Abstract

Despite the benefits associated with vertical communication standards such as electronic data interchange (EDI) or WebEDI, their diffusion among small and medium-sized enterprises (SMEs) has failed to a surprising extent. Accordingly, SME integration into value chains is still a critical issue for information systems research on standards diffusion. The goal of this contribution is to reveal the reasons for the slow diffusion of EDI and WebEDI among SMEs and to propose concrete solutions. Based on an empirical survey among SMEs in the German office supply industry, economic and technical obstacles to vertical standard diffusion are identified. First, it is shown that EDI and especially WebEDI solutions are economically dominated by a widespread practice in SMEs, which is using faxes for business document exchange. Second, as many SMEs do not deploy automated material management systems (MMS), they lack the necessary technical preconditions for economically viable EDI. Third, based on these findings an EDI application service provider (ASP) solution is delineated that accounts for the economic and technical particularities constraining SMEs. The solution developed may help to reduce some economic disadvantages linked with EDI for SMEs. It is successfully applied in the office supply industry today and enables SMEs to reap the benefits of bidirectional EDI while avoiding the expensive investments in EDI translator systems that have so far restrained them from participating in vertical standardization.

Keywords: vertical standard, EDI, SME

Some Economics of Vertical Standards: Integrating SMEs in EDI Supply Chains

ROMAN BECK AND TIM WEITZEL

INTRODUCTION

Electronic data interchange (EDI) has been used for over 40 years to exchange business data (e.g., delivery notes, invoices) between two application systems in a standardized, automated form (Emmelhainz 1993). Firms use EDI solutions in order to achieve efficient data and information management by reducing processing time and avoiding redundant data entry. In doing so, EDI has substantially contributed to integrating value chains across firm boundaries in a variety of industry sectors. For the benefits associated with traditional EDI, e.g., cost reductions induced by rationalization and automation, shorter order processing time, see Emmelhainz (1993) and Niggl (1994). Despite the alleged benefits, EDI is not as widespread as many had expected. There are estimates that only 5% of all companies who could benefit from EDI actually use it (Segev et al. 1997). The information systems literature has provided a variety of instructive examples on this so-called EDI dilemma: one frequently used explanation argues that the high costs of implementing EDI systems are a serious obstacle, especially for small and medium sized enterprises (SMEs). Nevertheless, in this paper...
Some research is concentrated primarily on the legal implications of EDI (Kilian et al. 1994) but greater attention is paid to the adoption and diffusion of EDI among firms (Chau and Hui 2001; Iacovou et al. 1995; Ketler et al. 1997), in vertical industries, e.g., in the automotive industry (Fricke 2003; Mackay and Rosier 1996), the retail/wholesale and distribution industry (Beck et al. 2002, 2003; Jimenez-Martinez and Polo-Redondo 1998; Vijayasarathy and Tyler 1997), or the pharmaceutical industry (Howells and Wood 1995). Some studies focus on so-called ‘EDI-Champions’ trying to learn from large corporations how to implement and use EDI to gain major benefits (Webster 1995). Furthermore, researchers have differentiated the impact of EDI depending on the depth of integration into existing material management or enterprise resource planning systems (Fearon and Philip 1999; Williams and Magee 1998). Other research areas are more focused on the multidimensional integration levels (technologically on the protocol layer, as well as contractually on the organizational level), in connection with newer forms of EDI such as InternetEDI (Segev et al. 1997) or WebEDI (Beck et al. 2003) and found a lack of EDI know-how to be an important entrance barrier (Muller 1998). From an enterprise point of view, the central EDI question is what degree of automation should be aimed at and is achievable (Swatman and Swatman 1991) and how partial or asymmetric compatibility (such as in the case of WebEDI) impacts overall benefits and standard diffusion. Consequently, the question is not how to create the optimal EDI relationships in interorganizational systems, but to identify the most satisfactory one in integrating even SMEs into an EDI value chain.

Literature on EDI adoption behaviour has focused on the utility of EDI for single firms related to communication cost savings by process automation or as resulting from pressure exerted by business partners (for an overview see Saunders et al. 2002). Unfortunately, the study mentioned has explicitly not considered contributions dealing with the importance of standardization and related impacts on adopters. Accordingly, current empirical research on EDI often fails to provide more than enumerations of EDI standards in place (for an example, see Otto et al. 2002). Such research, however, cannot help to explain SMEs’ reasons for adopting EDI and the resulting diffusion patterns, which are crucial for the overall interorganizational system benefit.

Empirical studies have shown that the diffusion of EDI is influenced, among other factors, by competitive pressure and/or pressure by powerful business partners (Barua and Lee 1997) or on the other hand by confidence and good business relations (Hart and Saunders 1997, 1998). Nevertheless, in general those solutions are designed to meet the demands of larger EDI-using initiators rather than having a more holistic
solution in mind that also takes the technological and economic environment of SMEs into account. EDI is therefore more than just the exchange of electronic data (Kubicke and Reimers 1996) and strongly depends on firm size and superordinate business environment agreements or collective behaviour (Brousseau 1994). One can find a close relation between the size of a firm and the number of messages that can possibly be transferred electronically. Large EDI partners can often benefit monetarily from electronic information exchange and in addition from internal process reengineering improvements based on just-in-time accurate data (Mukhopadhyay et al. 1995). This is not necessarily the same on the SME’s side, since SMEs are not necessarily miniature versions of larger enterprises (Chen and Williams 1998). Therefore, an often-mentioned factor limiting the successful implementation and use of EDI is the number of potentially electronically exchangeable orders, invoices, etc. (Beck et al. 2003; Chen and Williams 1998; Iacovou et al. 1995). In order to overcome this problem, a possible solution discussed in the literature is the offer of subsidies for SMEs by larger trading partners (e.g., Beck et al. 2003; Riggins et al. 2003; Riggins et al. 2003; Riggins et al. 2003). In order to increase the number of vertical network participants.

Factors limiting SMEs’ participation in EDI

Apart from often-mentioned small transaction volumes, there are further drawbacks to SME integration. Our empirical research shows that there are major obstacles to integrating SMEs that have been neglected in the literature. If SMEs do not deploy automated MMS systems and consequently cannot benefit from process automation potentials, one cannot expect any SME to adopt EDI voluntarily. Thus, technical readiness is not solely a cost- but rather an ability-related problem. In general, the following alternatives exist for SMEs planning to participate in EDI networks (see Figure 1): according to some publications (Muller 1998; Senn 1998), the maintenance costs of using traditional EDI may be reduced by introducing WebEDI for SMEs without MMS in place (Kalakota and Whinston 1996). WebEDI applications use html as a presentation layer to offer a web-front-end user interface for manual handling of EDI messages. Apart from adopting traditional EDI (for SMEs with MMS systems) or WebEDI, SMEs can also outsource the applications to ASPs hosting the EDI system or even the whole MMS system with EDI functionalities.

In addition, some hybrid forms of EDI exist, such as combinations of EDI and other available technologies that are not depicted in Figure 1. Examples are EDI hybrids like EDI-to-fax or EDI-to-email and vice versa (Schmied 1998). Similar to translators converting one language into another or adapters enabling the deployment of different norms and standards with each other, ASP solutions can support SMEs in participating in vertical standard networks without adopting the underlying communication standard themselves. That might hamper the diffusion of the standard among all network participants as a best solution, but it allows for the integration of non-EDI-adopting SMEs as a second-best alternative in order to increase the number of vertical network participants.

Regardless of a firm’s size, the automated processing of data is a necessary precondition for all kinds of electronic data exchange. All traditional EDI translator systems require at least an MMS system in order to process the data received or to gather data that is to be sent from an MMS system. It seems to be obvious that an integration of EDI into MMS systems is necessary in order to benefit from automation. However, it is essential to remember this when discussing the different forms and economic implications of EDI or B2B communication for SMEs (Swatman and Swatman 1991). When starting a new EDI relationship, some problems emerge, especially in the context of how SMEs conduct their business. If MMSs are in place, then the often different and independently designed, operated, and optimized systems support only a limited number of interfaces, protocols, data formats, and business process

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Figure 1. EDI alternatives for SMEs with and without MMS
designs, etc. Thus, EDI is more than connecting several MMS systems with the ERP systems of suppliers. Very often, it is necessary to redesign existing systems to benefit from integration potentials. Thus, in many projects it is not the EDI installation itself that is the most expensive element, but the redesign of the existing IT applications and infrastructure. For an overview of the history of EDI diffusion and the necessary internal adaptation processes, see earlier and mostly empirical contributions such as those provided by (Deutsch 1994; Kilian et al. 1994; Niggl 1994).

Thus, at least an MMS is a necessary precondition for SMEs to generate and send EDI messages such as purchase orders or invoices, as well as an inventory administration system for an automatic delivery schedule, a dispatch handling system to produce a dispatch notification, a scanning system for physical access and exit control to handle the selling data, and an accounting and billing application to send the invoice to EDI partners. The implementation and use of such relatively mature technologies is a difficult venture for SMEs and often not sufficiently considered in EDI literature.

In addition to such MMS or ERP systems, SMEs have to apply an EDI translator to communicate and interchange data. Depending on the depth of integration into the existing MMS infrastructure, the EDI converter can select data from the MMS to automatically address the receiver, convert data from an internal data format into an EDI standard language and also send it automatically by using the chosen communication layer, e.g., over the Internet.

Considering the two cases, MMS seems to be essential in order to generate further benefits, e.g., by automatic data handling and processing of the received EDI messages or to generate electronic orders. Subsequently, an economically useful EDI system has to be connected to the local MMS system. Common WebEDI solutions generally do not offer such an interface. Since automation benefits cannot accrue when WebEDI is used, this solution appears to be more a transitional, temporary phenomenon on the path towards a totally integrated and networked vertical supply chain. With a similar manual effort required to use it, WebEDI is more comparable to deploying fax rather than using EDI.

In the following section, the history of establishing vertical standards in the German office supply industry is depicted in order to illustrate the different efforts made to standardize communication. Afterwards, the results of an empirical survey conducted among SMEs using the eventually successfully established EDI solution within this sector are provided. In particular, the problems occurring during implementation and use as well as the most important perceived hindering reason for not using EDI are discussed in more detail. Since WebEDI solutions in general do not offer an interface to integrate them into an SME’s MMS, and since traditional EDI solutions are expensive and difficult to customize, the developed ASP EDI (WebConverter) solution presented in the section before last may help to close the EDI gap between SMEs and larger business partners.

**STANDARDIZATION HISTORY AND EMPIRICAL EVIDENCE FROM THE GERMAN OFFICE SUPPLY RETAILING INDUSTRY**

An empirical survey within the German office supply industry and retailers was conducted in 2000 in order to discover the technical and economic determinants of EDI diffusion among SMEs. The German office supply industry is a relatively small part of the retail/wholesale and distribution industry in Germany. Its size and market structure with its large number of SMEs makes it an ideal case for analysing the difficult but successful diffusion of EDI among SMEs. With SMEs accounting for more than 95% of all firms on the retail side, standardized electronic communication seems to be a difficult venture, as countless unsuccessful approaches in this industry have demonstrated.

As early as 1993, the German federation for office management (Bundesverband Bürowirtschaft) started an EDI standardization initiative called EDIoffice in order to develop a consortium-driven solution based on UN/EDIFACT for office equipment suppliers and retailers. A small group of suppliers with large trading volumes constituted the consortium. The goal was to customize and announce a smaller subset of EDIFACT as de facto EDI standard in that industry. At that time, retailers were not involved in the project. Due to heterogeneous interests among the consortium members and the lack of strategic concepts of how to integrate retailers, the initiative failed. Suppliers competing in the same market segment as other consortium members were particularly afraid of sharing sensitive customer-related data, such as price agreements, within the suggested intermediary solution (with its central data pool). Therefore, the projected central solution of establishing an EDI clearing centre for all office equipment suppliers failed.

Another EDI initiative named EDI-Part also started in 1993, consisting of six major office equipment suppliers and an MMS software provider. Although this project did not even survive the planning phase, it provided for the first time definitions and frameworks containing the necessary EDI message types together with suggested implementation guidelines for MMS providers to develop EDI interfaces in their software solutions. EDI-Part was based on an ASCII-oriented proprietary exchange standard and real-time point-to-point online connection between the communication partners, which added to the problems, resulting in marginal adoption rates. Consequently, and due to the low availability of MMS systems among SMEs, the benefits for SMEs were
too low since again no EDI requirement analysis was conducted on the retail side.

Despite the setbacks of earlier initiatives, further efforts were made, resulting in a finally successful intermediary solution established by an office equipment supplier consortium named PBSeasy. Starting in 1996, two EDIFACT-based solutions have been offered to retailers: a traditional EDI version with stand-alone EDI software, as well as a WebEDI solution. The following survey results are based on SMEs experiences with these two EDI solutions.

RESULTS FROM THE RETAILER SURVEY

After the aforementioned attempts to establish EDI among SMEs in the office-equipment retail sector in Germany in the 1990s, an installed base of EDI-using SMEs was finally in existence in 2000. This made the office retail sector a highly interesting research area, since empirical data on the diffusion of vertical standards among SMEs were then, and are today, limited. In order to analyse the adoption behaviour empirically, as well as the driving and limiting reasons for or against the adoption and use of EDI, a questionnaire was developed in cooperation with the EDI intermediary PBSeasy to get an improved understanding of the often disregarded problems and difficulties SMEs face when integrating and using EDI. To analyse the adoption benefits of an EDI solution and the reasons behind the decision, a questionnaire was sent to 223 retailers (representing 2.5% of all office equipment retailers in Germany) with a response rate of 15.25% (n=34). The questionnaire was structured into four parts: existing application systems, drivers and reasons for or against EDI adoption, planned or de facto intensity of EDI usage and economic impacts according to the EDI solution deployed, if any. The questionnaires were mailed with prepaid reply envelopes. To get analysable data, only retailers which had already adopted one of the EDI solutions or were known to be in the decision making phase, based on statements of interest they made during road shows or at fairs and exhibitions, were asked to participate.

One of the most important results of the survey was that the MMS systems used among SMEs were extremely heterogeneous, impeding an easy implementation of any kind of EDI converter software due to non-existent or non-standardized interfaces. More than 13 different software solutions were implemented among retailers with more or less equally distributed market shares. Of those MMS software installations, only eight offered interfaces for the partial integration of EDI into stand-alone EDI PCs in order to transfer the messages manually between the MMS system and the EDI software. None of the installed systems offered full integration of EDI into the MMS software for application-to-application EDI. Ten SMEs, equivalent to more than 29% of all SMEs surveyed, had not even installed an MMS system using WebEDI instead of traditional EDI. The diversity of MMS systems installed was one of the most important obstacles to the implementation of a vertical EDI standard in this industry. The questionnaire also asked for the reasons for the EDI adoption decision. Interestingly, pressure from larger business partners was rated as an unimportant driver (not important: 57%). One of the reasons might be the low diffusion of EDI among the customers of SMEs on the downstream side of the retail value chain in this segment, where possible pressure could only occur from industry partners on the upstream side.

In addition, the questionnaire asked for possible arguments against the implementation and use of EDI. One third of all survey participants responded that some forms of trading practices such as special deals and arrangements made directly with travelling salespersons are not possible when using EDI. Such special offers or arrangements comprise a large variety of different deviations, which ranged from special sales deal prices, individual supplier negotiations, unusual delivery arrangements, rebate in kind agreements, to changed compositions of complete sales product displays.

Furthermore, the success of an EDI solution depends on the number of EDI-using business partners (or the number of potential EDI messages) since the number of electronically conveyable and receivable business documents determines the potential savings of EDI on the communication level. On average, retailers participating in the survey had 147 industry business partners, while only an average of 14 of these industry partners offered an EDI-transfer at that time. Consequently, the reported average number of 3.56 EDI order messages per day sent by SMEs in 2000 was very low. This was equivalent to less than 10% of all orders for more than one-third of all SMEs (for further survey results see also Beck et al. 2002, 2003). As the economic sensitivity analysis in the next section reveals, the total number of orders and the fraction of electronic orders appeared to be too small to enable SMEs to benefit from the use of EDI.

ECONOMIC ANALYSIS OF EDI FOR SMES

Based on the findings from the survey, this section analyses the different economic implications of EDI and WebEDI for SMEs in the office supply industry as compared to using a fax as the most common process of communication. To compare the three communication modes, first the related costs are described:

- Fax: in contrast to EDI, conventional ordering was done by fax for € 1.27 per order on average. These costs for a fax-based order include the printing of an order from an MMS system and the manual
submission via a fax machine including the transmission fees for the telecom provider.

- **Traditional EDI**: The costs for traditional EDI include fixed and variable costs components: a base fee for the store-and-forward solution telebox 400 and a use fee. Furthermore, variable costs depending on the time and amount of transmitted data occur. Adding all this up, the price for submitting and EDI message varied depending on the overall amount of messages per year and was on average € 6.60 per message.

- **WebEDI**: For the comparison with WebEDI-based ordering it is assumed that a PC with Internet access is available and not used exclusively for the WebEDI application. Due to the low value and multiple possible applications, set-up costs for hardware are considered to be marginal and are not taken into account. As in the case of fax-based ordering, WebEDI requires manual interactions, in this case for data gathering and input into the web-front-end. Without an MMS in place automating the order creation process, the manual data input induces an additional workload compared to using fax. Therefore, WebEDI is more time consuming than a fax transaction, resulting in higher personnel and communication costs adding up to an average of € 2.37 per order.

Corresponding to the survey, the number of orders sent via EDI varies between 920 and 1,746 orders for the most active retailers per year. Therefore, the order numbers in Table 1 represent the reported numbers of orders by five SMEs and the resulting costs for the different order scenarios for SMEs are provided. The five are chosen to illustrate the range from the lowest number of orders to the highest number of orders and the subsequently occurring costs for each communication channel.

As the calculations in Table 1 indicate, from the perspective of an SME with small numbers of EDI messages, using fax is always a dominant strategy. Figure 2 (left) visualizes the increasing costs curves in accordance with the increasing number of orders. The order curve reflects the number of orders (scaled on the second axis). On the left axis the total costs for each order transmission method are drawn. Analogous to the increasing number of orders, the WebEDI and fax cost curves also increase while the cost development for EDI-based orders follows a more horizontal curve.

Since neither traditional EDI nor WebEDI seem to be able to reduce the communications costs for SMEs, the industry business partners started to offer two different incentive models for the use of EDI and WebEDI. For using traditional EDI, SMEs received bonus payments of € 5 for each of the first 500 orders, followed by € 2.50 for order number in the range 501–1,000, and finally € 1 for each order number in the range 1,001–1,500. For the case of WebEDI, 1% of the order amounts to a maximum of € 50 awarded to the SME per month.

Taking now the side payments offered by the industry partners into account, the situation changes. The diagram on the right of Figure 2 provides the implications of the two bonus models.

### Table 1. Fax vs. EDI vs. WebEDI

<table>
<thead>
<tr>
<th>Orders</th>
<th>920</th>
<th>1150</th>
<th>1380</th>
<th>1587</th>
<th>1746</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fax</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Material costs</td>
<td>56.45</td>
<td>70.56</td>
<td>84.67</td>
<td>97.37</td>
<td>107.11</td>
</tr>
<tr>
<td>Communication costs</td>
<td>169.34</td>
<td>211.68</td>
<td>254.01</td>
<td>290.48</td>
<td>321.38</td>
</tr>
<tr>
<td>Processing costs</td>
<td>940.78</td>
<td>1,175.97</td>
<td>1,411.17</td>
<td>1,622.84</td>
<td>1,785.43</td>
</tr>
<tr>
<td>$\sum (€)$</td>
<td>1,166.57</td>
<td>1,458.21</td>
<td>1,749.85</td>
<td>2,010.69</td>
<td>2,213.92</td>
</tr>
<tr>
<td><strong>EDI</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Communication costs</td>
<td>244.60</td>
<td>305.75</td>
<td>366.90</td>
<td>421.94</td>
<td>464.21</td>
</tr>
<tr>
<td>System administration costs</td>
<td>4,600.00</td>
<td>4,600.00</td>
<td>4,600.00</td>
<td>4,600.00</td>
<td>4,600.00</td>
</tr>
<tr>
<td>Maintenance costs</td>
<td>299.10</td>
<td>299.10</td>
<td>299.10</td>
<td>299.10</td>
<td>299.10</td>
</tr>
<tr>
<td>Depreciation</td>
<td>414.15</td>
<td>414.15</td>
<td>414.15</td>
<td>414.15</td>
<td>414.15</td>
</tr>
<tr>
<td>Fees</td>
<td>521.52</td>
<td>521.52</td>
<td>521.52</td>
<td>521.52</td>
<td>521.52</td>
</tr>
<tr>
<td>$\sum (€)$</td>
<td>6,079.37</td>
<td>6,140.52</td>
<td>6,201.67</td>
<td>6,256.71</td>
<td>6,298.98</td>
</tr>
<tr>
<td><strong>WebEDI</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Material costs</td>
<td>56.45</td>
<td>70.56</td>
<td>84.67</td>
<td>97.37</td>
<td>107.11</td>
</tr>
<tr>
<td>Communication costs</td>
<td>261.36</td>
<td>339.48</td>
<td>417.09</td>
<td>486.94</td>
<td>540.60</td>
</tr>
<tr>
<td>Processing costs</td>
<td>1,567.96</td>
<td>1,959.78</td>
<td>2,351.94</td>
<td>2,704.73</td>
<td>2,975.72</td>
</tr>
<tr>
<td>Fees</td>
<td>294.50</td>
<td>294.50</td>
<td>294.50</td>
<td>294.50</td>
<td>294.50</td>
</tr>
<tr>
<td>$\sum (€)$</td>
<td>2,180.27</td>
<td>2,664.32</td>
<td>3,148.20</td>
<td>3,582.54</td>
<td>3,917.93</td>
</tr>
</tbody>
</table>
Although side payments are made, the compensation is still too small to make WebEDI more desirable than using fax (mostly due to the limited refund of € 50 per month), as the higher gradient of the WebEDI curve compared to the order (and fax) curve illustrates. The curve is still steeper than the fax cost curve. Thus, despite the incentives, fax is still the favourite choice for SMEs. The subsidy model for traditional EDI is more interesting in contrast to the WebEDI model and might be able to attract SMEs with more than 1,475 orders per year. Above this threshold, using EDI is less expensive than using fax.

These findings imply a substantial and possibly often neglected impact of the underlying economics of vertical standards on EDI diffusion, especially for SMEs. Traditional EDI and especially WebEDI simply do not make sense for SMEs with low transaction volumes. That is not a new insight but contradicts many optimistic contributions from the first wave of e-commerce, which often regarded WebEDI as a solution to the EDI dilemma (Chau and Hui 2001; Muller 1998; Segev et al. 1997). The survey also found that the famous power argument (e.g., SME is forced to use EDI) turned out to be substantially less important than straightforward economic arguments, further supporting the significance of economically viable and technically feasible solutions. Finally, automation benefits accompanying the use of EDI make the deployment of MMS systems mandatory. Therefore, the developed WebConverter ASP solution described in the next section is oriented toward SMEs using MMS systems.

ASP-HOSTED EDI FOR SMES

The theoretical and empirical findings so far suggest that transaction volume, e.g., measured in number of orders per day, is a cost-related obstacle and that technical readiness, e.g., measured as MMS deployment, is a process or capability-related obstacle to EDI use by SMEs. Thus, two general requirements for successful SME integration are proposed:

1. Economic condition: standardization should individually pay off. EDI profitability has mostly been a premise or uncritical expectation and should rather be considered as a precondition of industry standardization.
2. Technical condition: standardization should ideally be possible with the IT architecture deployed when standard diffusion is the goal. In the case analysed, vertical standardization depends on the existence of an MMS system to gain the full economic potential from EDI.

What does this mean in terms of the efforts necessary to close the EDI gap? In the following, a solution based on the technical possibilities of SMEs is developed that is economically at least as advantageous using a fax machine (see Figure 2).

Motivated by the empirical findings, a WebConverter concept was developed that takes into account the technological and organizational environments of SMEs, thereby responding to the requirements necessary for successful bidirectional EDI. The WebConverter approach illustrates how the economic disadvantages of EDI for SMEs can be reduced by adapting existing technologies in an innovative way. The solution enables SMEs to use standardized data in their MMS without the need for traditional EDI converter software. At the time of writing, it is being successfully applied in the office supply industry in Austria, Germany and Switzerland, reducing barriers to entry in the initial adoption phase and generating economic benefits in daily use.

The application itself was programmed by an EDI service provider for the office supply industry. It is based on the ASP concept and minimizes the investment for a real bidirectional EDI relation between SMEs with MMS systems and industrial business partners with EDI translators. The solution does not require side
payments like the incentive system described earlier nor MMS adaptations and the implementation of an EDI translator.

The functionality of WebConverter is very simple: the only further requirement (apart from a MMS system) is an email program. The procedure can be described best by using an order process as example. After the MMS system has compiled the order, it generates an ASCII-based version of the order data, which is normally sent to a printer. The printed order is sent then manually using a fax machine. By using the WebConverter, the ASCII print spool is saved as a data file and transmitted as an attachment to a web server. The web server identifies the sender, opens the attachment and translates the ASCII order into the appropriate EDIFACT standard message, according to the mapping that the SME had customized earlier. The mapping is no more than the linkage between the ASCII fields and the EDI message fields, which is supported by a graphical user interface. After an SME has once made this setting, the communication and translation is carried out automatically.

In the other direction, SMEs can receive EDIFACT messages such as price and catalogue data (PRICAT) or invoices (INVOIC), which are translated into an ASCII string code and sent as attachment to the SME. Analogous to the sending of orders, the SME now opens the email, saves the data file and uses the import interface of its MMS system to update it. The only disadvantage is that a person still has to transfer the data manually between the MMS and email system and consequently no real-time data sending and receiving is possible.

The use of the Internet as communication platform for a web-based converter reduces the entrance barrier for SMEs while avoiding service and maintenance costs for expensive and complicated EDI translators at the same time. Figure 3 depicts the WebConverter solution schematically for EDIFACT-based messages. According to an interview with an SME retailer using the WebConverter solution in the office supply industry, the application is simple to use and enables SMEs to import and export data into and from the MMS very

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**Figure 3.** ASP WebConverter solution for SME with MMS
SUMMARY AND CONCLUSIONS

We have shown the importance of technological readiness and economic profitability for EDI adoption among SMEs. The application of an EDI solution does not hold benefits for all users per se, especially not for SMEs. Even more, SMEs who are, for example, forced to deploy EDI by larger business partners might face negative economic impacts. An empirical survey among German office supply retailers with 95% SMEs revealed that, in contrast to large sections of the modern literature on vertical standards, WebEDI is in fact not a viable solution to the EDI dilemma as it neglects the dominant alternative – fax – while failing to provide additional benefits. This is not surprising as most WebEDI approaches are nothing but html-based shopping systems: a person has to enter data by hand into web-based input fields using a web browser as communication interface. Consequently, there are no automation benefits, and, even more, media discontinuities are unavoidable because often no interfaces exist to exchange data between MMS systems and WebEDI front-ends.

Given this unfortunate situation facing SMEs, new solutions are necessary, first taking into account their limited IT resources and knowledge when compared to large firms and second allowing SMEs to benefit economically from such a new solution. Providing such solutions, e.g., in the form of the WebConverter solution developed relying on simple but common ASCII code in combination with a web service approach, might be one imaginable way. So far, it has been used successfully in Germany, Austria, and Switzerland and has contributed to integrating SMEs into EDI networks. That solution is lowering the technological and economic entrance barriers for SMEs with respect to EDI. It might not be the ‘optimal’ solution, but for the moment a satisfying one for SMEs.

The survey results and the WebConverter mirror the experiences and findings of other research: as long as the benefit of a standard depends on the size of a network, then a simple standard with a low entrance barrier (here a common technical denominator) will stand a higher chance of successful diffusion than a sophisticated, complex one. The use of the print spool file together with web services might be such a common denominator when trying to find a balance between simplicity on one hand and functionality on the other. The case of the office supply industry also suggests a prime role for vertical (industry) consortia, as they are possible areas of coordination, which can reduce the system’s interorganizational complexity.

Altogether, it was shown that there are technological and organizational drawbacks restraining SMEs from participating in EDI networks. Traditionally, EDI was adapted to the needs and capabilities of larger firms that can economize on costs by automating their business processes. In fact, EDI has been proven a great source of efficiency for high transaction volume communication. Nevertheless, when trying to broaden the range of network participants it is important to take into account who actually benefits from such architectures.

We expect important insights from future research on the economic benefit drivers of vertical standards. On the one hand, the role of consortia or intermediaries for solving coordination problems and possibly for redistributing costs and benefits of standardization, either directly through side payments or indirectly by providing services, know-how and information, might still be underestimated. On the other hand, network effects theory and its extensions have provided important insights into the impact of direct network effects on EDI diffusion but mostly ignored possible indirect network effects. In the EDI case, this might imply that an important value source has largely been neglected: EDI standards for large enterprises have been designed primarily to accelerate and automate the exchange of data. Like large firms, SMEs can also benefit substantially from standardized master data as an indirect benefit of EDI. However, such indirect benefits related to EDI communication are only available if MMS systems can be integrated into the data exchange. Thus, it is not the originally intended active data transfer that is the sole source of vertical standardization benefits, but the indirect benefits from the increased quality and availability of data.

References


