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Designing an EDI Solution for an Industry Segment: A Case from the Swiss Construction Industry

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ABSTRACT

Design and implementation of information systems for industry-wide data exchange have proven to be challenging tasks in many cases. When introducing such systems, standardization is inevitable and necessary in order to gain benefits from cross-company integration. However, this standardization potentially conflicts with strategic objectives of involved companies. Since the assessment of a system's costs and benefits varies considerably between potential users, the challenge is not only to balance different incentive levels, but also to create institutional structures which facilitate the successful management of the transformation processes and systems operations.

Our contribution focuses on a segment of the Swiss construction industry (mechanical and electrical services), in which a community of interest (Interessengemeinschaft Datenverbund für die Haustechnik - IGH) developed a solution for industry-wide data exchange between producers, wholesalers and crafts enterprises. Despite a lower than initially expected adoption rate, industry reactions and adoption activities by a range of companies suggest a successful implementation.[1]

Keywords

Diffusion of EDI, interorganizational systems, institutional design, standardization, construction industry, network externalities, interorganizational integration.

INTRODUCTION

Advantages of interorganizational integration have been propagated since the end of the 1960s (Kaufmann, 1966). In the 1970s and 1980s, standards for electronic data interchange[2] were developed at both national and international level (e. g. ANSI X12 and UN/EDIFACT). However, diffusion of those standards remained below expectations (Reimers, 2001) and is limited to a few industries, and mostly large companies. Empirical findings suggest that specifically small and medium enterprises perceive electronic data interchange as too complex and cumbersome (Iacovou, Benbasat and Dexter, 1995). Initial investment is high, there is considerable uncertainty regarding the speed of diffusion within the relevant business community and regarding the development and evolution of business message standards. The standardization process itself has to be viewed from a cost-benefit-perspective: advantages stemming from standardization have to be weighed against costs incurred by the standardization process and integration costs. A costly, long and tedious standardization process with an indefinite outcome incurs costs that can easily exceed standardization benefits. Additional integration costs result from standard adoption and subsequent adaptations to new standard variants. The commitment to a specific state of technology might possibly be suboptimal for single users. Risks regarding the acceptance / diffusion and the durability of standards also influence integration costs.

In the remainder of the paper we will discuss well known obstacles to the diffusion of EDI solutions, followed by a description of a case of successful diffusion of an EDI solution in an industry segment. The case discussion will follow the distinction of economic, strategic and institutional perspectives.

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[1] A previous, German-language version of this paper was presented at the Multikonferenz Wirtschaftsinformatik (MKWI 2004), March 9-11, Essen, Germany.

[2] We use EDI in the functional sense in order to describe inter-organizational solutions focusing on the exchange of information about business transactions and not related to a particular technology, communication infrastructure or message standard.

INHIBITORS OF EDI DIFFUSION

In their analysis of the evolution of outsourcing, Lee et al. (2003) distinguish three perspectives - the economic, the strategic and the social perspective, which together provide a comprehensive explanation why companies engage in outsourcing partnerships and provide some indication on how they could be managed successfully. We will use and adopt Lee et al.'s perspectives for the analysis of diffusion obstacles.

Economic Perspective: Proprietary vs. Standard Solutions

The development of message standards for EDI amounts to the definition of a business language with semantic, syntactical and pragmatic aspects (Reimers, 2001).[3] Moreover, agreements on a technical level are needed in order to allow seamless and trustworthy electronic communication. For companies with a high volume of business critical data exchange (initiators), such as car manufacturers and their message exchange with suppliers, proprietary solutions may initially appear most beneficial. The initiators can control the properties of the solution and can ensure that internal integration will be facilitated. However, there are obvious shortcomings of this rationale, since the initiator as solution owner will be responsible for the maintenance and ongoing development. Moreover business partners might not easily accept proprietary solutions as they involve partner specific investments (asset specificity) and potentially lead to a look-in situation.

On the other hand, the development of a standardized solution – at least within an industry segment – may seem advantageous in the long run. As network goods, EDI standards are associated with positive externalities (Katz and Shapiro, 1985): Diffusion of these standards leads to an increasing number of potential business partners with whom standardized messages can be exchanged electronically. Thus, utility of standard adoption increases for each user. Besides, the number of software companies supporting these standards has grown resulting in increased stability and professionalism. Traditionally, industry-specific business software solutions for SMEs hardly support interorganizational communication, and software companies are often hesitant to publish interface design and data formats for data import and export. The growing acceptance of XML makes technical integration of business message exchange easier, but individual integration of communication solutions with internal systems is likely to be too costly for most SMEs.

The development of industry-wide EDI solutions is difficult to initiate as consensus needs to be built between independent and partly competing players and as funding for the standardization process has to be solicited. The expected absolute number and percentage of electronically supported business transactions in a specific application domain, which usually vary across players, have considerable influence on amortization expectations and motivation regarding system implementation.

Strategic perspective: Negative Externalities and Asymmetrical Distribution of Benefits

Standards do also have negative externalities: the increasing diffusion of standards in a company's relevant market environment levels the competitive playing field and diminishes potential competitive advantages through standard use. Moreover, the introduction of information systems based on far-reaching standards leads to a certain harmonization and convergence of business practices (Graham et al., 1995).

Consequently, decisions regarding the adoption of solutions for industry-wide data exchange are a trade-off between standardization benefits and concerns of preserving or gaining competitive advantage through differentiation. The layer model perspective as illustrated in Table 1 helps to understand when companies may value the positive externalities higher than the negative ones. From bottom to top, the layers have an increasing impact on the users' socio-technical systems and thus on their differentiation potential and business strategy (Kubicek and Reimers, 1996). A major contribution to diminishing the standardization vs. differentiation conflict can be reached by separating business language and system integration. As argued above, EDI solutions benefit from the use of widely accepted standards on the lower layers. The competition for differentiation mainly takes place on the system and process integration layer (Österle, Fleisch and Alt, 2000). Thus competitive advantages can be achieved on these higher levels – without threatening system compatibility.

Benefits and incentives associated with standardized business message exchange are usually asymmetrically distributed. Cox and Ghoneim (1994) showed that the dimensions "centrality of application" and "degree of integration" have considerable influence on the benefits that can be gained with EDI. The first factor mainly results from a company's position within the value chain; the second is highly dependent on a company's activities regarding the integration of external communication with internal systems. Hence, in the early stages of an interorganizational system's life-cycle, the asymmetrical distribution of benefits often leads to a differentiation between initiators of an EDI solution (sponsors) and those companies that later on

[3] For a definition of these semiotic perspectives and their application to business language development see Kubicek (1992).

adopt a solution (adopters) (Cavaye and Cragg, 1994). By taking the lead and a higher share of the development costs, the initiators can level some of the initial asymmetries (Wang and Seidmann, 1995).

Institutional perspective: Collective Actors as Promotors

The economic and strategic perspectives informed about obstacles for the emergence of EDI solutions. Crucial for the success of EDI initiatives seems to be the existence (or formation) of a collective actor, be it an industry association or voluntary cooperation, who can crystallize the various drivers and create a momentum for a collective solution and thereby effectively discourage the development of proprietary solutions (Monse and Reimers, 1997). The role and function of the collective actor can be described in analogy to promotors of change within companies, i. e. an actor who actively manages and facilitates the design, implementation and stabilization of change processes. Witte (1977) differentiated between promotors by power and promotors by know-how. For the introduction of EDI solutions, promotors by know-how can be classified into promotors belonging to the business application domain (e. g. distribution or procurement) and into technical promotors responsible for technical infrastructure and information systems management. Chakrabarti and Hauschildt identified a third promotor role: the process promotor relies on system know-how, organizational and planning power and on interactive skills. Process promotors mobilize and coordinate potential and actual network partners and can win over different types of people (Chakrabarti and Hauschildt, 1989; Klein, 1996). Failure in forming an effective group of promotors increases the risk that the transformation processes within the affected organizations do not gain the required momentum.

Summary

EDI solutions represent complex inter-organizational systems which usually are split into different layers in order to facilitate a higher level of flexibility for differentiated needs, e.g. business partners with significantly different transaction frequencies. As for technological advances, communication protocols might e. g. change faster than message standards. Table 1 presents potential obstacles of EDI diffusion in the context of an EDI layer model, adapted from Kubicek (1992). Since the layers have a varying impact on business processes and strategies of players adopting an EDI solution, the model will also be used in the case analysis in order to explain how the standardization-differentiation conflict was dealt with in the case of IGH.

Layer			Inhibitors
Tech. and organizational integration		Application systems / user interface, process integration	To a large extent, EDI-benefits depend on organizational and technical integration (Cox and Ghoneim, 1994). Organizational integration is costly and time-consuming, effort for technical integration depends on available interfaces and exchange formats.
Business language	Pragmatics	Action-reaction-patterns, interchange agreements	Business relations and the resulting interorganizational processes are coined by partner-specific factors such as mutual trust, which can change over time. The formulation of individual, legally binding interchange agreements is costly and requires mutual trust; internationally accepted standard agreements can mostly not be drawn on (Bons, Dignum, Lee and Tan 1999; Bons, Lee, Wagenaar and Wrigley 1994; Kubicek and Reimers 1996).
	Semantics	Meaning of field contents	Standardized service and product descriptions do often not correspond with the interest of providers, since they increase comparability and thus might foster price competition. Furthermore, product and service descriptions are often company-specific.
		Field formats	Due to company-specific requirements regarding information contained in specific documents, a definition of document field formats can lead to conflict.
	Syntax	Document structure	For many industries neither national nor international standards meeting industry-specific requirements exist. Required documents / document fields often differ across companies. Bilateral solutions for interorganizational data exchange can lead to the rejection of industry-wide solutions due to specific investments and incompatibilities (also applies to other levels).
Infra-structure		Technical transport systems and security	The internet represents a cost-efficient, globally accessible infrastructure. However, many small and medium enterprises have limited experience with electronic data exchange and lack employees with the required skills.

Table 1. Inhibitors of EDI diffusion from a layer model perspective

Economic incentives for a joint solution may not be sufficient, companies may pursue strategies to block or effectively boycott the development of standardized solutions, or there may be a lack of a resourceful collective actor. Most likely we

see a combination of factors that fall into one or several of the sketched perspectives. Which leads to the question: how were the obstacles overcome in the case of IGH?

DATAEXPERT – INDUSTRY-WIDE COMMUNICATION INFRASTRUCTURE FOR THE SWISS MECHANICAL AND ELECTRICAL SERVICES INDUSTRY

In this paragraph we introduce a case study from a segment of the Swiss construction industry for which a solution for industry-wide data exchange has been developed. The subsequent case analysis takes up the discussed inhibitors of EDI diffusion and focuses on economic, strategic and institutional factors (Lee et al., 2003; Reimers, 2001). Since the cooperative culture within an industry or industry segment is a central influence factor for the development of collective solutions, we start with a short overview of industry characteristics.

The Swiss Mechanical and Electrical Services Industry

Main segments of the Swiss mechanical and electrical services industry are plumbing, heating, ventilation, air-conditioning and electrical engineering. Total sales volume is over CHF 2.5 billion for the plumbing and heating segments alone. The industry is characterized by a two-tiered distribution structure with manufacturers, wholesalers and crafts enterprises. Approximately 20 (excluding the electrical engineering sector) manufacturers distribute their products via 60 large wholesalers. The crafts enterprises, about 5.500 to 6.000 companies, are predominantly small companies. Their clients are mostly architects or planners who manage construction and refurbishment projects.

In 1994, ten companies founded the IGH (Interessengemeinschaft Datenverbund für die Haustechnik), a community of interest that aims to develop and improve the infrastructure for cross-company data exchange within the industry. Currently, the IGH consist of 68 dealers and manufacturers and the Swiss-Liechtenstein mechanical services industry association suissetec. IGH membership fees consist of a one-off admission fee of CHF 8.000 and an annual subscription of CHF 4.000.

Information Systems Use in the Swiss Mechanical and Electrical Services Industry

The use of IT in the industry has increased sharply over the last few years. Manufacturers and wholesalers mainly use ERP systems. The majority of crafts enterprises and planners uses industry software solutions which are tailored to the specific needs of these enterprises. The four largest industry software solution providers with suissetec accreditation have a market share of approximately 80%.

Most IT solutions used in the industry supported only in-house processes. Business process support across company borders was almost non-existent. The catalog data standard Win_Expert which was introduced by IGH in 1994 represented the only industry-wide data standard.

Process Integration Based on IGH DataExpert

At the end of the 1990s, some wholesalers and manufacturers initiated first projects for cross-company data exchange. Encouraged by these initiatives, IGH decided to develop a solution for industry-wide data exchange. It was crucial to start development quickly, as large investments in bilateral solutions would have hampered the launch of an industry-wide solution. The resulting DataExpert solution is presented below.

The DataExpert Solution

DataExpert provides integration components for interorganizational data exchange. It supports the handling of complete business transactions and can be used both between crafts enterprises and wholesalers as well as between wholesalers and manufacturers. (see Figure 1).

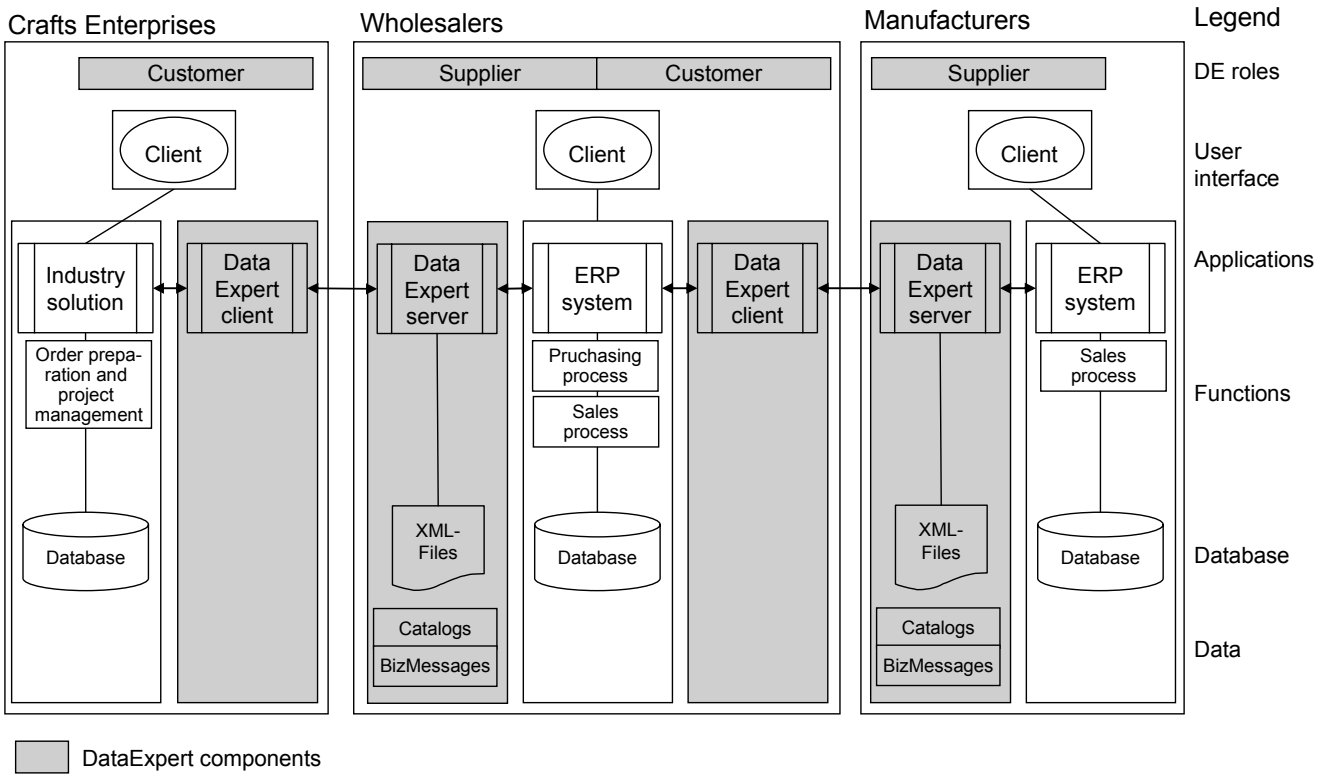

Figure 1. Overview of DataExpert's architecture

The DataExpert components validate business messages and transport them between trading partners. Transaction processing is still carried out by the trading partners' industry software solutions respectively ERP systems. Customers and suppliers directly communicate with each other; no third party is involved in transaction handling.

Business Perspective

The two-tiered distribution structure plays a key role in the industry. Manufacturers produce the required products and provide detailed technical product information. Wholesalers play an important role, as the high number of crafts enterprises results in considerable requirements regarding logistics and customer care. Due to geographical proximity and long-standing contacts, many crafts enterprises have strong relationships with wholesalers.

Process Perspective

The idealized sequence of actions in a mechanical and electrical services project is illustrated in Figure 2. Usually, wholesalers and crafts enterprises exchange the messages named in Figure 2. Individual messages, such as the call-off order, may be omitted depending on the situation. Traditionally only fax, telephone and mail are used for communication. The resulting need to switch between different media leads to high processing costs, reduced data quality and long throughput times due to multiple entries, increased error probability and loss of time.

DataExpert aims to remove these inefficiencies by defining standards for all required messages and for electronic message exchange. The traditional process sequence is not changed by DataExpert. Due to the generic definition of the supplier and customer roles, the system can be used between both crafts enterprises (customer) and wholesalers (supplier) and between wholesalers (customer) and manufacturers (supplier).

Data exchange between planners/architects (customer) and crafts enterprises (supplier) is not supported by DataExpert. It is handled using SIA451, a data format for service specifications and offers recommended by CRB (Swiss Head Office for Rationalization in the Construction Industry).

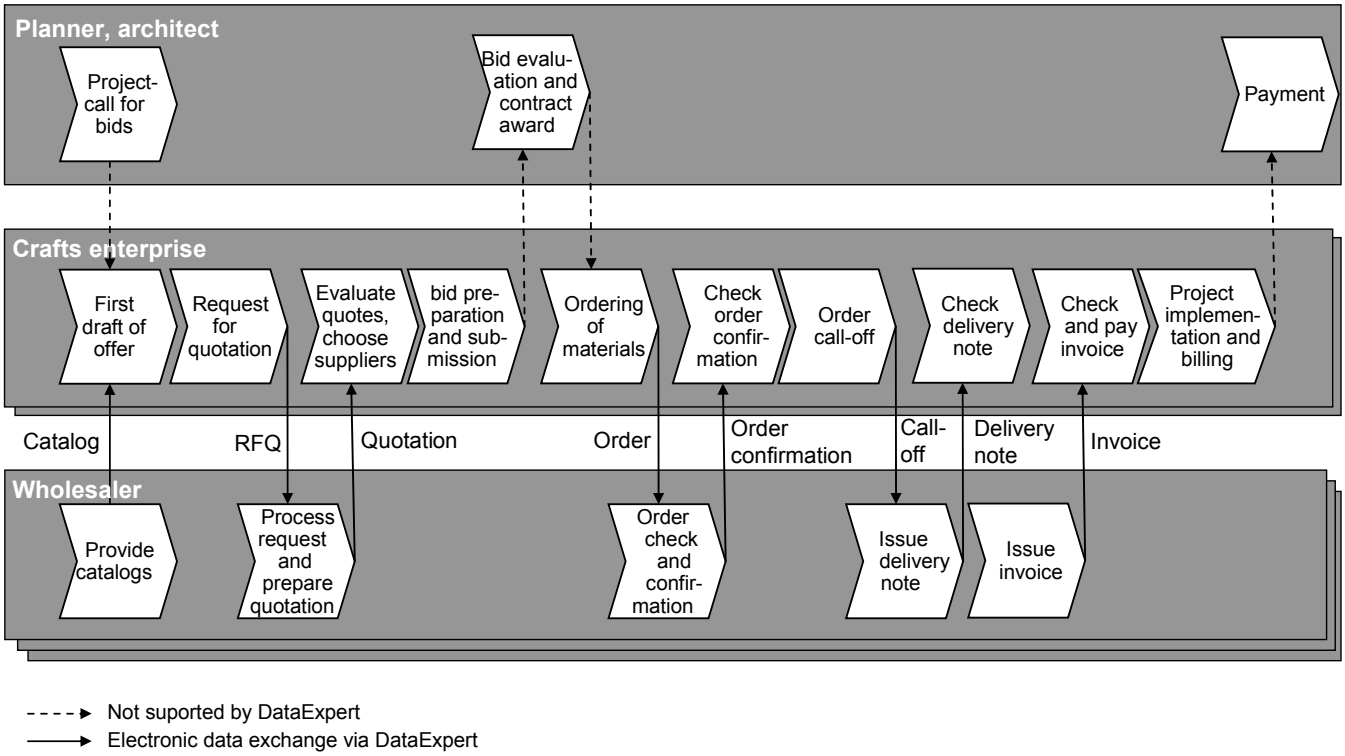

Figure 2. Idealized transaction process between architect, crafts enterprise and wholesaler[4]

Application Perspective

Figure 3 shows an example of the interplay between DataExpert and the trading partners' application systems. Communication between DE-client and DE-Server is based on web services which are installed on a supplier-based Microsoft IIS Web Server with ASP.net. The main component of the customer-side installation is the method library DE_Transfer, which validates documents and calls up web services on the supplier-side. The supplier-side installation of DE_Transfer communicates with the customer-side installation. It can also be used by suppliers' ERP-Systems to read messages stored in an upload directory and to export outgoing messages to a download directory on the server.

Applications on both customer and supplier side can call DataExpert methods offered by their local DataExpert applications via .net or COM interfaces.

[4] This process sequence also applies to transactions between wholesalers (customers) und manufacturers (suppliers).

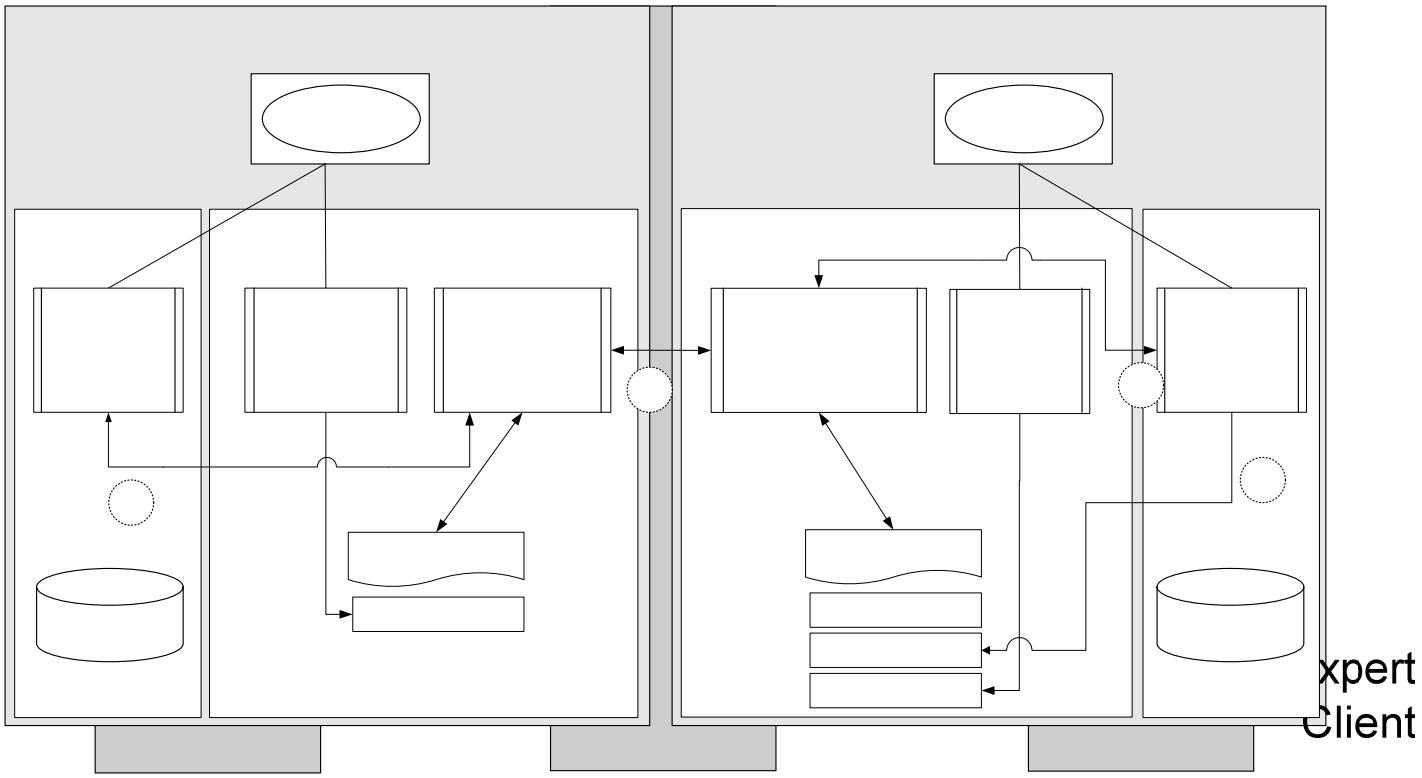

Figure 3. Internal and external integration with DataExpert

Data Perspective

Since none of the examined message standards met IGH's requirements, XML-schemata for DataExpert catalogs and business messages were defined. The DataExpert catalog standard is an extension of the IGH-defined Win_Expert catalog standard, with additional fields for detailed product information. Compatibility between both standards is ensured through a converter which is provided free of charge. With a few exceptions, suppliers can adjust message schemata to a certain extent by declaring data fields either as mandatory or optional fields. The customers' applications can load modified schemata via the DE_Transfer-client.

System Development and Implementation

None of the about twenty software solutions which were analyzed in the second half of 2000 met the industry's requirements. In 2001, it was thus decided to develop a new solution. bSquare and Zühlke Engineering were chosen as development and implementation partners. Implementation of DataExpert client and server components was completed in October 2002.

Total costs for standard definition and implementation of the DataExpert components were less than CHF 400.000, which is 5% below budget. The development was financed completely through IGH membership fees. The client component for the customer-side and the server component for the supplier-side can be used free of charge by IGH members.

System integration on the level of craftsenterprises is to be carried out by the industry software solutions providers, while wholesalers and manufacturers have to integrate the components with their ERP systems individually.

Current State of System Adoption

Although speed of adoption remained below IGH's initial expectations, the general attitude towards DataExpert is increasingly positive within the industry. Three of the four largest providers of industry software solutions for crafts enterprises have started integrating DataExpert functionality into their products. One has already finished integration and

plans to start shipping the new DataExpert-compatible software release to crafts enterprises in July. A second provider will enter a test phase this fall and provide customers with DataExpert-compatible release by the beginning of next year. A third one has implemented the new catalog standard.

Integration of supply-side functionality with existing systems on the wholesaler level has been started by at least eight companies. The first servers are scheduled to be operational by mid-year. Furthermore, a provider of software solutions for wholesalers with installations at about 6 IGH members also started integration of DataExpert.

More than ten wholesalers have started preparing their systems for an integration of customer-side components to exchange business messages with two manufacturers, who aim to exchange business messages with wholesalers by the end of this year.

METHODOLOGY

The single case study approach taken in this paper is used as exploratory device and prelude to further study (Yin, 1994). Since the case study is carried out at industry segment level, it encompasses different players such as suppliers, wholesalers and crafts enterprises. Although the resulting degree of complexity is considerably higher than in single firm case studies, it has been argued that industry segment level studies will allow significant insights into the way interorganizational systems evolve and are shaped (Reimers, Johnston and Klein, forthcoming).

CASE ANALYSIS

The case analysis, as the above analysis of EDI diffusion inhibitors, follows Lee et al.'s (2003) approach and focuses on economic, strategic and institutional factors. The insights into development and operation of industry solutions yielded by the analysis are of central importance to successful system design and management (Chan and Swatman, 1998).

Analysis of Economic Aspects

The first bi- and multilateral initiatives for building EDI solutions could have led to the creation of various incompatible and competing solutions. However, IGH reacted quickly and managed to consolidate, channel and integrate the various industry participants' interests. Design and implementation of the DataExpert components and of the business message standards took less than two years, including all required coordination and negotiation processes within the industry.

Wholesalers and manufacturers are relieved of the costs of individual development of EDI solutions. It seems that inter-standard competition and the costs resulting from the maintenance of multiple, partner-specific EDI interfaces have been avoided at least for the near future. Since software companies integrate DataExpert with the industry software solutions, the risk that the significantly smaller crafts enterprises will not be able or willing to adopt DataExpert has been diminished. Adoption of DataExpert requires relatively small investments since DataExpert makes extensive use of previously used software systems and only complements, rather than replaces, these systems. These low costs help to shift industry members' economic calculus from decisions regarding the development of individual EDI solutions to the question whether to adopt DataExpert or not.

Analysis of Strategic Aspects

The layer model perspective reveals that the reach of standards has been aligned with the strategic calculus and requirement of the different trade levels. Figure 4 summarizes the different standards employed in DataExpert. Those standards that can be attributed to the levels with higher influence on business strategy and differentiation potential leave more room for individual adaptation and differentiation.

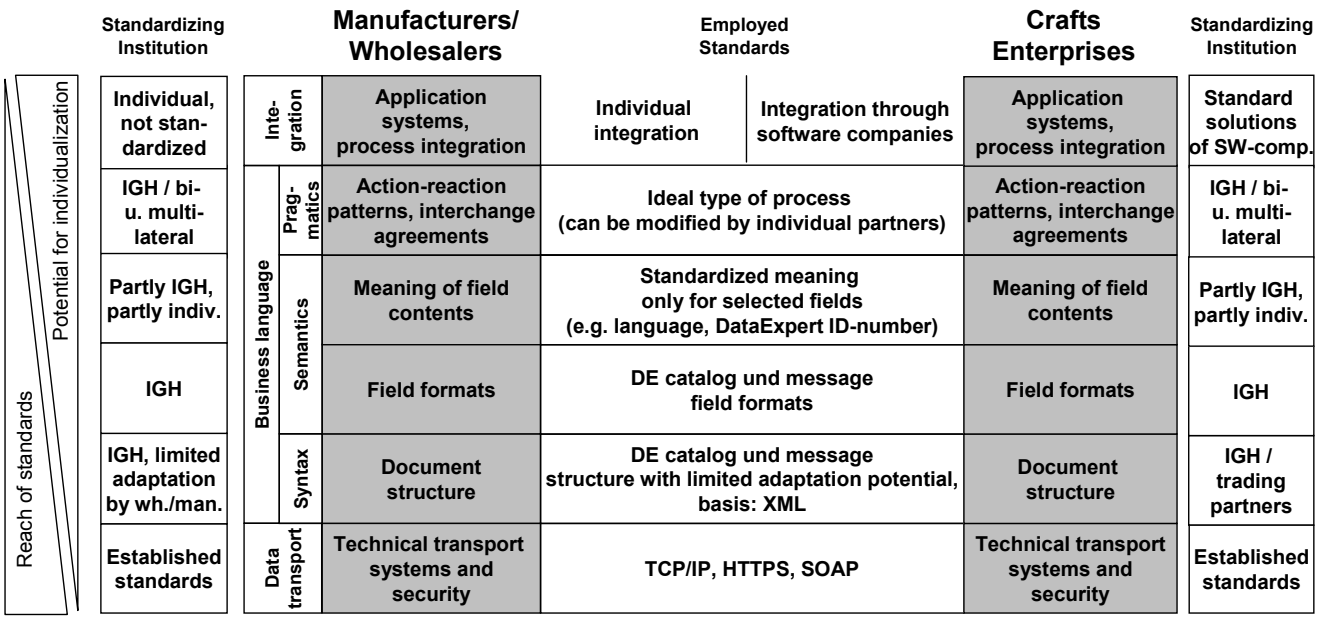

Figure 4. A layer model perspective on standards used in DataExpert[5]

On the *technical layer*, the Internet and web services as established, widely adopted standards of Internet-based data communication are used. On the *syntactical and semantic layers*, industry-wide standards for business messages and catalogs have been defined. Through the opportunity to modify message and field contents, a certain interpretive openness (Markus and Christiaanse, 2003) is given. An adaptation to individual situations is possible, without threatening message compatibility. Content of most document fields is only limited by data type definitions. On the *pragmatic layer*, business message have been defined for a generic, ideal type of process (see Figure 2). Individual message sequences can be defined bi- or multilaterally.

The different approaches regarding *system integration* comply with the varying centrality of DataExpert for crafts enterprises and wholesalers/manufacturers respectively. For crafts enterprises, strategic importance of IT is limited, which is reflected by the widespread use of only marginally configurable industry software solutions. The industry software solution providers however, who integrate DataExpert for the crafts enterprises, can differentiate their products by implementing individual integration approaches.

For wholesalers and manufacturers information system use and process automation is of strategic importance due to high transaction volume: requests and orders of a large number of crafts enterprises are distributed to a relatively small number of companies. Through individual DataEpert integration, they are given more differentiation potential. Furthermore, they can define individual incentive schemes such as price reductions or prioritized processing of DataExpert orders in case they want to promote their business partners' use of DataExpert.

Analysis of Institutional Design

The institutional design governing DataExpert's development and operation is illustrated in Figure 5, the management roles are described in Table 2. A central determinant for the emergence of this design is the fact that IGH was founded by industry members and subsequently accepted beyond the group of initiators. IGH developed into a collective actor whose power results from widespread support of manufacturers and wholesalers. Due to the successful previous introduction of the catalog-standard Win_Expert, IGH is considered trustworthy and competent by crafts enterprises, wholesalers and manufacturers, and gained the respect of industry software solution providers. Thus, IGH is in a good position to fulfill the tasks related to the assigned roles of standard manager, facilitator and mediator. From an innovation research perspective, IGH assumes a major share of the promotor tasks discussed above. However, IGH does not only function as a catalyst in the early phases, it plays a central role in the institutional design and contributes to the stability of the solution.

[5] The illustration is based on Kubicek (1992), Kubicek and Reimers (1996).

The alignment of the strategic and institutional perspective is reflected by the allocation of the 'internal integrator' role. Through the different approaches for internal system integration with crafts enterprises' applications on the one side and wholesalers' and manufacturers' applications on the other side, the role is assigned to both industry software solution providers and manufacturers or wholesalers respectively.

Furthermore, economic aspects are reflected in the institutional design. Due to the decentralized client-server-architecture and low system complexity, system operation is being delegated to system users. Thus, no costs for the operation of central servers are incurred and the users maintain control of their data, which was a central requirement of wholesalers and manufacturers.

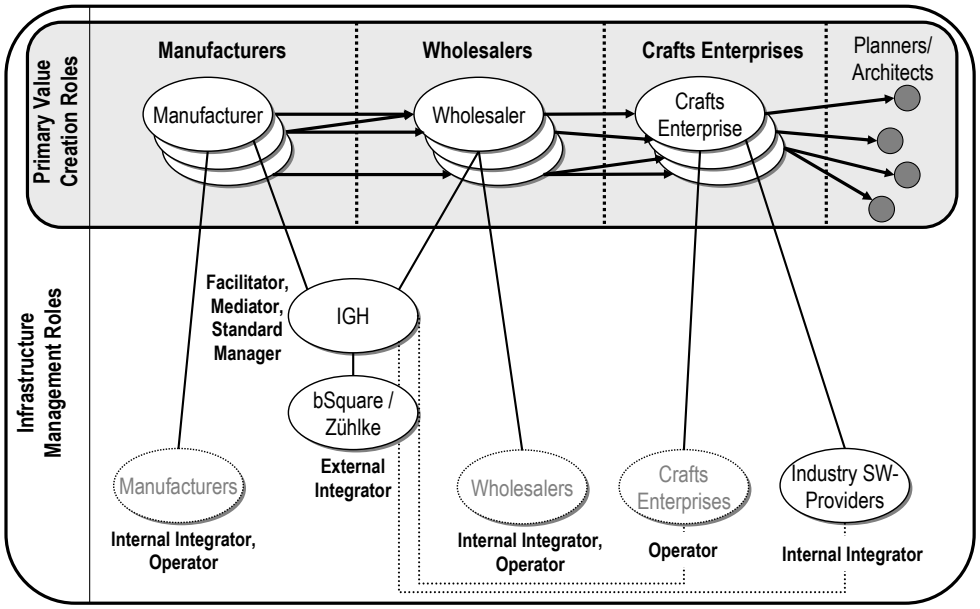

Figure 5. Allocation of infrastructure management roles in the case of DataExpert

The roles can be classified as social and technical roles, with both categories being of importance for the development of interorganizational systems (Graham et al., 1995). The socially-oriented roles, which comprise facilitator and mediator, support the necessary identification of collective interests within the industry and the development of a common identity, which is of importance especially in the early life cycle phase and subsequent transformation phases (Graham et al., 1995; Tschanz and Klein, 1997). The technically oriented roles comprise standard manager, operator as well as external and internal integrator. The allocation of technical roles should match the actors' organizational readiness, i. e. financial resources as well as technical capabilities (Chwelos, Benbasat and Dexter, 2001; Iacovou, Benbasat and Dexter, 1995).

	Roles	Role Description
Social roles	Facilitator	•Supports network formation by bringing together potential network partners and initiating negotiations. •Network configuration through operationalization and implementation of different partners' ideas. •Stabilization of network relations through implementation of institutional structures and promotion of social relations. •Adaptation of network to conditions changing over time. •Importance of the role: the ability to initiate and support the process of coordination between the potential participants is a critical success factor for the initiation of interoganizational systems (Kubicek and Reimers, 1996).
	Mediator	•Diplomatic role which is especially important to avoid and resolve conflict situations. •Balancing of different players' interests, advisory function that leads to a trusting atmosphere. •Point of contact for the involved actors. Responsible for the design and institutionalization of negotiation rules and procedures for balancing different players' interests – a factor that can be decisive for the success of interorganizational systems (Kubicek and Reimers, 1996).
Technical roles	Standard manager	•Definition of standards, especially message respectively information and interface standards. •Maintenance and adaptation of standards in order to improve standards, to adapt them to new requirements and to enable new services. •Public relations for the promotion of standards (promotor).
	Implementer – external integration (short: external integrator)	•Responsible for implementation and maintenance of information systems (together with external integrator). •Development of components for interorganizational data exchange between the different parties (e.g. development of a central server for message transformation and transmission).
	Implementer – internal integration (short: internal integrator)	•Responsible for integration of the external solution components with a company's internal systems and solutions (e.g. implementation of interfaces and adaptation of application systems in order to enable processing of the respective business messages).
	Operator	•Responsible for the operation of the platform for interorganizational data exchange. •In cases in which business messages are for example exchanged via a central market platform, the operator is the party that is responsible for operation and maintenance of the platform. •The role may be allocated to a third party as well as to a party that also has a primary value creation role within the industry.

Table 2. Description of infrastructure management roles[6]

CONCLUSIONS AND OUTLOOK

The initiation phase constitutes a bottleneck for network goods such as standardized EDI industry-solutions. In early phases, it is not certain whether the critical mass required for realizing benefits from system use can be reached (Quelin et al., 2001) and mostly no sufficient choice between compatible software products is available (Monse and Reimers, 1997). Since the utility of industry solutions strongly depends on the behavior of trading partners, which can hardly be influenced, system introduction is associated with high risk (Riggins and Mukhopadhyay, 1994). Also in the case of DataExpert, the speed of diffusion initially remained below IGH's expectations, which resulted from a widely adopted wait-and-see attitude. Players waited for DataExpert implementations by other parties to avoid betting onto the wrong horse.

Considering these challenges, the importance of coherent configurations across economic, strategic and institutional factors becomes obvious. We have identified design options which have been chosen in each of the three categories to overcome the known obstacles and to facilitate the diffusion and adoption of the EDI solution within the industry segment. A stable, consistent arrangement in which the three perspectives are aligned is needed in order to overcome the critical initiation phase and ensure adopter-oriented development and reliable operations. Furthermore, the cooperative culture within the industry, the use of new, progressive technologies on the technological layer, the compatibility to and use of former systems and structures all contribute to the achieved state.

Current developments of DataExpert are encouraging, although some uncertainty regarding DataExpert's success remains. DataExpert's potential is reflected by interest shown by other industry segments. The CRB currently plans on improving the

[6] The roles standard manager, mediator and facilitator have been identified and defined by Riemer, Klein and Gogolin (2002), the remaining roles were identified by analyzing the institutional design governing the DataExpert solution.

tendering procedures and initiated talks with IGH about an adoption of DataExpert standards. Thus, DataExpert might possibly be used between crafts enterprises and planners. The lighting industry, an important segment of the electrical services segment, already initiated talks about DataExpert adoption.

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