats, for deciding on solutions, and for assessing other unknown risks are required.

Secure systems can only be developed by combining various preventative measures. Organizational, technical, and architectural measures must be woven together [BAUK 90], [SCHE 92]. Security aspects affect all activities of an organization and, as such, must be part of an integrated security concept. Isolated solutions and branch-specific procedures which address security issues in the middle- and long-term cannot bring successful results.

Numerous technical solutions exist for managing the security aspects associated with documents and the exchange of data. These solutions include, among others, symmetrical and asymmetrical encryption algorithms (ex. RSA with Public Key Encryption and DES), algorithms for access controls (ex. chipcard access and password access), logging, accounting, monitoring methods, and authentication algorithms (ex. digital signatures) [DENN 83], [RULA 91].

The solutions mentioned above mostly find use in isolated solutions and not in the context of a comprehensive context-sensitive and flexible security concept even though, from the perspective of an organization that is highly integrated, information security must be an integral part of the well-being of the organization. The integration of security in document standards (ex. ODA/ODIF, EDIFACT, SGML) must be developed and well suited to each other. The integration of Public Key encryption into such environments is only in the planning stage and isolated from each other. To realize the integration properly founded theoretical studies must be done on the impact, dependencies, and related effects of security measures on the various layers of the OSI model. There is also a lack of unified concepts, methods, and examples in the area of distribution mechanisms and administration guidelines [LIPP 91].

The main problem of these previous efforts stems from their technology oriented bottom up view of security and the fact that IT is primarily used for data processing as the automatic part of the use of information [PARK 91]. To differentiate from this view, one has to distinguish between Data Security and

Information Security, which also covers the intellectual processing of information. By developing and integrating the security models in a top-down manner, its possible to arrive at a cohesive concept which allows us to apply a well coordinated mix of constructive and add-on approaches to security design.

6 Conclusion

In this paper we based our understanding of communication and information exchange on the acknowledgement of the importance of information as a production factor and the importance of IT systems to handle information, especially to realize information exchange. To survive in a changing environment, businesses must be able to manage their internal and external uses of information. While part of managing information includes streamlining, the quality, timeliness, and availability of information should be maintained. The data and document exchange standards which exist are one means of supporting the information exchange requirements of organizations. Documents are the carriers for highly and loosely structured information. A significant aspect of the introduction of new information technologies is, therefore, the integration of these types of documents in a heterogeneous environment. Standards can be selected according to the organization's document needs: EDIFACT or ANSI X12 for highly structured information; and SGML or ODA for loosely structured information. Each of these standards was briefly presented in this paper. Finally, in recognition of the importance of information, information exchange and It systems the requirements for secure information exchange have been proposed.[1]

Bibliography

[ABDA 93]   T. S. Abdallah: State of the Art: Standardized Information Exchange. Institutsbericht, Institut für Informatik, Universität Zürich, 1993.

[ANNE 90]   R. Anner: EDI als Wettbewerbsvorteil im Detailhandel [EDI as a Competitive Advantage in Retailing]. Thexis, 2, 1990.

[APPE 90]   W. Appelt: Document architecture in open systems: the ODA standard. Springer-Verlag, Berlin, 1991.

[BAUK 90]   K. Bauknecht: Der Computer als offenes System: Grenzen der Computersicherheit [The Computer as an Open System: Limits of Computer Security]. In: K. Bauknecht, C. Strauss (Hrsg.): Beiträge zur Sicherheitsproblematik bei Informatiksystemen [Notes on Security Issues of Information Systems], Institutsbericht, Nr. 90.04, Institut für Informatik, Universität Zürich, 1990.

[BORM 90]   U. Bormann und C. Bormann: Offene Dokumentenbearbeitung [Open Document Processing]. Informationstechnik, 32(3), 1990.

[BUCH 90]   T. Buchmann: EDIFACT: Entwicklungsstand und Anwendungen. Strategische Bedeutung für Logistik-Ketten und Informationsmanagement [EDIFACT: State of Development and Implementation. Strategic Implications for Logistics and Information Management]. Proc. ONLINE'90, Hamburg, 1990.

[BUMB 92]   F. Bumba: EDI in logistischen Leistungsketten [EDI in Logistic Productivity Chains]. Informationstechnik, 3, 1992.

[DENN 83]   D. E. Denning: Cryptography and Data Security. Addison-Wesley Publishing Company, Reading, 1983.

[FUCH 90]   J. Fuchs: Informationen als Impulse für Innovationen [Information as a Catalyst for Innovation]. Office Management, 12, 1990.

[ISO 86]   ISO 8879: Information Processing - Standard Generalized
               Markup Language (SGML). International Organization for
               Standardization, Geneva, 1986.

[KIMB 91]   Paul Kimberley: Electronic Data Interchange. McGraw-Hill,
               Inc., New York, 1991.

[KRÖN 90]   G. Krönert: Wird ODA/ODIF Bürosysteme verändern?
               [Will ODA/ODIF Change Office Systems?] Informations-
               technik, 32(3), 1990.

[LIPP 91]   H. Lippold, H. A. Gartner: Strategie für die Informations-
               sicherheit [Strategy for Information Security]. Office
               Management, 7-8, 1991.

[OPPE 92]   U. Oppelt, M. Nippa: EDI-Implementierungen in der Praxis
               [Practical EDI Implementations]. Office Management, 3,
               1992.

[PARK 91]   D.B. Parker: Neuformulierung der Grundlagen der Informa-
               tionssicherheit, Deutsche Übersetzung erschienen in: Daten-
               schutz und Datensicherung 11/91.

[PFEI 90]   H. K. Pfeiffer: The Diffusion of Electronic Data Interchange.
               Working Report 23, Institut für Wirtschaftsinformatik,
               Universität Bern, 1990.

[PICO 90]   A. Picot: Der Produktionsfaktor Information in der
               Unternehmensführung [The Production Factor Information
               in Management]. Information Management, 1, 1990.

[PICO 92]   A. Picot, R. Neiburger, J. Niggl: Erfolgsdeterminaten von
               EDI: Strategie und Organisation [Success Factors of EDI:
               Strategy and Organization]. Office Management, 7-8, 1992.

[RULA 91]   C. Ruland: Sichere Übertragung und Archivierung elektro-
               nischer Dokumente [Secure Transmission and Archiving of
               Electronic Documents]. Datacom, 3, 1991 .

[SCHE 92]   P. Scheidegger: Lassen sich sichere Elektronische Märkte
               mit EDI realisieren? [Can Secure Electronic Markets be

Developed using EDI?]. Diplomarbeit, Hochschule St. Gallen, St. Gallen, 1992.

[SCHM 92]   S. Schmidt: EDI - Elektronischer Informationsaustausch [EDI - Electronic Information Exchange]. Institutsbericht, Nr. 92.11, Institut für Informatik, Universität Zürich, 1992.

[ZSI 89]   Zentralstelle für Sicherheit in der Inforationstechnik: IT-Sicherheitskriterien - Kriterien zur Bewertung der Sicherheit von Systemen der Informations technik (IT) [IT Security Evaluation Criteria]. Bundesanzeiger Verlags ges.mbH., Köln, 1989.

Glossary

ANSI ASC X12	American National Standards Institute Accredited Standard Committee X12
CEFIC	Conseil Européen des Fédérations de l'Industrie Chimique
EII	Electronic Information Interchange
EDI	Electronic Data Interchange
EDIFACT	Electronic Data Interchange for Administration, Commerce and Transport
ISO	International Organization for Standardization
JIT	Just in Time
ODA	Office Document Architecture
ODETTE	Organisation for Data Exchange through Tele Transmission in Europe
ODIF	Office Document Interchange Format
SDIF	SGML Document Interchange Format
SGML	Standard Generalized Markup Language

411