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Interorganizational Networking and the Institutional Gap

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1. Introduction

In our paper we will focus on the economic forces shaping the development patterns of computer-based information and communication networks. This, however, requires a shift of perspective. Economic forces are not just limited to the bounds of organization which interact in a cultural, national or regional environment but arise from the interaction processes between companies. Thus it is necessary to include these 'network effects' in the theoretical framework which is to be used to analyze and understand the development of technically based networks. Network effects are located on an institutional level as compared with economic effects on the organizational level. We will discuss these topics by referring to several case studies which deal with the establishment of Electronic Data Interchange (EDI) networks.

The development of EDI networks has opened a new branch in the telecommunication industry which is expected to be considerably expanding in the near future. The ECC even expects the telecommunication industry to take over the role of the key industry in Europe. Data communication is considered a major element in this scenario although at the time being it does only cover a small fraction of the total telecommunication market. Thus the development of EDI networks is of major relevance for the future competitive strength of the European industry. Nevertheless, theoretical understanding of the economic forces behind the development of EDI networks is poorly developed and there has been little empirical knowledge so far. Most analyses of related topics, however, remain on a descriptive level which does not allow generalization. It seems as if traditional analytical tools in those disciplines dealing with innovation, diffusion, new technologies etc. cannot be employed in the analysis of EDI networks. This, in our view, is due to the 'network' aspect of the treated topic. Whereas traditional analysis could afford to either focus on single organizations or treat economic subjects as atoms which interact in a macrosystem, the analysis of networks is to take both aspects, i.e. micro and macro level into account. It is necessary to analyse organizational structures in order to understand the relationships between organizations as well as the organization of the network itself. The startling task is to do two things at the same time: focus on the elements of a network and do not lose analytical grip of the network itself.

If adopting the social shaping of technology perspective it should be clear that the development of new technologies cannot be understood by deducing their future prospects from the technical characteristics only. Instead it is neseccary to look at the social system, in which the new technology is embedded. Having a glance at recent EDI literature it is revealed that the method of deducing future developments from technological characteristics is still dominant. Phrases such as 'EDI will quicken communication flows and thus lead to reduction in stocks' or give rise to other clearly desireable outcomes are still frequent. The future of EDI

is still commonly derived from the potential it has in the eyes of its commentators. This perspective often leads to confusion when new technologies do not disperse and unfold their inherent opportunities as expected including all the social changes that have wishfully been linked with the new technology treated here (e.g. videotex and the decentralization of work)

The structure of the paper is as follows. First a short outline of three case studies in the field of consumer goods industries is presented. Second a concise theoretical framework to understand the development of EDI networks is introduced. Then this is followed by an interpretation of the case studies in the light of this theoretical framework. Finally some conclusions for further theoretical efforts and possible policy implications are drawn.

2. Case studies

The first case deals with the set-up of a system which eases the exchange of electronic data concerning high value product descriptions. These data are to be used as input in electronic planning systems in the retail of tailored kitchen furniture. The standardization of a dataformat which is at the core of the set-up process was monitored by software companies which supplied retail shops with the planning system. The guiding principle was the idea of a cost-saving potential by centralizing input activities for all vendors of the planning systems (which already incorporate the product data of specific kitchen manufacturers). The bargaining took place between software companies and manufacturers. The latter preferred a dataformat which was able to comprise a great variety of products and hence would be rather voluminous. The former were interested in reducing the size of the dataformat since they were mainly interested in cutting the costs of data transcription. The process took place in a working group having formed a committee for the purpose of standardization. The first attempt having failed it took the participants seven years to make their project a success. (see figure 1)

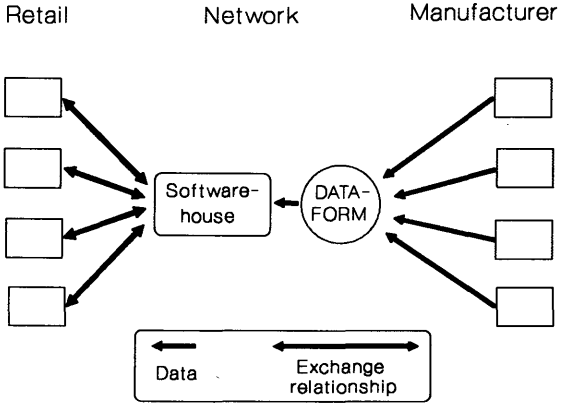

Figure 1: Interchange of electronic data for product descriptions in the kitchen industry

The second case study concerns an information system for the electronic exchange of market data in the footware industry. The concept for this information system was designed by a consulting company on behalf of an official authority as part of an industrial development project. The main result of this analysis was that German shoe manufacturers were poorly informed about what was happening on the consumer market. Therefore the system was to strengthen the manufacturer's market competence. The article numbering standard resembles the European Article Number (EAN), which inspired the consulting company. The dataformat containing all types of data to be exchanged and also describing their respective relationships was very complex and included a lot of options for compiling statistical data about market developments. The finally accepted standard represents only a small fraction of the initially far-reaching goals due to a lack of interest of the purchasing companies, which consider the comparison of their members' market performance an essential part of their business policy. For two years the system has remained on a pilot-project level. A development, similar to the formerly described project, seems unlikely. (see figure 2).

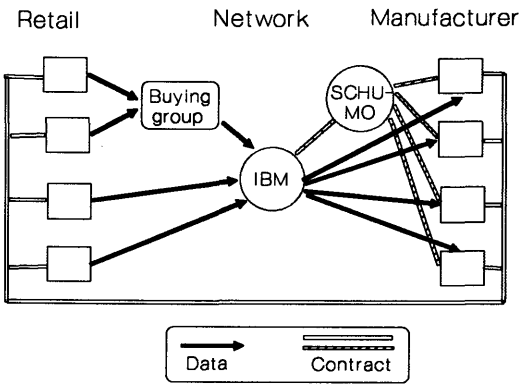

Figure 2: Electronic interchange of market data in the footware industry

A network service for the electronic exchange of business data in the clothing industry is the subject of the third case study. The basic idea behind the development of this network service was the concept of 'Quick-Response' in the fashion market, aiming at the ability to react towards changes in consumer preferences within a very short time. The main activities in establishing the VAN were carried out by a textile retailer. Other important players were a software company promising to provide access to about 2000 users of a stock-management system and a textile manufacturer who developed a CIM-system. These three actors formed a pressure group which tried to put through a proposal for a dataformat as an EDIFACT-subset in order to increase the incentives for participation in the planned VAN. These activities collided with the attempt of the European Article Numbering Association to develop an

EDIFACT-Subset on the basis of the European Article Number (EAN). Hence potential users became confused regarding the future situation and preferred to wait until a clear winner appeared. (see figure 3)

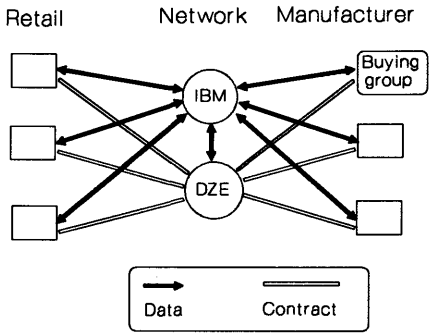

Figure 3: Electronic data interchange in the clothing industry

3. Theoretical framework

The set up of an EDI-network concerns the way companies exchange information. Thus the question arises whether the process of information exchange is just transferred on a technical medium or will rather be altered by the use of EDI. If only the former is true some inprovements in the way information is exchanged can be expected, i.e. faster and/or cheaper delivery of data. In this case organizational and institutional change might be induced on the level of carriers, e.g. National Telecom Services might be substituted by private VANs. However, we will not concern ourselves with these changes.

Nevertheless, the common thesis is that EDI will change the structure of the information exchange process. Thus organizational change is assumed a neccesity in the course of introduction of EDI. Although we do not want to question this thesis we contend that *organizational factors* do not sufficiently explain development patterns of EDI and claim that *institutional factors* must be taken into account. In the first place that means that there are at least two institutionally distinct actors who have to coordinate their actions (if we leave EDI-links between companies and subsidiaries etc. aside). It is this aspect of coordination that requires special attention since the development of EDI might be hindered by meerly institutional factors, whereas otherwise it would have become an EDI success.

In order to come to grips with organizational and institutional factors shaping the development of EDI we propose in the first place to analyze both aspects seperately. Thus costs and benefits of EDI must be evaluated on an individual and a collective level respectively. The individual level concerns the internal EDI impact for an organization. At the same time EDI has by definition external effects that also influence the cost/benefit ratio of actors within the

EDI network. These external effects will shape the collective action that might or might not result in the set up of an EDI network. Collective action will change the institutional framework for individual action and thus influence the internal cost/benefit ratio.

On the level of an individual organization the exchange of data via EDI might change the informational relationship between the organization and its business partners. To understand this it is useful to distinguish between general and special information. Both types of information are neccesary to trigger some kind of transaction, e.g. the delivery of goods or the transfer of payment. Special information has to be transmitted each time a distinct transaction should be started whereas general information is stored locally and will only be activated as a function of the transmitted special bit of information. The splitting of information into general and special parts is achieved by comprising those parts that are constant in each instance of transaction. Then it is only necessary to transmit that part of information which is unique for a specific transaction. The splitting of information into a constant and a unique part is called a transformation (Kosiol 1972).

Standardization of dataformats for the electronic exchange of data often implies such a transformation on the level of an individual organization. Let us consider the examples of EDI for invoices and orders respectively. Due to a strict regulatory framework the exchange of invoice data whether via EDI or conventional means requires all bits of information to be transmitted for every instance of transaction. In contrast, the transmission of orders could be reduced to the designation of an article plus required quantity plus (if consignee and sender are identical and the addressee is identified via transmission procedure). The article designation and consigne will be codified so that in essence only two numbers must be transmitted, which can identify all other relevant information in locally stored databases (master files). Therefore, the efficient transmission of transaction data requires a substantial transformation, i.e. splitting of information into general and special parts.

The transformation of special into general information allows the rationalization of internal procedures. There are two aspects to this rationalization effect. (1) Any kind of electronic data interchange requires at least some kind of transformation of data if the received data are to be processed automatically since software controling the information processing could be considered as a kind of general information. (2) The rationalization effect is bigger the less special information has to be transmitted in order to start a single transaction and the higher the number of transactions which could be managed with one set of general information (i.e. one master file). Therefore the costs of information transformation must be traded against potential rationalization effects. Since transactions are normally not equally distributed among business partners it is assumed that there are few business partners whose participation in the coordinated transition towards common EDI procedures promises high rationalization effects and a bulk of others which offer rather small rationalization effects when joining the EDI network.

With the increase in numbers of business partners the transformation costs also increase. The number of codes for article numbers, addresses etc. e.g. will increase with the number of EDI partners if there has been no prior standardization effort. Additionally, converters which cope with different dataformats, transmitting protocolls etc. are becoming increasingly complex. It will sometimes be necessary to add hardware components in order to communicate electronically with additional business partners. Thus the rationalization effects might be counterbalanced, rendering the EDI participation economically objectionable. In figure 4 the curve NI represents the net internal benefits of EDI in relation to the number of participants, which is composed of internal rationalization effects on the one hand and additional requirements through new participants on the other hand. We propose that the values of the NI curve could become negative if the number of participants increases.

Nevertheless, it is possible to mitigate these effects by collective action, e.g. standardization or joint VAN operation. Otherwise we would expect serious limitations to the development of EDI which are illustrated by the intersection of the NI curve with the horizontal axis in figure 4. Thus we have to ask, which economic factors shape the collective action of which the aim is to change the network's institutional setting. These external effects consist of positive network effects and of opportunitiy costs. Positive network effects stem from saving transaction costs, that would be caused if an EDI system were to be established by a set of bilateral contracts between business partners. The transaction cost savings are thus the larger the more business partners participate in a multilateral contract system. Examples of such systems are closed user groups like EDIFICE, EANCOM, CEFIC etc. as well as the world wide potential user group of EDIFACT.

The participation in a new EDI network system also includes opportunity costs. Opportunity costs originate from the fact, that either established patterns of communication or other EDI systems exist which have to be disposed of rspectively whose benefits could not be made effective use of. A firm e.g. might have developed effective routines for delivery procedures with a huge body of local knowledge which will be made useless by the transition into EDI procedures. Similarily, EDI links might already exist on a bilateral basis which confer considerably benefits to their users. A change to a multilateral network at least results in a partial loss of some of the former network's benefits. The combination of positive network effects and opportunity costs is indicated by the curve NE in figure 4. Opportunity costs of participation in a new network may offset its positive network effects if only a small number of business partners participate. The values of the external effects gradually become positive as the number of participants grows.

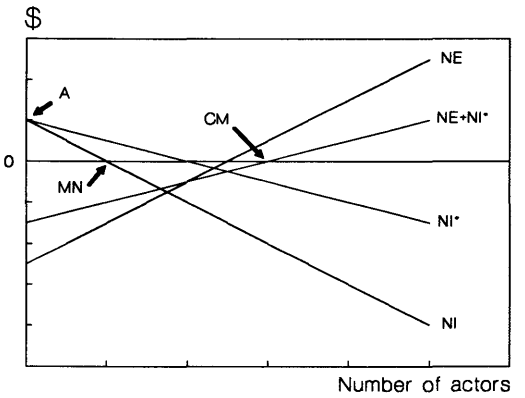

Figure 4: The problems of critical mass and maximum number of participants

Finally only internal and external effects together reveal the true potential of EDI for each organization. It is thus necessary to understand how the NI and the NE curve are related. Of course collective action aims at improving the results of internal rationalization which means an anti-clockwise rotation of the NI curve in point A. The collective efforts result in a changed position of the NI curve indicated by the NI^* curve. Thus the aggregate of the NE and NI^* curves indicates the break even of participation in the collective action which aims at the

establishment of a multilateral EDI network system. Beyond this point (CM for critical mass) participation in the network is self-enforcing. Up to this point the development of a multilateral network system will not take off unless some other incentives are provided; instead a network system based on bilateral contracts will evolve whose growth is limited to the point MN (maximum number of participants).

The existence of a critical mass for a collective action clearly shows that the development of EDI networks cannot be fully understood from the point of view of a single organization. There is an 'institutional gap' which could not be overcome by collective efforts unless some institutional arrangements are offered. Otherwise economic behavior will result in a bilateral approach which seriously limits the development of the EDI network. Different institutional solutions are possible which will be demonstrated by a discussion of the three case studies in the next section.

4. Interpretation of case studies

In order to understand the differences between the three case studies two aspects should be distinguished. First it is necessary to analyse the costs and benefits of those actors who take a rather passive part in the developing process, i.e. who decide on the basis of the current state of development whether to participate or not. These actors are only interested in an effective use of the system. Second the problem of critical mass has to be examined. According to the above presented analysis it is clear, that network development processes do not start right away but display a considerable inertia in the initial phase due to negative values of the aggregate of internal and external effects. Therefore there must be actors who are interested in the set up of a network because otherwise multilateral network systems would not develop. These actors are of an entrepreneurial type, since they face considerable profits from the set up of a new network.

Analyzing the passive type of actors the above presented analysis is used. Therefore internal and external effects must be examined and their combined effects evaluated. With respect to the problem of critical mass three distinct possibilities of overcoming the initial inertia in the development of networks will be illustrated.

The dataformat for the kitchen industry had to be accepted mainly by the manufacturers. A first attempt failed because of the manufacturers' reluctance to participate in the system. So the question arises which kind of costs and benefits for manufacturers can be derived by participation. The manufacturers' interest in introducing electronic planning systems in the retail of kitchen was to simplify the visualization of a tailored kitchen, to ease the calculation of final prices and to avoid haggling with retailers through inaccurate orders. On introducing electronic planning systems a huge rationalization potential might be realized. On the other hand individual actions of manufacturers were soon limited by the enormous increase in either proprietary systems in retail shops or data volumina handled by software companies. Thus rationalization effects tended to be offset by additional costs through the uncoordinated introduction of planning systems.

Initially the coordination of manufacturers' actions, however, had considerable opportunity costs, since some manufacturers had to give up competitive advantages through the introduction of proprietary systems, others had to confine their product descriptions to the limits of the dataformat, if they originally did not use their own planning systems but relied upon the services of software companies to supply planning systems. Positive network effects could, nevertheless, be derived from the saved transaction costs that otherwise would originate from the interaction with software companies or retail shops since they could save a lot of duplicate work or duplicate computer systems resp. In that way the coordination of the

manufacturers' actions required a critical mass of manufacturers participating in it. The question now is how to organize this critical mass.

The software companies had a major interest in solving the problem which arose form uncoordinated actions since they had to transcribe product descriptions into electronic formats and transfer these costs via the prices for their planning systems to their customers, i.e. retail shops. This way of handling increased costs prooved increasingly problematic because small service providers were willing to offer transcription services at low prices. Attaching a data quality guarantee to their products and at the same time reducing the costs of data transcription software companies tried to add value to their products. This required the foundation of a central agency for the data transcription, which also functioned as a quality certification institution. A significant reduction in transcription costs could be achieved by standardization of data material so that any manufacturers' product data could be combined with any software company's planning system. This incentive prooved to be sufficient to organize the critical mass of manufacturers that finally agreed on one dataformat. After one year of having gone into operation about 100 manufacturers participated, at the time being about three new manufacturers join the network every month.

The information system in the footware industry in contrast was set up by a consulting company which was asked to find measures for improving German manufacturers' competitiveness. The main insight of the consultant was that the information flow between retail and manufacturers had to be improved. In order to come to an operational level with this analysis, the consultant presented a concept which had essentially consisted of a technical system of information exchange. Thus the idea was to establish an information flow and at the same time economize on this information flow by using technical means of information exchange. The information flow was originally designed bilaterally, i.e. manufacturers receive market data for their products and return compiled data for each retail shop. Nevertheless, only the information flow from retail to manufacturers should be technically supported. Retail shops and manufacturers were expected to bilaterally contract the terms of informational support through manufacturers, which not only included the transmission of compiled data but also advisory support to the retail shops.

The question arises which benefits the information system might provide to participants. Governmental intervention sheds some light on this question as it has obviously been necessary to force manufacturers into this kind of coordination via monetary incentives (manufacturers would have been cut off subsidies if they refused to participate). Thus the governmental intervention has rather the character of providing merit goods. The larger manufacturers also had their own measures of evaluating their market performance, e.g. panell services or bilateral contracts with some customers providing them with a sample of market data. These companies could not see any additional benefit in participating in the new information system, although they were aware of structural problems in the German footware industry. In their opinion the system would mainly benefit small companies which could not afford to set up information channels on their own.

Drawing a conclusion from this case one can say that the benefits of the information system were small compared with existing systems of market data creation, which caused high opportunity costs for the large shoe manufacturers. A change form bilateral relationships to a system of multilateral contracting would thus have inevitably rendered the participation of a great number of manufacturers to offset the high opportunity costs through positive network effects. Accordingly, the development of the information system did not take off. After one year it still remained on the level of different pilot projects with some of the big manufacturers having adopted a wait and see position.

The set up of a system for the electronic exchange of business data in the clothing industry promised a huge rationalization potential combined with savings in lead time, which is especially important in this fashion oriented industry. It is the classic field of EDI, since it comprises all potential kinds of information flows, initially focussing on orders and invoices. It is normally assumed that a coordinated action might increase the benefits of EDI enormously since a vast amount of converters and bilateral contracts would become superfluous. Because of the medium sized character of this industry there are only few EDI links on a bilateral basis demonstrating that the rationalization potential is not as evident as assumed normally.

Nevertheless, the benefits of a coordinated action seemed clear and different solutions were conceived. An important initiative was started by one owner of a retail shop together with a software company which planned to set up a Value Added Service (VAN) network for the clothing industry. In order to increase the incentives of participating in a coordinated action the initiators tried to define a dataformat which they wanted to be accepted as an EDIFACT subset. Since this attempt has not been successful industry and retail are still hesitant to participate. A major factor to be taken into account is that an alternative network for the whole consumer goods industry exists. The operators of this alternative network tried to have their network accepted by the EDIFACT board. This alternative network seems to be much more successful than the initiative of the clothing industry. This is the well established German branch of the International Article Numbering Association, which runs an EDI system and makes considerable effort in establishing an own EDIFACT subset, called EANCOM.

The interesting aspect about this case study is that we have a profit oriented approach in overcoming the problem of the critical mass. This means that different EDI service providers compete on the market, thus increasing the opportunity costs of users, i.e. the critical mass. Although rationalization effects are considered to be relevant and a multilateral approach is welcome by all participants, the efforts of the initiators did not succeed in organizing the critical mass because of a market mediated development process generating external effects which consist of high opportunity costs through competitive actions.

5. Conclusion

Our conclusion is twofold. On the one hand we refer to the political implications of different set-up patterns. On the other hand we analyze the consequences of our case studies for theoretical approaches towards understanding the development of EDI networks. The case studies demonstrate that different ways of overcoming the problem of the critical mass could result in different development patterns. In the case of the EDI network in the clothing industry a market orientated approach was started in order to combine the efforts to organize a critical mass with the commercial activity of setting up a VAN. From this we draw the conclusion that such an approach might cause problems when different systems compete, due to positive network externalities that can be expected, if one of the systems is successful. These effects will force potential participants into a wait and look position since they would otherwise take the risk of having put their stakes into the wrong system. (see table 1)

In the case of the information system in the footware industry the attempt to organize the critical mass externally was confronted with the problem of proper examination of the costs and benefits of a mulitlateral approach compared with different bilateral contracts. In this case it seemed that the benefits were not properly calculated and monetary incentives were not sufficient to move potential participants into a multilateral system of information exchange. The example of the dataformat in the kitchen industry reveals an interesting solution because of the combination of market and organizational mechanisms. On the one hand the software companies had a commercial interest in organizing the critical mass of manufacturers, on the

other hand they restricted themselves by setting up a non-profit organization for the operation of the system. This result could be achieved, because the market for software products is complementary related to the kitchen market, thus enabling software companies to take over the role of a catalyst. They could organize the critical mass without linking this effort with an immediate commercial interest. Instead they were collectively able to neutralize the commercial aspect via a non profit organization. Nevertheless, their effort was economically motivated by increasing the quality of their products and by reducing their prices. However, these economic effects are not derived from the operation of the network itself. This is the important difference between the EDI network in the clothing and the kitchen industry.

Industry	Kitchen	Footware	Clothing
Who solves the problem of the critical mass?	Software Companies	External Management	Network Service Provider
Which kind of institutional solution does this provide?	Complementary Market	Governmental Intervention	Market Solution
Who operates the network?	DATAFORM (non-profit organization)	SCHUMO (Manufacturer`s Association)	DZE (Network Service Provider)

Table 1: Comparison of the three cases

Finally some conclusions on the more theoretical level should be drawn. The three case studies demonstrate that the logic of networks is different from the logic of markets and hierarchies respectively (Mayntz 1992). Whereas actors in a market setting interact via bargaining procedures which might have some unintended results, e.g. negative internal effects through a strictly bilateral EDI approach, the set up process of the analyzed EDI networks required coordinated action which intentionally aimed at a collective result. In contrast these forms of coordinated actions could not be achieved by a command mechanism as it is used with hierarchies (like companies). Instead a negotiation process had to be used in order to coordinate individual activities. We found, however, that the coordination of individual actors itself is shaped by economic factors which are described by the problem of critical mass. Different institutional settings are possible in overcoming this problem. Among the three solutions presented (market coordination, government intervention and coordination through complementary markets) it was the latter which proved most successful. Here a third party acts as a catalyst neutralizing economic motives. At the same time it is driven by commercial interests.

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