TEDIS Project:
Social and Economic Impact of EDI

The Role of Intermediary Organizations in the Development and Diffusion of EDI

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Apendix

1. EDI - a technical or a sociotechnical system?

1.1 The application gap

They are there: the UNSMs (United Nations Standard Messages) according to the UN/EDIFACT Standard. But they are not applied as was expected, due to a very rational idea: The exchange of documents between organizations affords a lot of ressources. As many organizations already use computers for the internal storage and processing of these documents, it would be of advantage to the single company and the whole economy, if these documents were no longer printed out, sent by mail and rekeyed into the next computer, but if these documents or rather the data in these documents were exchanged from computer to computer instead. This idea of Electronic Data Interchange is pursued since more than 20 years. It has been promoted most of all by industry associations or very large companies and in the meantime has led to a wide range of standards for single industries in certain countries. But because many companies exchange documents with other companies belonging to different industries, it was assumed that this diversity counteracts the original objectives because of high costs for providing several standards or transformation costs.

Scope of EDI-Standards	***restricted to one industry***	***independent of special industries***
international	ODETTE SWIFT EFTPOS,ISO Spur 3	**EDIFACT**
national	**SEDAS** **VDA**	TRADACOM (GB) ANSI X.12 (USA)

Fig. 1: Scope of EDI-Standard

Of greatest advantage to everyone would be a universal worldwide standard for messages which should be applied in all industries including the public sector and which also would fit the requirements of large companies as well as those of the small and medium sized ones. This assumption was the basis for establishing UN/EDIFACT as a worldwide project or organization with thousands of people spending millions of days to develop a body of rules and procedures for the development of message types such as invoices, bay plans, and many others, as well as dealing with suggestions for such UNSMs.

But so far the system is not very successful. The output of certified messages is rather low and, even more important, the EDIFACT messages do not replace the already existing special data exchange formats in single industries and nations to the extent which was expected. And even industries starting the development of message standardization do not completely obey the EDIFACT procedure. In many cases they apply some of the syntactic rules, but do not strive to apply the structure e.g. of an invoice, but rather develop so-called subsets. In practice, subset means that invoices in the textile industry are not identical to those of the cosmetic industry, so that retailers still have to deal with two different types of electronic invoices.

Thus the diversity of industry standards is going to be replaced by a diversity of subsets. But the idea of universal message types is still propagated. So many companies are waiting whether EDIFACT will win the battle and do not enter the stage.

1.2 Present remedies

From the point of economic theory and computer science there are good reasons to believe that the EDIFACT concept will win in the end. And for an officer within the EDIFACT bureaucracy it is more rational to look for impeding external factors or even for improvements of the internal procedures instead of questioning his organization's goals. Thus the main remedies for the application gap or lag are

a) awareness campaigns and pilot projects,
b) search for impeding contextual factors such as telecommunication infrastructure, legal requirements, etc.
c) reforms of internal procedures.

(a) If you are convinced you have got a good idea, but nobody follows, you tend to believe that they have not heard the message or have not understood it. Then you organize awareness campaigns, if you can raise the money. But of cause it is better,

if you can offer money for pilot projects. This is what the CEC did in TEDIS I. To promote the idea of EDI several industry projects were started, which were quite successful in developing industry standards. But this success is now becoming a problem for the change-over to EDIFACT. And developing interindustry projects is in many respects more complicated. There are no existing institutions to take over such projects. And what is even more serious, there are no natural borders defining different trading networks or communities. And ideas which may seem logical from the point of view of an outside observer such as following the value added chain of production might very well interfere with the view of the organization in this chain on their environments.

(b) The analysis of impeding contextual factors is also supported by the CEC in the TEDIS programmes. It is still too early to decide how important the availability of telecommunication networks, the market for telecommuniation services, technical means of data security, legal regulations and other factors are. However, our assumption is that these factors are of some importance with regard to the international differences in the diffusion of standards, but do not explain the general application gap.

(c) The change of internal procedures is the subject of a recent paper by the Experts on Data Elements and Automatic Data Interchange within the UN Committee on the Development of Trade with the title "A New Way to Design EDI Messages"[1]. In this paper the experts criticise the way EDI messages are designed so far:

> ".. What happens when a new messages is required? Currently, EDI messages are designed the same way they were 20 years ago - by committees in specific industry sectors or in different organizational disciplines for various industries. Each committee comprises of a collection of business and technical people from that industry or discipline. Most committees have at least a few "experts" who understand either the flow of business documents (the message) or the support directories (the segments) needed to create the message. Many committees have a few experts who understand both...
> ... A group proposing a change must issue a data-maintenance request which all message design groups must approve. This is a complicated process. Each message design group has its own way of solving the same problem. In many instances each group has their own "expert" who believes his/her way is the best way. The original creators of a segment - either the individual or the design group - feel that the original intent or purpose of "their" segment must be protected. Consequently, resistance to the data-maintenance request can arise. In addition, the design group's experts may be inexperienced in working with the

1 A New Way to Design EDI Messages. Paper for the Meeting of Experts on Data Elements and Automatic Data Interchange, forty-seventh session, 17-18 March 1993. United Nations, Economic and Social Council, Economic Commission for Europe, Committee on the Development of Trade, Working Party on Facilitation of International Trade Procedures (TRADE, WP. 4/R.909) 12 January 1993, p. 2.

support directories (the composite, data element, and code lists), which leads to errors and delays.

... Finally, the technical assessment people can review the new message. It may pass. It may not. The group may have to start from square one again."

In order to improve the development process old concepts by Henry Ford and new formal data-modelling techniques are suggested (p.3). The main point is a new division of labor between three groups:

- Business Requirement/Message Specification, "composed of experts who know the business needs of their function or industry". The use of information modelling techniques shall eliminate "the trial-and-error approach". In the EDIFACT environment there shall be "one group serving each application area".

- Message Structuring shall be the task of "one group that serves all industries, regions, and countries", because this is a formal and technical task which starts with the specifications by the Requirement Groups. As these specifications are defined with formal information modelling techniques the design can use them and apply CASE tools.

- Support Directories is the third group. It, "too, will serve all industries and nations, countries and regions" by creating and modifying segments, adding "needed code values to the code list".

The basic idea is that a specialization of tasks and the use of formal techniques will lead to more consistent results in less time. 20 years ago the same remedy has been suggested to overcome the software crisis. But they could not solve this crisis. Therefore recently different approaches to software development have been devised which give up the phase-oriented structuring and the belief in lasting requirement definitions and rather emphasize the cyclical character of the never ending process of the development of new versions, the need of permanent cooperation between users and developers and other issues. It seems that the EDI Experts are proposing the old remedy again.

Before going deeper into this point a fourth remedy should be considered: to reduce the level of aspiration concerning the scope of universality and to accept that there are good reasons for differences between documents with the same names, e.g. invoices between industries, and to reduce the expectations about what EDIFACT can achieve. If EDIFACT was conceived as a language only, it would be no surprise that not everybody understood every message formulated in this language. The doctor's bill, the telephone bill, the carpenter's bill, and the bill of my supermarket are bills, but they are quite different, because they deal with different subjects and also employ different words belonging to different "cultures". They

may all use the German language, but are not completely understandable to everybody because the use different jargons, technical vocabulary etc. which are special to the respecvtive subculture.

As long as there is a definite and not too large number of "sublanguages", i.e. "subsets", this might not even reduce the economic benefits of EDI, because the translation from the home format into one or n other formats can be done automatically by converters.

From this point of view we have to rethink the diagnosis of a subset chaos and ask whether this is really a problem to users and not only to EDIFACT officials, and in which respect. In particular the technical, organizational and economic aspects of converters would have to be analyzed in detail. And if the coexistence of many subsets should prove to be an economic disadvantage, we still have to examine to which degree the ideal of universal message types can be achieved at all and at which costs.

But in order to pursue these questions one has to broaden the perspective of viewing EDI not only as a technical, but rather as a socio-technical system and the development of standards as a socio-economic process.

1.3 An enhanced architecture for EDI

Up to now the standardization of EDI messages is handled the same way as the standardization of telecommunication networks (e.g. ISDN) or plugs, windows or other industrial goods. The economic arguments for the increase of benefits with increasing universality correlate with the traditional approach of computer science striving for universality by employing a high level of abstraction and in particular neglecting the content and context of information.

Unfortunately this reduction of content is not adequately expressed by the concepts employed. Especially the concept of open systems interconnection (translated into German as open communication) suggests that every computer employing the respective standards can communicate with every other computer employing the same standards. Actually the OSI reference model issued by the International Standardization Organisation structures the objects for which agreements (protocols) have to be made in order to facilitate certain functions of a communication system in a technical sense.

The OSI reference model consist of 7 functional layers. They are put into a hierarchical relationship by the definition of services where each lower layer provides a defined service to the next higher layer. Often it is overlooked, though, that this model explicitly refers to only a section of the total of all elements required

for a computer communication in the sense of mutual understanding of the data transferred and an automatical processing (see Höller 1992 for more details).

This section is defined by

- a system cut separating the internal from the external relationships; the OSI reference model only refers to the external relationship of a system to the transit system and to the target system;

- an application cut, i.e. the applications concerning the contents are not the subject of examination; but rather the abstract functions are standardized which make available the socalled services to any applications.

Often the independence of the OSI standards from applications is not taken note of, probably because the upper layer of the 7 layer model is called application layer. But in this case application is an undetermined term which can be explained best by generalized communication functions. The application layer includes common application service elements (CASE) like the remote operation service (ROS) establishing a client-server relationship, or the reliable transfer service (RTS) facilitating an agreement on transmission rights. Further there are specific application service elements (SASE) where at least a connection with abstract applications in the sense of the common linguistic usage can be made out. Examples are:

- MHS (message handling system, X.400) for the exchange of messages,

- FTAM (file transfer, access and management) for the transmission, opening, closing as well as the access to the files of another computer.

The standards given for EDI like EDIFACT are usually not included in the application layer of the OSI reference model. From the point of view of OSI they are application data (in computer science they are called transparent which means: not taken note of) which are passed through the communication system unchanged. Standards for these application data are called data exchange formats.

Whether they are assigned to the 7th OSI layer or to a new 8th layer or looked upon as external features is a question of systematics without much practical relevance. Practically very relevant, however, is the question whether these data exchange formats like e.g. EDIFACT, define syntax, semantics and pragmatics for an automatical processing of business documents like purchase orders and invoices in a sufficiently exact way. And despite other statements in literature the answer has to be NO.

First of all EDIFACT defines the syntax of message types (e.g. invoices), i.e. the sequence, length and data type of the segments of a message. For an invoice, for example, sequence and length of the data fields supplier, customer, article, quantity, price etc. are defined.

Semantics refer to the meaning of the characters in these data fields. In few cases (price) they can be understood only by a further qualifier (currency). Concerning the supplier, customer and article a common key has to be agreed on. And also for the quantity a packing unit has to be determined.

Pragmatics is to be understood as the expectation of which activities the message will set off with the receiver and which reactions will have to be reckoned with. For that the action-reaction pattern concerning the functionality of the application programmes have to be determined.

Therefore a simplified architecture model of EDI, which, however, includes all relevant aspects, includes the following layers (see Fig. 2):

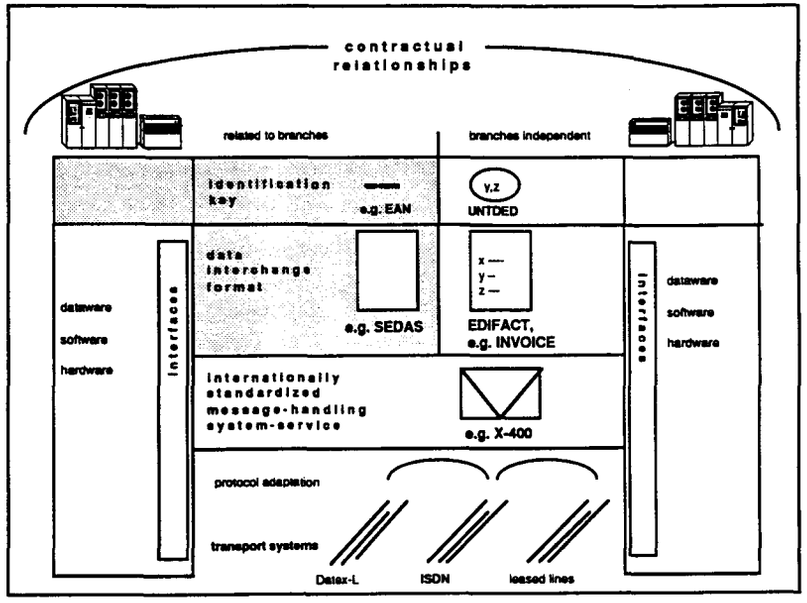

Fig. 2: Enhanced layer model for EDI

1 Standards for unspecified data transmission are required on the lowest layer.

2 Then a more specific transmission service has to be defined for messages, files etc. including - metaphorically speaking - the envelopes and the classical postal services (letter distribution and delivery) (e.g. X.400).

3 Moreover, types of messages and their formal structure (syntax) (e.g. EDIFACT), and

4 common data keys (semantics) have to be defined.

5 Finally, action-reaction patterns (pragmatics) have to be determined, if required.

Only if at least the first four layers are standardized, an automatical processing of electronic documents will be possible. But up to now the international standardization in the field of EDI is restricted mainly to the first three layers. So the international standard for invoices in EDIFACT syntax defines at which place of the data set the data field "article number" has to be put, how many digits it may have, and a further field for the so-called qualifier which indicates which code is used for the article number. These codes or keys themselves, however, are not the subject of the EDIFACT standard. Sender and receiver therefore have to agree on a defined key or to take the name of the article into the EDIFACT documents in clear. But that means that the employees at the receiver_s would have to translate the article names into the internal code used.

The data keys on layer 4 therefore play an important role for the realization of the EDI targets of automatical processing of documents. Therefore we propose to speak of dataware and data management besides hardware and software. Dataware means the definition of the field of objects of the information flows accompanying the goods and financial transactions in a clear data model

This field of objects mainly consists of three classes of elements:

- the objects of the transactions (goods, accounts),

- the partners of the transactions (customers, suppliers) and/or the places where they are located (addresses),
- the type of service and/or the informational transaction referring to it (purchase order, invoice, transfer).

Every enterprise using edp has it_s own data model for the objects it deals with. These models depend on the individual purposes of the enterprise. The modelling problem in connection with EDI applications consists in developing a common

model which comes up to the different positions and interests of the transaction partners (multi-actor - multi-context problem).

While the agreements on the layers 1 to 3 can be made via socalled interfaces which hardly influence the internal organization of the transaction partners, dataware strongly influences this internal organization by the internally used keys. This is still more true for the fifth layer, the action-reaction patterns. Therefore these issues are much more difficult to standardize because they go beyond mere technical issues and belong to the social organization which has to be dealt with differently.

However, in taking a second look the EDIFACT standard partly goes beyond the level of syntax and enters the level of semantics in defining the data fields to be incorporated. But as mentioned before a telephone bill, a doctor's bill, and a supermarket bill contain quite different elements. And it is diffcult to explain to people working in these areas that they should change over to one common set of elements for their bills.

The same mistakes were made in the development of standard software for business functions and information systems. In these areas, however, these mistakes are acknowledged more and more.

1.4 The interdependence of form and content of communication

EDI shall change the form of communication. This requires technical knowledge. As a computer expert one could take a paper document as a definition of requirements. But if there are different paper documents which shall be merged into one data model, issues of content, of usability, meaning, etc. are raised which go beyond the technical knowledge. Rather experts on the business function and industry are required, from a technical point of view one speaks of users and application knowledge.

Computer science, in particular software engineering, for a long time believed that users are able to specify their information needs completely and definitely, so that functions, data models and user interfaces may be specified and handed over to programmers.

But the experiences of thousands of unsuccessful software development projects has shown that this assumption is false. Of course it is possible to specify the regular cases and procedures of the past. But it is impossible to specify the exceptions in the future. In practice many people even have difficulties to describe what they are doing. In particular, what is self-evident often ist most difficult to recall. And there are big differences between people in fulfilling the same tasks and also in the descriptions of people doing the same task the same way. Finally, if the

changeover from paper work to electronic data processing is not only to electrify the traditional routines, but shall be taken as an opportunity for improvement of procedures, forms, etc., it shows that most people in the respective working area are not able to imagine and describe a new way, because they do not know what they can ask for, i.e. the range of different options opened by new technology.

If computer experts try to fill this lack of knowledge about options they run the risk of offering solutions which do not fit with the everyday work because they do not have this experience. So very often things are programmed which afterwards are rejected or not used by the users.

In order to overcome these problems new models of software development view it as a permanent process of cooperation between computer experts and work experts, called users. Instead of a clear distinction between phases of a development process there are several cycles of producing and reviewing a version of the final system. Starting from a rough description of the objectives a prototype version is developed which enables the users to specify what they want and what not. Of course such a prototype may be shown to different users in order to find out whether they can accept it and discuss what they want to be changed..

The proposition for a new structure for the development of EDI messages, in contrary, assumes that a clear specification is possible and tries to reduce the interaction between those responsible for the form and those responsible for the content. Instead a reform of the development process should reach a higher degree of cooperation between technical experts and user representatives.

But who should represent the users?

1.5 The organization gap

The question of who should represent the users incorporates two dimensions concerning the professional qualification of the representatives and the area or domain they shall represent.

With regard to professional qualification it seems obvious that people from the respective business functions and not from the computing centers should represent the users. But they have difficulties in communicating with computer specialists in general and the EDI experts in particular. If you give the EDIFACT rules or even a UNSM to a senior purchasing or sales manager you will hardly motivate him to evaluate it or even suggest improvements. At the moment the users to whom the whole project is said to be dedicated to are not able to participate. A language and procedures have been established which hardly motivate user experts. Thus a professional subculture of computer experts on EDI designs messages without

interference by users and is surprised that afterwards these are not accepted by the users.

The second problem is even more difficult. It concerns the selection or development of intersectoral EDI communities. As mentioned already, it was rather simple to develop EDI standards for the intra-industry exchange. For many industries there are either a small number of big companies and/or associations which represent the industry or even take particular care of productivity improvements for small and medium-sized companies. In some cases these associations have already carried out industry-wide standardization and/or rationalization efforts, so that they can put EDI projects in this tradition.

But in some industries and in some countries even intra-industry agreement may be difficult. For example in retailing the big department stores have quite different interests compared to supermarkets and both compared to the specialised trade. However, a general structural problem arises for EDI concerning the ordering, transportation and billing of goods, because regularly several industries are involved. In order to incorporate the users there must be a forum and a convener who decides who should cooperate with whom.

It seems quite obvious that for the ordering of goods between retailing and brand article manufacturers both industries should get together. But there are different forms of retailers, and brand articles are produced by many industries (e.g. food, textile, electrical goods). And if you consider the producers of light bulbs such as Osram or Philips, you will find that they are in exchange not only with different kinds of retailers but also with the automotive industry as an industrial supplier.

One could think of an overall sociogram of the communication relationships and to define subsystems which maximize the internal communication and minimize the external one. But there are not only practical problems in gathering the respective data. More important, the external view on communication frequency is incomplete and will not represent the views of the organizations concerned. They are different with respect to size, market structure, and competitive strategy, degree of computerization and many other aspects. So some companies may prefer EDI along the value added chain of production while others are more interested in a complete coverage of all partners in one stage of this chain. Some companies put more emphasis on agreements with few others on the international level, while others are more interested in a broad coverage on the national level.

Industrial policy has to take care of international competition as well as the small and medium-sized companies.

There the main problem is to define EDI communities out of an endless number of possibilities. And this does not only raise the question of meaningful boundaries. It is also crucial to find organizations who can organize this process of negotiation between different users and to represent their views in relation to the technical experts. These organizations may be called intermediaries. They may be industrial associations, regional bodies, organizations especially created by industrial or regional boards, telecommunication services providers, or software houses, management consultants etc..

At the moment it is not possible to say which kind of intermediary is the best for the development of diffusion of EDI. It may well be that the organizational dilemma in innovation processes also holds for EDI and that the kind of organization which is best for the development phase is less effective in the operation phase. And of course the situation of the industries, the importance of national vs. international scope, the importance attributed to small and medium-sized companies also play a role in determining which kind of intermediary suits best. Therefore it seems most important at the moment to show the range of intermediaries involved in different cases and at least develop some hypothesis which type might be best for which goals in which situation.

2. Definition and method

Intermediaries vary in their institutional form and are able to select single functions out of a set of different possible functions. This seems to give the impression as if there were no clear limits for the term "intermediary", it rather seems that the meaning of this term changes with every new situation. Furthermore, there is the difficulty of an ambivalence of the meaning of this term because most of the times intermediaries mean mediators of two-sided deals. This ambivalence contains an implicite request to choose another term to express what is meant here. But as strong the pragmatic component of such an request might be, as indispensable is the intuitive content of the term for the description of organizations which shall be examined. A first characterization shows that these organizations are on the one hand mediators which means that they bring different organizations together; on the other hand they are inbetween them, having a position which is classicaly reserved for markets. Both aspects are expressed by using the term "intermediaries". Therefore, it will be used despite of its ambivalence.

Intermediaries can be characterized according to the function or task they fulfill, and by the groups they represent or organize, i.e. their institutional qualities. Both aspects are important for the question of how to evaluate intermediaries. On the one hand, it has to be questioned which possible consequences a certain profile of function has which characterizes an intermediary. On the other hand it has to be questioned how the institutional composition of the group which is represented or organized by an intermediary influences the development and distribution of EDI-networks.

2.1 A scheme of functions for the development of EDI-networks

For the development of a scheme of functions a logical phase-model is taken as a basis. This scheme describes single phases of the development whilst each phase represents the necessary condition for the following phase. This is in so far not a temporal scheme as in historical development processes on the one hand necessary elements can already exist which means that the process in the sense of a logical course does not need to start from the beginning, on the other hand it is possible, at a later point of time, to pick up the earlier phases, e. g. through re-negotiations. In general, there are three phases to be distinguished:

- co-ordination phase
- implementation phase
- operational phase

The co-ordination logically preceeds the implementation- and operational phase. But it is perfectly possible to use co-ordinative activities at a later point of time if

for example parts of an EDI-system are already existing (proprietary systems of single users). Furthermore, as already mentioned, new negotiations might become necessary at a later stage if e. g. different EDI-networks should be connected with each other. On the other hand, the co-ordination phase can cover different activities:

- Awareness about EDI and its potential benefits (awareness)
- Initiation of multilateral negotiations aiming at establishing EDI-networks
- Organization, moderation and control of negotiations
- Centralized co-ordination of the development of EDI-networks

It is characteristic for the co-ordination phase that the activities of potential users are agreed upon ex ante. Because of that, all elements of a future or present network can be subject to co-ordination activities. This co-ordination aims at determining or standardizing those elements which were chosen out of the set of all possible elements. This determination or standardization should be first of all general binding for the group of implicite or explicite participants of the co-ordination activities. In so far, the implementation- and operational phase extend into the co-ordination phase (see figure 3). This relationship has two aspects:

- All elements which were subject of the co-ordination phase have to be transformed, i. e. for those there is an implementation- and operational phase.
- All elements which were not subject of the co-ordination phase but belong anyhow to a functioning EDI-network, have to be realized in the implementation- and operational phase.

It follows that some elements can appear in all phases, whereas others only appear in one phase. The following list of possible elements illustrates this relationship.

- Standardization of data
- Standardization/development of data formats
- Standardization of/agreement on transmission protocols
- Agreement on communication networks
- Agreement on clearing procedures/transmission procedures
- Agreement on control procedures
- Agreement on control procedures
- Agreement on hardware configurations
- Agreement on participants (admission/limitation)

- Agreement on/development of software pakets for:
  -Stock management
  -Order processing
  -Financial accounting

  -Invoice processing
  -Data acquisition
  -Data transmission
  -Data clearing
  -Data/format-converting
- Installation
- Consultancy
- Training

- Data acquisition
- Data transmission
- Data clearing
- Data-, format- and protocol-converting
- Billing of transmission fees
- Authorization of users
- Certification
- Control of agreements
- Conclusion of participation contracts
- Maintainance of EDI-systems[2]

Those three blocks can roughly be assigned to the three phases. But there are no fixed border lines. There can be e.g. a commitment for a certain software wether collective through a choice of already existing software, or individually through the choice of software. In the first case, this belongs to the co-ordination phase and to the implementation phase (possibly also to the operational phase if the maintainance of EDI-systems is included), in the second case, it only belongs to the implementation phase (and possibly to the operational phase).

On the other hand, the border lines between the implementation- and the operational phase are not fixed as can be illustrated by the example of converters. If different data formats are used for operation, a so-called conversion becomes necessary, i.e. single fields in one data format are assigned to the corresponding fields in the other data format. Such a conversion can occur either through individual EDI-systems whilst appropriate software is developed and implemented, or centrally through e.g. a service provider. In the first case the conversion belongs to the implementation phase, in the second it belongs to the operational phase.

[2] In the following the term EDI-system describes an individual system, the term EDI-network however a multilateral agreement and installation of EDI-systems.

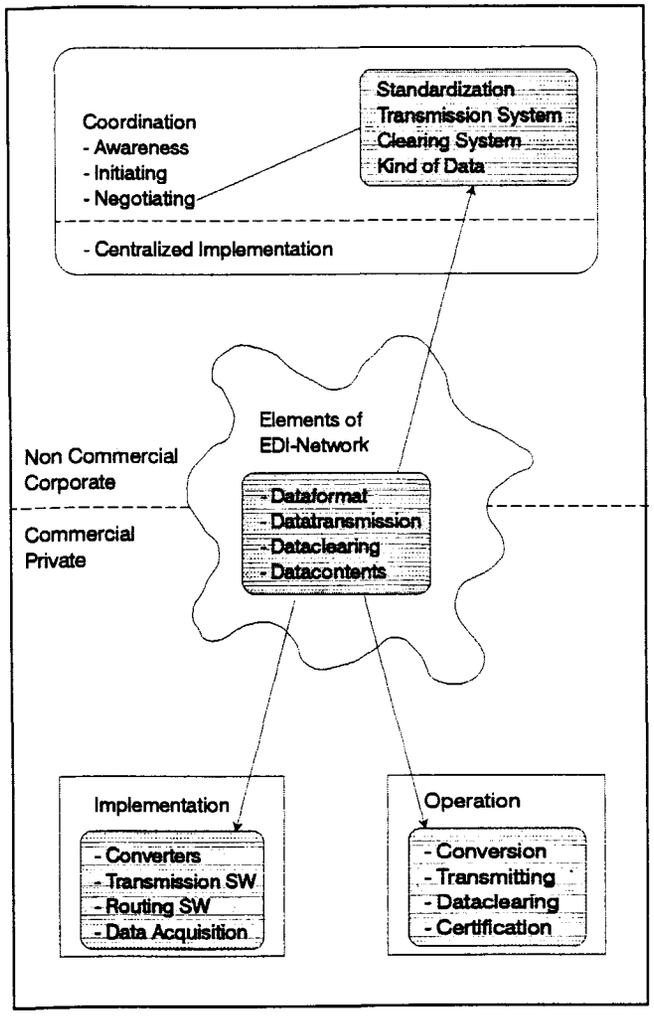

Figure 3: Scheme of logical development phases of EDI-networks

Finally, there are also alterations between the first and the two following phases as will be clear by the last example. Instead of conversion, all data formats can be standardized. As well, all transmission protocols can be agreed upon etc., which means that in an extreme case the operational phase will become superfluos (i.e. all necessary routines will be carried out decentrally, there will not be any organization inbetween for the operation).

The question is now which of the activities mentioned can be assigned to intermediaries, i.e. by which activity does an organization become an intermediary and by which not?

From the discussion in section 1.5 follows that organizations which concentrate only on the second and third phase are not intermediaries because their subject is not the co-ordination of the development. This does not exclude that there might be a quasi-co-ordination as a side-effect of their acitvity. A second exclusion can be done for the activities within the co-ordination phase. Organizations which exclusively deal with the promotion of knowledge about EDI are no intermediaries in the sense of the definition presented. There should be a different assement about those activities if they would not distribute knowledge about EDI and its benefits but knowledge about users and potential users. Then, they could have a co-ordinating effect if potential users through the information about the willingness of other potential users are encouraged to start with or to participate in negotiations. In that case, negotiations would be initiated through the activity of the organization.

Therefore, intermediaries at least have to initiate negotiations, and/or have to organize and moderate, or to take over the central co-ordination of development activities. Furthermore, intermediaries can become active in other phases of the development process.

The interesting question is about the importance of the co-ordination phase. The spectrum goes from an almost complete exante co-ordination to partial solutions, e.g. only standardization of a data formats or commitment for a specific network and everything else hase to be done by "the market". This question will be presented with the help of the empirical material and will then be examined concerning its economic effects.

2.2 Institutional qualities of intermediaries

In addition to the functions or activities which are perceived by intermediaries their institutional qualities are on the one hand important for the definition of the concept, on the other hand probably critical refering to the economic effect of their activities.

In the following, the institutional qualities of intermediaries are represented through the scheme of the value added chain. In this scheme, one starts from the assumption that in the refining process starting with the so-called primary-production, all production- and distribution processes finally end up in the consumer goods market. Normally, this scheme refers to physical goods, but it can also refer to intangible goods. As this study examines only the industrial sectors, we will only deal with the physical value added chain.

This value added chain consists of a net of organizations which are tied through transactional relations. First of all, this means companies, but there can also be transactional relations to non-companies, e. g. customs authorities or tax offices. A transactional relationship is characterized by:

- The exchange of goods and service against money
- A single-sided performance (as a rule: money)

According to this definition no transactional relationship will be established through the exchange of information. Then, the respective organizations are not members of the same value added chain.

Considering the flow of goods in a value added chain, two different forms of transactional relations can be distinguished: sale/purchase of goods on the one hand, and sale/purchase of supporting services on the other hand. The first creates vertical, the latter lateral relations. Supporting services comprise:

- Transportation of goods
- Handling/storage

- Transmission of data/clearing activities

- Consultancy/organization development
- Development of software

- Handling of payments
- Granting of loans

- Accounting
- Invoice processing

Lateral relations can be distinguished according to whether they support a vertical transaction or not. In the first case they are complementary in relation to vertical transactions. This includes especially the transportation of goods, transmission of

data, and handling of payments.[3] In contrast, lateral relations which refer only to a single company in the value added chain can be called single lateral relations. The different forms of transactions are presented in their context in figure 4.

In the vertical direction, EDI-networks can now be developed according to two possible principles: "upstream" and "downstream". "Upstream" means that the network starts with the buying organization and extends step-by-step untill the stage of primary production is reached. "Downstream" means the opposite. In that way, the number of possible transaction partners decreases with every step. Looking at the composition of the product instead of looking at the transaction partners, the two principles can be characterized like the following:

- 1 consumer good consists of n raw materials
- 1 raw material is processed in n consumer goods

Both principles are represented in figure 4 through funnel-shaped segments which are created by the diagonal. Segment A structures an economic system according to the production processes, segment B according to distribution processes. Both segments are applicable for the sectoral structure of an economic system.

This description of the value added chain illustrates the difficulty of the conception of economic sectors for EDI-networks. A network cannot only be developed for single sectors, each company of the value added chain is rather part of one or more production- and (!) distribution-segments. With each further step the number of possbible transaction partners in one sector decreases. Furthermore, each company is normally part of several sectors, therefore, even EDI-networks between only two stages of the value added chain are problematic if they are restricted to one sector.

With the help of this scheme it is possible to determine and distinguish the institutional qualities of intermediaries. Intermediaries can be developed out of:

- Members of the value added chain which entertain vertical transactional relations
- Members of lateral markets
- Members of other social sub-systems (e.g. state)

The possible institutional forms of intermediaries which meet the criteria developed so far are manifold:

[3] Concerning the term 'complementary' see Teece 1987. Teece uses the term in different sense. According to Teece, all services are complementary which support the sale of goods.

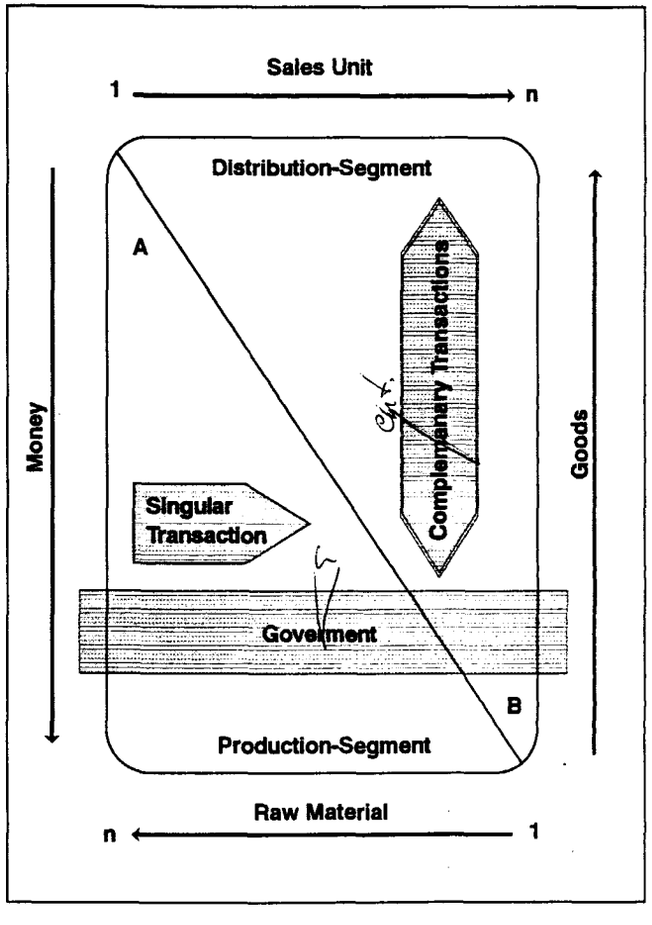

Figure 4: Transactional relations in the value added chain

- Vertical value added chain
  - Trade associations
  - Informal working groups
  - Single companies

- Lateral markets
  - Transport companies
  - Software companies
  - VANs
  - Consultant companies
  - Banks
  - Company associations
  - Informal working groups

- Other social sub-systems
  - governmental agencies/authorities/ministries

Intermediaries, therefore, can principally be single companies or aggregates of companies. This has immediate implications for the question of how to differentiate intermediaries through their institutional qualities. Aggregates of companies are already results of a collective action, therefore, the action of aggregates of companies is identical with collective action.[4] The same is valid for state agencies. It could be assumed that activities of aggregates of companies or state agencies rather aim at a multilateral agreement than the actions of single companies.

A discussion of the conditions under which single companies organize collective action should not be anticipated here. But it is important to emphasize that organizations can only be seen as intermediaries if they organize a collective action.

A classification of aggregates of companies with the aid of the scheme of the value added chain results in the following possible combinations:

- Horizontal association of companies
- Vertical co-operation between
  - Production companies
  - Distribution companies
  - Production- and distribution companies

[4] This statement is valid only in a narrow sense. Companies can be understood as aggregates as well, then the action of companies would become collective action. Therefore, it depends on the desired level of analysis.In this examination companies are the smallest unit of analysis.

- Lateral co-operation between
  - Vertical and complementary groups of companies
  - Horizontal associations with single groups of companies

The classical trade associations correspond to the horizontal asssociation of companies.[5] Here, typically all companies of one sector are associated. The promotion of the interests of the members includes on the one hand the classical lobbying activities, i.e. the attempt to incluence political decisions; the typical activities of trade association also include the preparation of relevant information. Only occasionally the co-operation with other associations the members of which have transactional relations with their own members is seen as being essential for the activity of the association.

Compared with trade associations vertical co-operations are normally not that strongly institutionalized. Mostly, they are formed for certain problems and have, therefore, the character of ad-hoc groups or informal teams. A vertical co-operation between manufacturers might use EDI not only for classical trading documents but also for the exchange of technical information. Compared to this, EDI between manufacturers and distributors will be useful not only for the exchange of trading data but also for the transmission of e.g. market data. Lateral co-operation can appear in the following form: Vertical and complementary groups of companies co-operate e.g. in the set-up of EDI in the area of transportation or banking. The most likely way of co-operation of a horizontal group of companies with single companies is that an trade association commissions the development of EDI-systems or -networks. But this cannot be seen as a form of co-operation in the narrow sense, it rather has to be seen as a market transaction. Nevertheless, this form of the development of EDI-networks is very common.

As a conclusion, there are the following possible institutional forms of intermediaries:

- Horizontal association
- Vertical co-operation
- Lateral co-operation
- State

These institutional forms do not exclude each other, combinations are rather possible, e.g. trade associations can co-operate (combination of horizontal association and vertical co-operation) or a vertical co-operation can be supported by

[5] Buying groups are also a form of horizontal association of companies. Nevertheless, buying groups also have transactional realtions, therefore they are treated like companies. For the importance of buying groups in the development of EDI-networks see appendix 2.

state acitivities. Furthermore, the terms do not have a good selectivity, e.g. vertical co-operation mostly includes a horizontal association on the stages of the value added chain which are involved. Still, they represent an independent phenomenon the economic effects of which have to be examined.

2.3 Method of presentation and design of empirical studies

Even if intermediaries mostly represent highly aggregated forms of organizations, very often this degree of aggregations is not sufficient for the presentation of results. Furthermore, around intermediaries so-called EDI-initiatives are established which are indicated by more or less fancy names of the structur: EDI plus sector specific acronym (EDIFICE, EDITEX, EDIFURN etc). The different actors of such an intiative can not be treated isolated. But as the central unit of analysis is the individual intermediary, it is relevant to identify the dominating actors in an initiative and to determine their relation to other actors. Therefore, the aim is to identify one intermediary per initiative. Criteria for this determination can be:

- Initiation
- Legitimation
- Control

The aspects of initiation and control of the development process result already from the co-ordination function. Initiation means not only that there is somebody who utters the idea for the development of an EDI-network which is then picked up by others, instead it also includes first steps of the network development. Through this, co-ordination functions are already taken over. For the aspect of control it is important that an effective co-ordination is only possible if the development can be controlled to a certain extent (e.g. determination of the participants in committees etc.).

The aspect of legitimation follows not directly from the task of co-ordination. Nevertheless, it was included. The reason for this has to be seen in the specific features of EDI-development processes in contrast to other innovation processes. In the development of EDI-networks so-called positive network externalities play an important role. This means that the willingness to participate in the development of an EDI-network increases with the number of existing participants. For the potential participants it is quite difficult to evaluate in the beginning of a network-initiative how the network will develop. Therefore, they have to look for other criteria. The legitimacy of an intermediary, therefore, plays an important role. If an actor with a generally high level of legitimacy (e.g. the state) supports the initiative, potential participants can suppose that there will be a broad basis of participants. The same is true for trade associations with respect to the companies they represent.

The actual development and implementation itself is not a criteria for intermediaries because development can be carried out on behalf of an intermediary. It is difficult to evaluate the situation if those three components are distributed over different organizations. If it is impossible to determine only one intermediary per initiative with the help of these criteria (see figure 5a), the situation has to be examined seperately with different intermediaries per initiative.

In an extreme case the three elements of activity are assigned to three organizations which stabilize each other. E.g. a constellation shown in figure 5b is conceivable. Since in this constellation all three organizations participate in the co-ordination phase, the initiative has three intermediaries. Finally, there is a theoretical possibility, that only one intermediary controls the co-ordination phase and all activities of the implementation and operational phase, while in this example the standardization is realized externally (e.g. through a take-over of existing standards) (see figure 5c).

The analysis concentrates on network-initiatives in the consumer goods market. Therefore, it follows that all companies of the value added chain finally are related to the retail trade. The restrictions in the presentation of the scheme of value added chains are made with regards to the restrictions of the empirical subject. The vertical direction thus follows the refining process of consumer goods.

The following intiatives were included in the analysis:

- SDS (retail Germany)
- EDICOMM (retail Italy)
- AECOM (retail Spain)
- HANCOM (retail Denmark)

- EDITEX-Germany (textile retailer and textile manufacturers Germany)
- EDITEX-Italy (textile sector Italy)
- EDITEX-Denmark (textile sector Denmark)

- EDIFURN (furniture sector Germany)
- EDIKOS (cosmetic sector Germany)
- PhonoNet (phonographic industry Germany)

We included the following organizations in our own investigation:

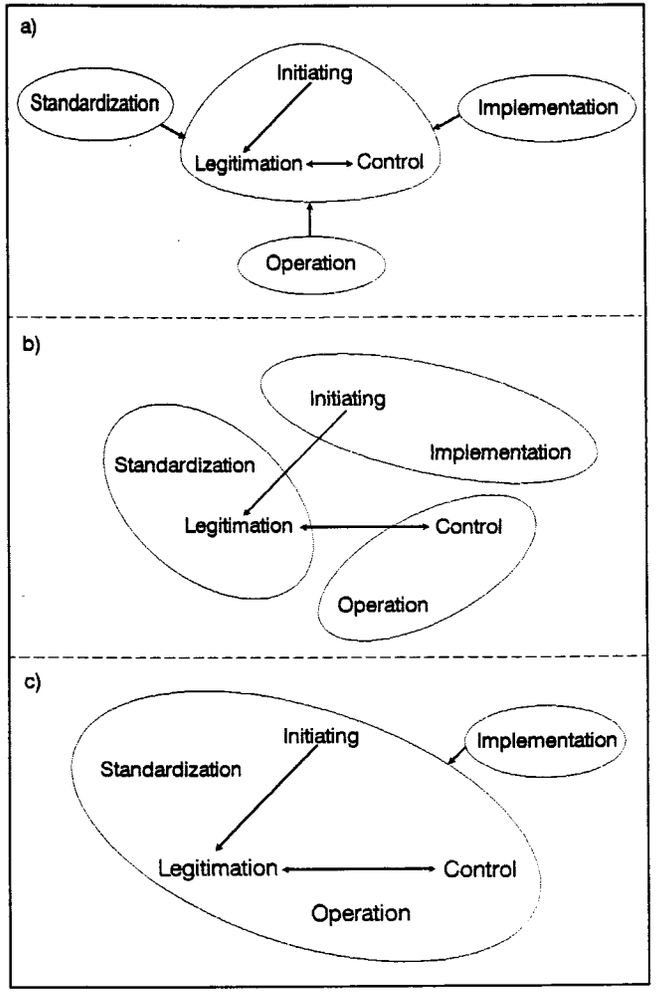

Figure 5: Initiatives and intermediaries

- CCG (German EAN representative)[6]
- EDITER (Italian consultant company of the association of all companies in the tertiary sector)
- DTB (co-operation between textile and clothing industry)
- DZE (EDI-clearing center for retail trade, especially in the textile sector)
- BBE (association of German clothing manufacturers)[7]
- ASTER (regional development agency for Emilia Romagna)
- SOI (Italian consultant company in the textile sector)
- GLI (German software company specialized in EDI-systems)
- DATAFORM (German software company in the furniture sector)
- Fiat sepin (Italian representative of ODETTE)[8]
- Banca Commerciale (Leader of the Message Development Group for the banking sector in the EDIFACT-Board)[9]

The organizations were investigated in semi-structured interviews, which took between two and four hours. The organizations and the initiatives are described in the following section.

3. Results

3.1 The stage of network development for the different initiatives and their resp. sectoral background

Table 1 provides a survey about the development process of the EDI-initiatives analysed. This table shows on the one hand extreme differences in time elapsed since the beginning of the initiative, on the other hand big differences of growth rates, inside single sectors (retail, textile) as well as between them.

Most of the initiatives have their origins in the 80's, while here the implementation of EDI was not the starting point. One network initiative can be traced back untill the 60ies (SDS). This was about the development of a standardized article number (EAN) (see below, section 3.2.1.1).

The growth rates differ significantly. In the textile industry, the development did not exceed first pilot projects. In the retail trade, on the contrary, there are high

[6] Only telephone interview
[7] Only telephone interview
[8] This interview aimed at receiving information about the Italian net operating authority INTESA
[9] This interview has not been included in the analysis

growth rates (EDICOMM, AECOM, HANCOM). On the other side, the network-initiative in Germany has grown within seven years only up to 122 participants, with only 83 actually doing EDI. In one case, the network has grown up to 150 participants within one year (Phononet). These different development processes have to be explained in this study. They can be evaluated as a measurement for the "success" of a network intiative.

A first hint for the explanation of different growth rates is the differences of industrial structures. Therefore, it can be supposed that in strongly fragmented sectors the development of EDI-networks is more difficult than in highly concentrated sectors.

The food retail is compared to other sectors the most highly concentrated. In Germany, 88% of all shops in 1986 ordered their goods from purchasing co-operations. In Denmark, there are still 20% of the shops independent. The ten largest companies in the food sector have a market share of 78 % in Germany, of 34 % in Italy and of 20 % in Spain. But in Spain, the number of the traditionally small dealers in the food sector has declined from 94.230 in 1987 to 71.734 in 1991. Therefore, in Spain, there were 96.644 points-of-sale in 1991, in contrast to Italy with 140.000. In Germany, the share of the traditional small to medium-sized specialized shops (including non-food) was 55,4% in 1980 and has declined to 39,1 % in 1992. The number of shops per 1000 inhabitants is 6,6 in Germany and 17,5 in Italy.

Despite of the general concentration in the retail sector and especially in the grocery sector, there are differences in the countries presented. These are obviously not appropriate to explain the different growth rates of the network initiatives. E.g. the relative successful initiatives in Italy (EDICOMM) or in Spain (AECOM) developed in an environment which was far less concentrated than the initiative in Germany (SDS). At the same time, the case of HANCOM shows a successful development in an highly concentrated environment.

Structural differences occur also among the network participants. If there are relatively few distributors compared with the number of participating manufacturers in Germany (SDS) and Denmark (HANCOM), the initiatives in Italy (EDICOMM) and in Spain (AECOM) show the reversed ratio (see table 2).

The picture becomes more uniform for the textile- and clothing industry. These are, in contrast to the food sector still characterized by medium-sized companies. Within the EC, in 1991 there were 61.590 companies in the textile and 84.760 companies in the clothing industry. Companies with less than 20 employees had a share of 75 % in the textile and of 85 % in the clothing industry. In Germany, the companies in the textile industry have in average 171 employees and in the clothing industry 95

employess (1987). In contrast, in Denmark there are only 37 employees per company in the textile sector (in the industrial average there are 55). Concerning the textile and clothing industry, Italy is traditionally characterized by very small companies. E.g. only in the region of Carpi (Emilia Romagna), there are 700 companies in knitwear-manufacturing.

Therefore, the difficulties in the development of EDI-networks can be related to the fragmented industrial structure. But even with the help of these statistics, it cannot be excluded that other factors also might be important.

Summing up, the explanation of EDI development through differences in industrial structure does not seem to be sufficient. It is might be rather possible to explain different growth rates between single sectors with the help of the industrial structure than to explain the differences within sectors.[10]

The explanation of the development of EDI-networks through the industrial structure is for two reasons not satisfying:

-Structural characteristics of sectors are in general not open to exerting political influence, eather because of ideological reasons or because, if ideological concerns are not to be considered, it would be unjustified to extert political influence to change industrial structure just for improving the conditions for faster diffusion of EDI; it is therefore important to identify other factors which could be reasonably influenced in order to improve the conditions for EDI.

- The "rest" which cannot be explained by industry structure could be essential for the success or failure of network initiatives. Therefore, differences development patterns and institutional characteristics might become important.

In this study we will mainly analyse the role of intermediaries in the development of EDI-networks as a further factor for explanation.

3.2 Characterization of the networks and development patterns

The development of the different network initiatives can be characterized through their functional and institutional (see section 2). First, the functional features of the development will be analysed. An analysis of the institutional features follows in section 3.3.

[10] This becomes obvious if e.g. the automotive and the textile sector are being compared.

3.2.1 Origins of the different network-initiatives

The networks presented refer to different initiatives which were originally not aiming at the development of the electronic exchange of data. The following list will provide a survey about the original ideas of the different initiatives:

SDS	Standardization of article numbers and standardization of business documents
EDICOMM	EDI
AECOM	Standardization of business documents
HANCOM	EDI
EDITEX-G	Development of a label- number for of textile goods
EDITEX-I	EDI
EDITEX-DK	EDI
EDIDATA	Development of a data format for the exchange of electronic product data
EDIKOS	EDI
PhonoNet	EDI

3.2.1.1 Retail initiative in Germany (SDS)

The SDS-initiatives[11] has the longest history of development.[12] The basic idea was to introduce a classifying article number in the buying co-operatives in the grocery sector. Especially in the area of buying co-operations it was important that the article number would be used by manufacturers in their business documents because a large part of the business takes place directly between associates and suppliers. To enable the buying group to compare and analyse relevant data (turnover, range of goods etc.) of its associates directly but also for the central control of the assortment and the purchasing policy, a comon numbering system proved essential. But the producers were not prepared to implement customer-specific numbering systems, they demanded an agreement among the distributors on one numbering system.

The following conflict mainly arose between the different forms distributors, especially between the buying co-operation and the department store chains. Furthermore, there arose conflicts between the different sectors., e.g. between retail and the textile sector. Buying co-operations and chains demanded a a classifying

[11] SDS:SEDAS-data service; SEDAS: Standardregeln Einheitlicher Datenaustauschsysteme (standardized rules of comon systems for the exchange of data)

[12] The following presentation draws on Gerpen, Kubicek & Seeger 1991; Gerpen, Klein, Kubicek & Seeger 1990.

number, department store chains tended to an identifying numbering system. However, the textile companies were also against a classifying numbering system.

Beside the so-called "soft-savings" which should be realized through a classifying numbering system, the possiblity of the rationalization of the inter-company exchange of data was included from the beginning. In that way, the number of goods should firstly be used on punch cards, later on magnetic tape. In that way, an automatic accounting control could be facilitated which should have realised considerable "hard-savings" for the traders.

After the participants agreed upon a classifying numbering system in 1970, the international development caused a change in the whole concept. Following the example of the North-American[13] and the French[14] an identifying numbering system was implemented in Germany which afterwards has been adopted on the international level.[15] The motivation for the implementation of the EAN is not mainly to be seen in the inter-company area but rather in the new possibilities of using scanner technology for automating cashier processing. Through this technology rationalisation potentials arose which could after difficulties in the beginning be realised today. The most important hindrance was the degree of EAN-labelling which reached with 75 % an operational level only in the beginning of the 80ies.[16]

With the implementation of EAN, new conflicts arose, this time mainly in the textile industry. The textile industry critized that the EAN was too "narrow" for the typical product variation in the textile sector (colour, size, design). This criticism could still be traced in the German EDITEX-initiative the starting point of which is the conception of an alternative numbering system (see section 3.2.1.3).

At the same time the problem of the management of master-data arose for the users of EAN. Since the EAN represents an identifying numbering system, these numbers have to be translated into product descriptions with the help of master-data in order to use them in a sensible way. This problem becomes the more serious the more fashionable the goods are, since product data could only be used for a short period. This proves to be also an important hindrance for using the EAN for EDI.[17]

Since 1973, word on the standardization of order- and invoice formats has been carried out on the basis of the EAN (SEDAS), through which a rationalisation of electronic and conventional exchange of business data should become possible. In

[13] UPS: Universal Product Code.
[14] GENCODE: Groupment d'études, de Normalisation et de codification.
[15] EAN: European Article Number.
[16] 1980, 19 scanner check-outs were in use in Germany, in 1988 there were 2250.
[17] See the presentation of the EDI-initiative in a buying co-opertion, appendix 2.

1976, four buying co-operatives and six suppliers initiated a first pilot project for the exchange of magnetic tapes for invoice processing. Nevertheless, only in 1984 the accompanying transmission of paper-invoices could be given up after a resolution of the Ministry of Finance legitimated the tacit concent of financial authorities. Today, around 700 companies use the SEDAS-invoice format for the exchange of magentic tapes. For the processing of orders the SDS-network was developed in 1985. In contrast to the quick diffusion of the electronic invoice processing, the development of the SDS-network is rather difficult. In seven years 122 companies signed participation-contracts, but only 83 participants actually used the network.[18]

3.2.1.2 Retail initiative in Spain (AECOM)

The origins of the Spanish retail EDI-initiatives are not directly related to the aim of implementing an EDI-network but, comparable to the situation in Germany, to the standardization of business documents.[19] In 1985, an initiative for this purpose was founded of representatives of manufacturers and distributors within AECOC.[20] The standardization of business documents was finished in 1987.

These standards were not used in the following because the advantages of rationalization of using standardized documents was not obvious. In 1988, when the EDIFACT-syntax was passed as an ISO-standard, the project gained dynamic. In the same year, the EDIFACT-syntax rules were incorporated into the messages and published. After the announcement of a network system, a pilot project with 12 participants from industry and trade was started in 1990. Two years later, the number of participants was already 180.

3.2.1.3 Textile initiative in Germany (EDITEX-G)

As already mentioned, the textile sector in Germany was from the beginning against the implementation of EAN.[21] The todays conflict between SDS and EDITEX is rooted here. In 1980, a dealer together with a software company which develops and distributes stock management systems started to work on an alternative numberin system. From the beginning, there was an attempt to involve the manufacturers in the negotiations because in the end, they should be the ones who

[18] With regard to the real turnovers, the degree of use has to be seen in relative terms. In 1992, 7 mio. order-positions were transmitted. This is quite few, taken into consideration that a mid-sized buying co-operative (in this case with a turnover of DM 5 bill.)processes approximately between 10-20 mio. order positions per year.
[19] The following draws on Eistert & O'Callaghan 1991.
[20] Asociacion Española de Codificación Comercial; Spanish EAN-representative
[21] The following draws on Biervert, Monse, Bruns & Reimers 1992.

would use the numbers (means they would use them in their documents). The initial idea was to create a number which does not indicate a certain article but a concrete specimen of one article. This would result in the numbering of each single label. According to this number it would be possible not only to identify and evaluate variations (colour, size, design) of the goods but also the date of delivery and, therefore, the age of the specimen (means the duration of staying in the shop), which is especially important for textile goods.

This concept means that beside the identification of the article and the supplier (both included in EAN), information about size, colour, design, base price, selling price and date of incoming merchandise should be included. Here, the date of incoming merchandise and the base price were especially important, both could be deduced from the delivery note. Then, rationalization potentials arise form the electronic transmission of delivery. This was possible because the data included were automatically used for the printing of labels (which follows in this conception in agreement with the common practice in textile retail). The necessity for an electronic exchange of data, therefore, arose form an alternative (competitive) numbering system in the retail trade. The competitive situation between the SDS-network and the EDITEX-Germany is beside an existing commercial motivation rooted in this historical conflict. Since the starting of the operation in 1990, the network is still in the status of a pilot project.

3.2.1.4 Furniture initiative in Germany (EDITATA)

The EDIDATA-initiative goes back to a system which was introduced in the kitchen furnishing business firstly in Germany.[22] The starting point was to organize the exchange of electronic product data between the manufacturers of high-quality kitchens and specialized dealers. Software companies were put inbetween developing and distributing systems for planning kitchens . For this kitchen planning software, the catalogue data of the producers had to be acquired in an electronic format. In 1984, an intiative of software companies, buying co-operatives and producers started with the development of a standardized data format for the acquisition of product data which firstly was not accepted. In 1990, a second data format was finished (AMK data format) and simultaneously an new organization for the acquisition of data was created (DATAFORM) which was by far more successful. Today, the network includes 120 software companies at home and abroad, and 150 producers (by this, at home nearly 100% of the companies are participants).

In 1991, a group under the leadership of producers, distributors and software companies was established. Their aim was to develop an EDIFACT-subset for the

[22] The following draws on Biervert, Monse, Bruns & Reimers 1992.

furnishing sector. The basis for this subset should be the AMK-data format.[23] In 1992, the subset called EDIFURN was finished for the documents purchase order and order confirmation. A pilot project started in autumn 1992 failed. Subsequent to this, two actors tried hard for a further development but there is the threat of a mutual blockade (see section 3.3). A presentation of the system is planned in September 1993.

The other initatives presented were aiming at the introduction of an electronical exchange of data from the very beginning. Therefore, there is no need for a presentation of the original ideas for this initatives.

3.2.2 Determination of network elements in the co-ordination phase

The network initiatives analysed, therefore, differ already significantly because of their problem solving strategy in the beginning of their development. While some have a long history of preceeding projects which resulted most of the times unplanned in the implementation of EDI-networks, the aim of the "late" intiatives was a sector-wide use of EDI. Therefore, the late initiatives have in so far an advantage as they did not have had to trouble with historically caused conflicts.

Beside the criteria of their history of development, the network initiatives can be distinguished according to their degree of ex ante determination. This refers to the range of elements on which design the future participants agreed upon before the starting of the network operation. The possible range is large, it goes from the restriction to standardization of the data formats used to the central development and implementation of the whole network. With the help of the critera for the elements of EDI-networks developed in section 2, corresponding co-ordination profiles for the single network initiatives can be presented (see table 3).

The first column in table 3 shows if beside the data format also an agreement about the content of the data was tried to be achieved resp. was realized. This is valid exclusively for the initatives which support EAN. EAN standardizes the article number to be transfered. Here, the company number is centrally assigned whereas the article number is assigned decentrally by the individual company.

All network initiatives have in common that the format for the electronic transmission of data was standardized. In so far, the statement often used is confirmed that electronic exchange of data and standardization are two sides of the same coin.

[23] Beside the AMK-data format for product data there was an AMK-data format for invoice data.

With two exceptions, the carriers were determined ex ante. But there is a variation in the way in which the transmission of data was determined ex ante. In the SDS-network, firstly General Electrics was taken under contract. GE operates the physical network (MARK III) as well as the mailbox. According to the wishes of single customers, the IBM's data network (IBM-Connect) was also incorporated. The same is valid for the mailbox-service of the German Telekom (Telebox.400) which is available since 1993. This service is based on the ISO-norm X.400. Therefore, the number of suppliers in the SDS-network was enlarged step by step. The decision which products should be included was always taken centrally. The different data networks are not linked through gateways. Currently, the IBM-network does not play an important role (practically, there are no users of it in the frame of the SDS-network). The Telebox seems to become more and more important, mainly in the area of the exchange of invoice data, because large quantities of data are to be transmitted. There are two reasons: on the one hand, the structure of fees for the Telebox is cleary more favourable than that of the private suppliers; on the other hand only Telebox has an ISDN-connection which makes significantly larger capacities of transmission possible than the traditional modem-connections. Furthermore, it is significantly cheaper than a connection to the data network of the Telekom (IDN).[24]

In the EDICOMM-network the carriers used were also centrally taken under contract. But there is the explicite policy to force the suppliers to errect connecting gateways. Untill today (September 1993) this has not been achieved. The number of carriers is basically variable, but, as in Germany, the existing supply is decisive which in Italy is today restricted to the products of General Electrics (GEISCO) and IBM (INTESA[25]) because in Italy there is no public supply for a data network. The carriers also run the mailbox needed.

In Spain, a complete integrated network system has been established by a private supplier in comming up to an call for tenders of AECOC (The Spanish representative of EAN). This includes besides the transmission of data and the data clearing also the development of software and the choice of workstations. Out of the four participants in the call for tenders (including IBM and GE), a consortium of TSI[26] and GSI[27] has been chosen which got a contract for five years.

The Danish EAN-based network initiatives (HANCOM) had to do without the fixing of a certain carrier or value added service providers (VAS). This observation can be seen in relative terms if considered that in Denmark there is practically only one vendor: daNet.

[24] See Telecom input, appendix 3.
[25] INTESA is a joint venture between IBM and Fiat.
[26] TSI is a subsidary of the Spanish Telecom company.
[27] GSI is a subsidary of a French telecommunication service company.

The German EDITEX-initative differs basically through its being controlled by a VAN. The service offered consists mainly in the operation of a mailbox. For the transmission of data the IBM-network is used. Through this, the carrier is fixed. This situation essentially contributed to a restraint of potential users.

The situation for the Italien EDITEX-initiative is similar. Originally, there was a decision for one carrier.[28] But this decision was withdrawn, therefore, the use of a certain carrier was not clear. It is nevertheless clear, that a central decision is desired.

The EDI-initiative in the German furniture sector is controlled by a software company which plans to operate the mailbox in the same way as in the German EDITEX-iniative. But there has been no decision for a certain carrier. Furthermore, it is not clear if a central decision is desired. The project still is in the development phase. Parallel to the EDIDATA-initiative, a competing network in the furniture sector has emerged which is operated also by a software company. Here, it is also planned that the software company takes over the data clearing (For the institutional backgrounds see section 3.3).

The EDI-network project in the German cosmetic sector uses the public carrier and its clearing service (Telebox.400) for the data clearing.

The EDI-network project in the German phonographic industry differs because after the failure of negotiations with CCG (the German EAN-representative) the decision was taken for the development of an own mailbox-operation. For this, an independent company was founded whose price-structur was clearly more favourable to users than the offer of General Electrics.

The hard- and/or software to be used was co-ordinated centrally only in four network initiatives. In the Italian EDICOMM-initiative there is an explicite strategy of the project management to support companies which use the network in the choice of their EDI-systems. This support consists on the one hand of the choice of hard- and software, on the other hand of their distribution to reduced prices. A similiar motivation can be seen behind the Spanish strategy. This is about choosing cheap, userfriendly and easily available systems. The criteria for the individual EDI-system were specified in the announcement and are now distributed through the consortium of TSI and GSI.

In the German EDITEX-initiative EDI-systems have been eather selected centrally. This is due to the fact that the development of the EDI-network was carried out in

[28] This was the internal data network of the largest Italian bank Instituto San Paolo di Torino.

close co-operation with a software company which has a large installed basis of stock management system Simultaneously, there were negotiations with other software companies with the aim to convince them to implement EDITEX-compatible EDI-functions in their stock management systems.

A main reason for the decision to install an own mailbox in the phonographic sector was that there should be a windows-compatible EDI-software available for users. This demand failed at the possibilities and the willigness of General Electrics. The mailbox now installed allows the use of EDI-systems which work under windows.

An important criterium for the creation of EDI-networks is the question of how the administrative control of the network should take place. This complex refers mainly to the admission of new participants, the billing procedures and the design of contracts. Within the network-initiatives analysed there seems to be a preference for the central control of the network administration. An explicite exeption is the Danish initiative which has restricted itself to the aspect of standardization. Therefore, the data network operators have the administrative control. The situation for the initiatives which are still in their pilot phase is still open.

3.2.3 Determination of the range of EDI-messages in the co-ordination phase

Considering the range of messages on which the network-initiatives concentrate in their initial phase, it follows an almost reverse picture: Where elements of the network were co-ordinated almost completely, there will be a concentration on only a few messages. This statement is valid mainly for SDS, EDICOMM and Phononet on the one hand, and HANCOM on the other hand. (See table 4)

First, the SDS-initative concentrated on two messages (invoice and order), the invoice only being used in a project just started.[29] Parallelly, there is a project for the exchange of master data (SINFOS). The producers deliver the master data to a central collecting point, and are retrieved from customers. The low qualitiy of the data (no central control) and the low level of participation from the side of the producers does not allow an economic use of these data through dealers (see appendix 2).

In the Italian retail trade, only invoice- and order-data are transmitted. Additionally, a special message (Just-in-time retail) is used which enables a delivery on request. Nevertheless, the number of the messages developed increases steadily.

[29] Invoice data will be transmitted via ISDN through the clearing service of the German Telekom (Telebox.400).

The Phononet-initiative first concentrated on orders and delivery notes. This shows the high logistical requirements in the distribution of phonographic articles (mainly CDs). The electronic exchange of master data is unique in the Phononet-initiative. This is in general a necessary prerequisite for EDI because of the high rate of changes in master data.[30]

In the textile sector, the main emphasis in the beginning was put on orders and delivery notes. The electronic transmission of delivery notes serves for a possible early printing of labels. When printing the labels already before the goods arrive, the time span between the incoming merchandise and the presentation of the merchandise can be reduced, therefore, the asset turnover can be increased.

The projects EDIDATA and EDIKOS which are in their pilot phase have realised the classical constellation of invoice and order. This is because of the close connection to the EDIFACT-standard in which these two messages are the only stable norms at the moment.

Since the HANCOM-initative is closely related to the EANCOM-standard, many standards could be taken over. The HANCOM-messages mainly represent subsets of the EANCOM standard.[31]

The AECOM-initiative mainly relied on the French GENCOD-standard and incorporated later the EDIFACT-syntax.

3.3 Role of intermediaries in the different network initiatives

So far, the different network initiatives were treated as a black-box, i. e. their institutional structur remained unexplained. But as the central unit of analysis is the intermediary, the first step is about identifying the involved intermediaries in the different initiatives (section 3.3.1). Afterwards, their institutional characteristics have to be demonstrated (section 3.3.2).

3.3.1 Identifying intermediaries in the different network initiatives

Table 5 provides a survey about the different organizations involved in the resp. EDI-initiatives. In the first three columns, the constitutive elements for intermediaries are listed (see section 2.3.) All organizations mentioned in the first

[30] With a stock of about 100.000 articles there are 10.000-20.000 changes per month. The format for the electronic transmission of master data was set by Phononet. But there are semantic problems in the processing of the format, e.g. keys for the music category are not used in a homogenous way.

[31] Except for an EDIFACT-segment (CONTROL), which is needed for the special case of the Danish system of taxation for alcohol.

three columns, therefore, can be called intermediaries. The three activities which are mentioned in the last three columns can be looked after by intermediaries but do not have to. There are question-marks were the situation is undecided.

Table 5 shows that only two initiatives are controlled by one single intermediary (SDS, AECOM). Furthermore, in both cases these central organizations took over the standardization, but development/implementation were left to other organizations.[32]

The Phononet-initiative goes back to the Bundesverband der Phonographischen Wirtschaft (BWP) (Association of the phonographic industry) which founded an own company for the implementation of the network: Phononet. This externalization aims at a neutralization of the effects which arise through a single-sided control either through the producers or the distributors. A software company (Inovis) was in charge of the development of the EDI-systems, the operation of the mailbox is taken over by a subsidary of the software company (Inovismedia). Therefore, two intermediaries can be assigned to this initiative, which are connected institutionally, but whose independency is intended and therefore relevant for the discussion.

Corresponding to the strategy to concentrate only on standardization, in the HANCOM-initiative, development/implementation and operation was not collectively decided. In the first development phase there was a support from the government which was later rejected, because politically this did not seem to be opportune. The participants are all large, prospering companies which are not dependend on a support by the government. Furthermore, an external influence should be avoided, i.e. the control over the initiative should be enlarged. It follows that the governmental support mainly increase the attractiveness of the initiative for potential participants. But as further governmental support has been sacrificed in the second phase, it is justified to see the HANCOM-initiative as the only relevant intermediary.

The Italian network in retail trade was initiated and supported by the association of bying groups in the grocery sector (FEDERCOM). The control over the development activities was taken over by a consultant (EDITER) which is a subsidary of the association. EDITER also carried out the standardization of the data format and the selection of the hard- and software. The operation is beeing outsourced to the main Italian network service providers. In this case, FEDERCOM together with EDITER have to be seen as the relevant intermediaries.

[32] For the the implementation function see section 3.2

In the German and Italian textile sector and in the German furniture sector, one organization initiated as well as controled the development of the EDI-network. In these cases, the initiators looked after additional legitimation through company associations. The German EDITEX-initiative is based mainly on an organization which tries to improve the co-operation between the textile and the clothing industry (DTB[33]), and on the support through the association of the clothing industry (see section 3.2). Initiation and control is carried out by the DZE[34], which also takes over the other three activities (Standardization, development/implementation - together with a software house - and operation). Therefore, there are three independent intermediaries.

The Italian EDITEX-initiative goes back to a regional development agency (ASTER[35]). The initiative is supported through the national counterpart of ASTER (ENEA[36]) and through the Italian clothing association (FEDERTESSILE). The support through FEDERTESSILE is only half-heartedly because the initiation of a regional development agency is not appreciated. The standardization is operated by ASTER and a consultant in the textile sector (SOI), while SOI also provides the second representative in the EDIFACT-Board. Therefore, also here three intermediaries can be identified.[37]

In its structure, EDIDATA is similar to the HANCOM-initiative and the German EDITEX-initative. The network has been initiated by a software company (DATAFORM) which also controls the development. It ensured that there will be a support through the Bundesverband für die Möbelindustrie (VDM[38]) The EDIFACT-subset has been developed by a software company (CEFEC) commissioned by the VDM. Development/implementation and operation should be taken over by the software company. Therefore, as in the EDIKOS-network, two intermediaries can be identified. The difference in the planned EDIKOS-network compared with EDIDATA is that the association (VKE[39]) became initative and engaged the software company for the development. But the software company controls the co-ordination phase in e. g. taking the decision about the structur of

[33] DTB: Dialog Textil-Bekleidung; Dialogue textile-clothing.
[34] Datenzentrum Einzelhandel; Data center fot the retail trade.
[35] ASTER: Agenzia per lo Sviluppo Tecnologico dell'Emilia Romagna; Emilia Romagna Technological development Agency.
[36] ENEA: Ente per le Nuove Tecnologie, l'Energia e l'Ambiente; National Committe for the New Technologies, the Energy and the Environment.
[37] Furhtermore, the initiative is supported through a regional development agency for the textile industry (CITER) which is relevant in the implementation phase. At this time, the role of CITER is not yet decisive.
[38] VDM: Verband der Deutschen Möbelindustrie; Association of the German furniture industry.
[39] VKE: Verband der Vertriebsformen kosmetischer Erzeugnisse; Association of the distribution forms of cosmetical products.

participants of the pilot project, that means the software company can be seen as an intermediary too.

3.3.2 Institutional properties of intermediaries

For being able to discuss the role of the intermediaries in the development process, it is necessary to to analyse the institutional characteristics of the intermediaries. Table 6 gives a survey. The table has been designed mainly according to the criteria of distinction developed above. These are: Horizontal association, vertical and lateral co-operation (see 2.2).

With one exception, the intermediaries can be categorized according to this scheme. The exception refers to the CCG[40], which is responsible for the German EDI-initiative in the retail sector. The CCG resulted out of two trade associations, the RGH[41] and the Markenverband (association of brand name manufacturers). The RGH comprises all important purchasing co-operations in the food sector. On the other side, the producers of consumer goods organized themselves in the Markenverband. Beside the RGH, another trade association was involved (BAG[42]), which mainly represented the interest of the department store chains. Finally, RGH and the Markenverband together created the CCG in 1974 with the aim to accomplish and to disseminate EAN in Germany.[43] The committees of the CCG consist equally of representatives from industry and trade.

In contrast, in the Spanish retail trade there were no trade associations prior to the implementation of EAN. AECOC was founded in 1977 by a small group of producers and distributors (in total 20), aiming at the same as CCG. In 1992, the organization included 8500 companies. Almost all companies of the food sector are included. The composition of the committees is similar to the CCG. Therefore, in contrast to the CCG, AECOC is an original association of companies but in the form of a vertical co-operation because producers and distributors are associated.

The HANCOM-initiative has not been institutionlised. Comparable to CCG and AECOC, it is a vertical co-operation but on an informal basis. Only a small office has been founded which is responsible for the project management. The initiative goes back to an EDI-project between a large purchasing co-operation (FDB, market share 36%) and a producer of milk-products (MD-Foods, market share 95%). In

[40] Zentrale für Coorganisation; Center for co-organization.
[41] Rationalisierungsgemeinschaft des Handels; Association for rationalisation in the retail sector.
[42] BAG: Bundesarbeitsgemeinschaft der Mittel- und Großbetriebe des Einzelhandels e. V.; Federal co-operative association of medium-sized and large companies in the retail sector.
[43] The CCG is the German representative of the International Article Number Association.

1987, a pilot project was started (financed to 50% by the government) in which almost all relevant producers and distributors in the food sector participated (the producers have in their sector a market share of typically over 80%). Among them, there were also trade associations, e.g. of wholesellers or suppliers.[44]

FEDERCOM is the association of the buying groups. This association is organized within the institutional framework of CONFCOMMERCIO, which includes the whole tertiary sector (financial services excluded). Beside CONFCOMMERCIO there are: CONFINDUSTRIA, CONFAGRICULTURA, and CONFARTIGIENATO (Crafts). By this, the Italian economy is in a unique way divided into subsystems while tensions are not always avoidable. On the one hand, the groups' members have economic relations (e.g. industry and trade); on the other hand there are ownership relations in a way that some parts of the distributive sector rather belong to the industrial area. E.g., one of the largest department stores 'Rinascente' belongs to Fiat. Nevertheless, industryg-group specific projects normally do not cross the borders of the national "Super-associations". This becomes obvious with regard to the Italian EDI- and EAN-project. EDITER is not the Italian EAN-representative, the International Article Numbering Association in Italy is rather represented through a software company (INDICOD), which through ownership relations belongs to the industrial sector. EDITER is responsible for EDI, INDICOD for EAN, since in Italy the 'users' of the EAN are regarded to be manufacturers. This is quite different form the German situation, where the EAN-organization (CCG) tries to gain control over the EDI-development process.

CONFCOMMERCIO outsourced all its commercial activities into a subsidiary which again has shares in the consutant EDITER. EDITER has been founded in commission of FEDERCOM with the EDICOMM-project, which has been supported by the EC.[45] FEDERCOMM includes in total eight purchasing groups.[46] Beside FEDERCOM there are two more important associations in the area of retail trade: FAID for the large chains and FIDA for the independent companies.

The DZE is the only example for a lateral co-operation with a complementary company. The DZE as a clearing center invested in the co-ordination phase in exchange for the later take over of the operation of the network. But this hope increasingly becomes unlikely as the legitimating companies draw back their support. This is mainly relevant for the DTB as the vertical co-operation between producers of textile companies and the confectionaries, but also for the association

[44] Furthermore, a group of banks was represented. But it was decided that EDI with banks should not be a subject of the project.
[45] Because of obvious reasons, the EC is not treated as an intermediary.
[46] The purchasing groups represent 227 cash and carry markets, 78 Hyper markets, 1500 Supermarkets, 3500 Super adds (under 200 square meters of sales area), 5300 Outlets, which altogether represent 277 companies.

of clothing manufacturers which currently tries to persuade the other relevant associations (textile manufacturing and textile retail) to take over the control in the German EDI-initiative. (For the development process of this initiative see section 3.1.1.3).

DATAFORM is also a lateral co-operation. But the main activity of DATAFORM is not to be seen in the operation of a future network service; it rather goes back to a cooperation of software companies in the area of the kitchen industry. This was mainly about a centralised and standardized acquisition of the necessary product data for the realisation of kitchen-planning software for all software houses (see appendix 1). (For the development process see section 3.1.1.4).

ENEA is a development agency for whole Italy, mainly for the area of technoloy transfer, which arose out of a former nuclear research center. ASTER is a regional development agency of the government of Emilia Romagna whose main activity falls into the area of technology transfer. Also represented in ASTER are: local chambers of commerce, banks, trade associations and artictic associations.

The other intermediaries are traditional trade associations of the manufacturers (BBE for the German clothing company, FEDERTESSILE for the Italian clothing company, VDM for the German furniture industry, BPW for the German phonographic industry). The VKE is an association which mainly includes the drugstores. Therefore, it is restricted to a certain type of distribution and sector.

3.4 Perspectives of network development and development problems

The problems of development which the different network-initiatives have to face, are quite different. A schematic survey is provided by table 7.

The three main problems of development can be assigned to the co-ordination phase (Critical mass) resp. to the diffusion phase (Proprietary networks, collision with other initiatives).

There seem to be no problems of development in the Italian and Danish retail initiative. The biggest difficulties are to be found in the whole textile industry. The network-initiatives analysed in the textile industry have in no case reached the critical mass.[47] In Denmark, the interest of the textile and clothing companies is too low because presently they simply have to struggle for survival. An EDI-initiative of the association has not been successful because the required financial

[47] Critical mass here means a stage of development beyond the stage of pilot projects. I.e. (1) participants have to use the network for their actual business procedures, (2) a stable field of participants has to exist (no big fluctuations) and (3) continous growth.

funds for a subsidy of 50 % could not be raised. In Italy, the interest of the companies is also quite low. It is open, wheter governmental support will be successful.

The problem of "colliding networks" is especially relevant for the German situation. In the case of the German EDITEX-initiative, the conflict with the CCG has a well documented history (see Biervert, Monse, Bruns & Reimers 1992 and section 3.1.1) The projects which are in the pilot phase (EDIDATA, EDIKOS, and Phononet) in their beginning contacted the CCG, but then decided against a co-operation with the CCG. Here, substantial protest is expected from the side of the big distributors. In the case of Phononet, this resistance already became manifest, therefore, the project management presently is in negotiations with the CCG. Between the VKE (the supporter of the project of EDIKOS) and the CCG there is an agreement that the EDIKOS-subset will be a part of the new version of EANCOM (based on the 92.1 directory).

4. Discussion

The presentation of the different network-initiatives showed that there is no standardized scheme for a successful development of EDI-networks. Neither the question of how to allocate functional specifications over the different development phases nor the institutional design show "schemes of success" which can be clearly identified. Thus, in the HANCOM-initiative only a small part of the necessary elements for a network were fixed in the co-ordination phase, namely the data formats to be used; in contrast, in the AECOM-initiative almost all elements of the planned network were collectively decided in the co-ordination phase. Both networks can be considered successful:[48] HANCOM has, after two years of operation, already 90 paricipants in the food sector with all market leaders participating with a market share of normally over 80%; on the distribution side all important distributors with a market share of over 80% participate; the Spanish EDI-initiative in retail trade has after two years of operation 180 participants.

There are similar observations about the extent of messages agreed upon in the beginning. The range of possibilities goes from the restriction to only three messages (EDICOMM) to an almost complete standardization of all relevant business transactions (HANCOM).

Also the institutional structure of the different initiatives is quite different. Intermediaries are, in most of the cases, trade associations, but also other organizations can take over this function, namely governmental agencies and/or

[48] The term "successful" is extremly problematic. If the term is used here, it means the reaching of the diffusion phase (see footnote before)

private companies. There is a variation also in the roles the intermediaries played in the development process. E.g.: in two cases all co-ordination functions (initiation, legitimation and control) are taken over by an association (SDS; AECOM), in three cases the support by the associations serves to the broadening of the basis of legitimation without taking over further functions (EDIDATA, EDITEX-G and EDITEX-I).

A discussion of the network-initiatives presented has to rely upun further theoretical support which allows to interprete the cases and to come to conclusions. We refer to theoretical thoughts presented eleswhere which mainly works with the concept of transactionalcosts (see appendix 1). The discussion follows with the logical development phases of EDI-networks presented above (see section 2.1).

4.1 Development problems in the co-ordination phase

4.1.1 Theoretical models of co-ordination

Under certain conditions which should not be discussed further, for the development of EDI-network a bandwagon might be conceivable which will make the co-ordination phase superfluous. Such a bandwagon process starts with the use of EDI between two transaction partners, further transaction partners will participate step by step untill the network is established totally in a certain area. Theoretically this means that the critical mass for the development of EDI-network becomes zero. In such development processes, intermediaries do not play any role.

The co-ordination phase becomes important if either:

- the network grows through the step-by-step addition of new EDI-connections which require each time the installation of new EDI-systems (with all necessary elements, see section 2.1), causing the number of EDI-system to increase proportionally with the number of the transaction partners connected,
- or no EDI-connections are realised at all because the installation of EDI-systems for the single business partner is not worthwhile.

In the first case, the development of the network reaches its absolute limits because the number of transaction partners for which the installation of individual EDI-systems could be worthwhile is restricted (e.g. because of the volume of turnover, stabilitiy of the transaction relation or the volume of data to be exchanged, see appendix 1). The second case can be seen as a special case of the first, whilst the

limit for growth of the network which consists of bilateral agreements and systems, is at zero.

.The limits for growth can only be overcome if instead of bilateral EDI-systems a multilateral network[49] is implemented. However, this is not a sufficient condition because it cannot be excluded that the implementation of EDI-networks in certain areas/sectors even with a large number of participants is not worthwhile.

In overcoming the limits of networkgrowth, intermediaries play an important role. Their function is the co-ordination of the simultaneous implementation of a network (in contrast to the sequential evolution of networks in bandwagon processes). This can occur in two ways:

- Organization of a negotiation-process between the future participants of the EDI-network
- Centralized development and implementation of the EDI-network

These two variations form the extremes of a continuum which includes different intermediate forms of co-ordination models. The following are conceivable:

- Catalyst model
- Centralized development with explicite agreement/rejection (Quasi-negotiations)
- Centralized development with de facto agreement/rejection

Catalyst model means that the potential participants of a network will be motivated to negotiate without pre-determining the future shape of the network. This model could consist e.g. in the dispersion of information about the willingness of potential participants, provision of rooms for the negotiations, publishing of results of the negotiations etc. Furthermore, within the catalyst model the design of the negotiation process can be influenced without giving direct inputs concerning the future shape of the network. E.g. design of the agenda, fixing of dates for negotiations, invitations of participants and creation of protocols.

Quasi-negotiation means that all fixing first occur without the participation of future network participants but whose agreement is taken into consideration afterwards for being able to include critical comments and demand for extension. Finally, a de facto agreement does without explicite agreement of the potential participants and relies on the "power of facts".

[49] In the language of this study, networks are always seen als multilateral networks. If a network is built up with bilateral EDI-systems, this will be referred to by using the term 'bilateral network'.

For the success of the co-ordination phase it is decisive if the critical mass is reached. For the discussion of the network-initatives analysed with the respect to the success of the co-ordination phase the scheme of different co-ordination models will be used.

4.1.2 Characteristics of co-ordination models aplied in the network-initatives

The categories used in the analysis for the indication of the activities of intermediaries in the co-ordination phase are initiation, legitimation and control. The question now is, how these aspects relate to the different co-ordination models in the different network initiatives analyzed.

For the question which co-ordination model has been used it is decisive, in what way the control function has been used. In three cases, the control function has been handed over from the initiating organizations to third organization (Phononet, EDIKOS and EDICOMM, see table 5). Each of the associations engaged software houses for the development of network-elements which either were founded by the association itself (EDITER and Phononet[50]), or are independent (GLI).

In these cases, the association initiated the development process as well as used its basis of legitimation to increase the willingness of potential participants. Only in two of these cases negotiations actually took place. While EDITER and Phononet organized the negotiations between the potential participants, GLI tried to find out the requirements of the participants of the pilot on the basis of a questionaire.

It follows, that only the EDICOMM- and the Phononet-initiative were developed in the framework of a catalyst model, whereas the EDIKOS-initiative rather corresponds to the model of the quasi-negotiations. In all three cases the associations did not take influence on the design of the future network, but when actually developing the nework elements the organizations in charge of the development applied different approaches.

In all other cases the initiating organization kept the control about the co-ordination phase (see table 5). If the development was initiated by an association, there is no need for a further legitimation (SDS, AECOM). In the other cases, an additional legitimation seemed to be necessary (HANCOM, EDITEX-G, EDITEX-I, EDIDATA). The initiators either tried to get support through the associations or, in the case of the HANCOM-initiative, they relied on governmental support.

[50] Phononet is at the same time the name of the initiative and of the founded subsidiary which is in charge of the implementation of the network. Here, the latter is meant.

Where the development was initiated by associations, the catalyst model can be reconstructed. The CCG and AECOC ensured, that the committees consist equally of representatives of industry and trade. The same is valid for the HANCOM-initiative which was completely supported by the future participants.

The future participants were, to a great extent, not involved in the development of both EDITEX-initiatives. The DZE presented its development work on the conferences of the DTB and in that way tried to include the future participants prior to the set-up. In Italy, the companies are being visited and questioned about their requirements. The results of these questionaires are then included in the programm for further activities. Thus, in both cases model of the quasi-negotiation has been applied.

The EDIDATA-initiative relies on the convincing power of the example and hopes on an ex post agreement. Prior to the project there was an informal working group in which the network should be developed. After the failure of this attempt, the project management rather relied upon the de facto agreement of the future participants.

Because the initiatives EDIKOS and EDIDATA are only in their pilot phase, these initiatives cannot be evaluated according to their success. If these two initiatives are exluded from the evaluation of the results, there is strong support for the thesis that the catalyst model is superior to the quasi negotiations. From a theoretical perspective this thesis can be supported because the de facto participation of the future EDI-users gives a reliable hint for the creation of the necessary critical mass. If the future participants already invested in negotiation processes, it is rather likely that they in fact participate after the implementation than if they document their intention only in congresses or questionaires. Furthermore, through the de facto negotiation it was possible to overcome an important hindrance: the co-operation with competitors. If competitiors negotiate with each other before the implementation of the network, there are bigger chances to keep their competitive position than this would be the case ex post. Finally, there are also bigger chances in the catalyst model that different requirements of future participants are taken into consideration. Different requirements can occur on the one hand according to the elements which have to be co-ordinated ex ante, on the other hand according to the types of business which are processed with EDI. No standardized scheme for the design of networks can be deduced from the tables 3 and 4 . The degree of variation of the standardized messages is rather big and cannot be taken as a criteria for the success or failure of the network-initiative.

4.2 Development problems in the diffusion phase

The development problems in the diffusion phase can be of an external or internal nature; i.e. they can be result of the institutional and functional design in the co-ordination phase and/or result from the collision with other network-initiatives or proprietary networks.

4.2.1 Internally caused problems in the diffusion phase

For the internally caused problems in the diffusion phase the concept of the feed-back relation between the different development phases is decisive. I.e. the incentives for the participation in the EDI-network are already partly determined in the co-ordination phase. The benefits as well as the cost for potential participants can be increased in the co-ordination phase. The question is in what way benefits and costs in the diffusion phase are able to be influenced by the institutional design of the co-ordination phase and the ex ante fixing of network features. Amongst others, there are the following possibilities:

- Scope of the standards
- Operation of the clearing center
- Selection of the hard- and software

The scope of the standards is decisive for the size of the potential network which is able to operate without further converting service. The smaller the potential network the more it is likely that the expansion of the network will cause increased costs through converting services or converting software. For the operation of the network it is decisive that the fees for the participation per participant decrease with the size of the network (consumtion economies of scale). If this potential for decreasing costs can be realized depends on the competitive situation of the operator. If it gets a quasi-monopoly position through the agreements of the co-ordination phase, it barely can be expected that participants benefit from consumtion economies of scale. Finally, the ex ante fixing on individual EDI-systems (Hard- and software) plays an important role. The selection of user-friendly and cheap EDI-systems can contribute to a decline in the costs in the operational phase.

In the network-initiatives analysed, the data formats were in two cases developed by a software company (EDIKOS and EDIDATA), in one case by a network operator (see table 5). In the case of the EDIDATA-initiative, a software company was engaged with the development. In the two other cases the companies were at the same time intermediaries whose investments in the co-ordination phase should be compensated by earnings form network operation in the diffusion phase. The software company (GLI) is specialized in the development of EDI-converters and

connects with its investments the expectation for a corresponding market for its products. The operator (DZE) hopes to insure that the investment of the co-ordination phase pays back through the operation of the network. It can be supposed, that in both cases there is a conflict of interests, on the one hand between the creation of data formats and format converters, on the other hand between the creation of data formats and the offer of value added services to which also the conversion belongs.

There were different ways in the selection of EDI-systems and operators. Either single companies were engaged for the development/selection of suitable EDI-systems and clearing centers (SDS, AECOM, Phononet), or the selection followed through an intermediary (EDICOMM). In restricting to only one carrier, the risk of a single-sided exploitation through positive network-externalities arise. In the AECOM-initiative, the contract was restricted to five years. But it can be supposed that the installed basis will be that large in five years that the switching costs will be prohibitively high. In fact, the level of fees for carrier services in Germany represents a hindrance for the further distribution of EDI. This becomes obvious through the fact, that with the entering of the German Telekom into this market offering ISDN and the X.400 clearing service (Telebox.400) new EDI-potentials in the area of the transmission of large quantities of data (e.g. invoices, master data) apear. The Italian initiative in retail trade puts the main emphasis on competion in selecting different EDI-systems and carriers. Nevertheless, this competition only works out if the different offers represent permanent alternatives, means not only at the starting point of the operation of the EDI-system. This requires that the EDI-systems work with the same standards and that the carriers are connected through gateways. At least the latter is required by the project management (EDITER) but has not been realised yet.

4.2.2 Externally caused development problems in the diffusion phase

Externally caused development problems in the diffusion phase are related to the collision of network-initiatives with other intiatives resp. exisiting proprietary networks. The term "collision" means a situation in which intermediaries of different network-initiatives are competing for potential participants or legitimacy. As desirable such a competition for potential participants is when refering to the supply of EDI-systems (Hard- and software) and value added services, as harmful is this competition if it arises between intermediaries. This statement is based on the positive network externalities, means, that an open communication is favourable for each participant. The function of intermediaries has to be seen in the arrangement of a collective action which will be prevented by a competition between them.

In the network-initiatives analysed this problem mainly arose in Germany, and here potentially in all analysed networks. Traditionally there is a conflict between the

CCG and the DZE, but also the three new initiatives are affected by this conflict. This problem is especially interesting because it did not occur in the other initiatives.

Table 5 will be used for an analysis of the reasons for this phenomenon. From this survey follows that there are only two initiatives which are built up through multistage organization patterns (HANCOM and SDS). In both cases, horizontal trade associations were united in vertical co-operations. In two other cases, there are purely vertical groups (DTB and AECOC). Concerning the other organizations these are tradtional trade associations (FEDERCOM, BBE, FEDERTESSILE, VDM, VKE, BPW), single companies in lateral markets (DATAFORM, GLI) or governmental agencies (ASTER, ENEA).

Therefore, the comparison of these institutional characteristics is not sufficient to explain the phenomenon of the collision of network-initiatives because all institutional forms occur as well in collision phenomena as in 'undisturbed' developments. Only if the whole institutional situation of each intitiative is considered, the phenomenon can be explained. If the institutional structure is clear, this is easy. In Spain, there was no other association before the foundation of AECOC, therefore the problem of competition among associations became irrelevant. But a specific problem occurs because the largest department store chain was not included in the initiative. The company is not prepared to give up the advantages caused by its proprietary network.

In Italy, there are clear boundaries of competence for the associations. These boundaries correspond to "natural" boundaries on the level of transactional relations. Therefore, the competition between the association is not much of a problem. Concerning EDI, this becomes obvious by the example of INDICOD (the Italian EAN-representative). The members of INDICOD use the EDICOMM-network; on the other hand the EDIFAC-subset used in EDICOMM contains the EANCOM-standard as a subset. The effects of the support through the large trade association (FAID) goes into the same direction, whereby this association does not participate directly in the project. This structur has evolved histrically, it is therefore not possible to copy it.

In contrast, in Denmark the industrial structure is concentrated to such a degree that the co-operation of companies replaces the one of the associations. The essential problem in Denmark was to motivate the competing manufacturers for common action. Presumable the coalition of distributors exerted sufficient pressure on the manufacturers.

A similar situation was characteristic for Germany before the introduction of EAN. The picture changed when the co-operation in form of the CCG was

institutionalized and, therefore, own interests of the intermediary were established (diffusion of EAN). From the conflict with the textile industry, the competitive situation of CCG and DTB as the organization which legitimates the EDITEX-initative in Germany arose. The situation for the furniture industry has to be evaluated in a similar way, because EAN here is comparably irrelevant as for the textile industry. The association of the phonographic industry is mainly interested in strengthening those forms of distribution which are not represented in the CCG (this refers to the independent specialized dealers, which in contrast to the large distributors have a range of articles which covers more than just the "Top-100" and, therefore, offers an attractive distribution channel). The same is true for the Verband der Vertriebsformen des Kosmetischen Einzelhandels (VKE) (Association of the distribution forms in the retail trade for cosmetics), which also, like phonographic industry, uses EAN, but which is not represented in the CCG.

It follows that there were competing interests between intermediaries in Germany before the implementation of EDI, which only surfaced with the implementation of EDI. These can be enforced through the interference of companies from lateral markets (e.g. DZE in the EDITEX-initiative). But this mutual blockade would not have arisen if the DZE would not have mobilised a sufficient potential for legitimation with the help of DTB.

Externally caused development problems, therefore, stem from the institutional structure of involved sectors. These structures cannot be changed. Therefore, it seems unlikely that externally caused problems of diffusion can be solved through the intermediaries involved. Here, it is necessary to look for alternative mechanisms of co-ordination.

5. Conclusions and policy recommendations

Considering the implications of this analysis for the EC-policy with respect to the promotion of EDI it is important to keep in mind the main objectives as formulated in the TEDIS Interim Report 1992. These are:

- Integration of information systems on national and sectoral levels
- Examiniation of the impact of EDI
- Raising of awareness

Although these are the main objectives it seems clear that the latter two are rather instrumental for the first, i.e. the overiding aim is to link the different initiatives that have developed. This becomes clear with regard to the allocation of funds which is an expression of the EC's priorities. Among the total of EC-funds being spent in 1991 and 1992 (i.e. withing TEDIS II) the largest proportion has been used to support projects (36%). Among these funds multisectoral projects got the biggest

share (74%). This expresses the importance which is asigned to integrating different network initiatives. Nevertheless, if one scrutinizes the multisectoral projects it soon becomes clear that there are varying degrees of 'multisectorness' among these projects.

In the TEDIS Interim Report there could be identified explicit approaches to multisectoral EDI-promotion . These are:

- Establishing of a coordination mechanism
- Supporting the set-up of new user groups
- Establishing an intersectoral EDI forum
- Conformance testing
- Coordination of national EDI initiatives
- Coordination of awareness centers
- EDI-inventory

Considering the actual multisectoral projects being supported by the Commission there are some more implicit approaches to multisectoral EDI promotion:

- Interoperability between industry groups (EAN, EDIFICE, CEFIC, ODETTE)
- Expansion into related industries (from chemical into paints, textiles, agriculture, construction, petrochemicals, pharmaceuticals)
- Linking of related industries (road freight, distribution, customs and financial services)

When coming up with policy recommendations in the following we focus on industry projects i.e. we leave apart other possibilities like awareness, coordination mechanism and so on.

1. Distiguishing between the coordination and diffusion phase

A first immediate result of our analysis is that it might be important to distinguish between the coordination and the diffusion phase. Both require different policy measures. Intermediaries, which organize the set-up of an EDI-network, seem to be much more capable in the coordination phase, than in the diffusion phase, i.e. in integrating different networks.

2. Distinguishing between different coordination models

Nevertheless, intermediaries differ in their capability to coordinate network-initiatives, depending on the coordination model applied. If a catalyst coordination model is applied the success seems to be warranted. This is the case if the

negotiation process between potential participants is only triggered by intermediaries such that potential participants (i.e. users) also participate in the development process. In contrast, centralized development often leads to a failure in reaching the critical mass. Since trade associations tend to adopt a catalyst model of network development there is strong support for the view that trade associations should be preferred when promoting network initiatives.

Also, the involvement of network service providers or software companies in the coordination phase is likely to produce trade-offs between reducing transaction costs in the coordination phase and increasing operation costs in the diffusion phase, thus forcing potential users into a wait-and-see position.

3. Shifting the level of coordination from industry groups to EDI service providers

In contrast, trade associations could cause many problems in the diffusion phase if the institutional structure of the relevant sectors is such that trade associations are competing or struggling for legitimacy. In such circumstances it does not seem possible to solve the conflict on the level of trade associations or other industry groups. Any effort to bring them together will be in vain unless there are very strong incentives. It is nevertheless rather unlikely that the Commision could provide such strong incentives. Financial support only counts for weak and small organizations, but institutional problems are most urgent where intermediaries are strong. Therefore it might be more effective if the focus of promotion will be shifted in the diffusion phase.

We therefore suggest that policy measures in the diffusion phase are much more effective if involved network service providers and software companies (if necessary also other third parties like consulting companies) are included. This means that since new coordination requirements are emerging on the level of EDI-vendors new intermediaries are necessary which group EDI-vendors. They should be asked to cooperate in the first instance, e.g. by setting up gateways, offering converting services etc., which of course would increase competitive pressure on them. On the other hand this would enormously increase the market for EDI-services, thus providing compensating incentives. This could only be brought about if eather:

- potential users exert effective pressure on EDI-service providers which also might offer a new role for intermediaries,
- market growth becomes a realistic perspective for EDI-service providers which could be signalled by a changed policy on the part of the Commission.

4. Institutional structure of network-initiatives matters

For both phases it is necessary to carry out in depth analysis of network-initiatives on the level of participating intermediaries including functional specififfications and the institutional background prior to policy measures. Only then it will be possible to judge properly the impact these measures might have. Thus the set-up of new users groups will not be brought about by simply supporting a European user group. Rather it is necessary to know which intermediearies are actually involved, which role they play and what their institutionel background ist. Similarly the coordination of national or sectoral initiatives requires an in depth knowledge of all relevant factors, especially institutional structure of the sector resp. national economy.

Similarly, it might be futile to expect that established industry groups would easily give up their domains and control potential over the development process. To know whether such efforts promise success again requires prior knowledge about their institutional relation and about the network characteristics. It seems a dangerous tendency that the stronger intermediaries are the more likely the support to their advantage will be, since the strong intermediaries will probably cause the biggest problems in the diffusion phase. Therefore new approaches to EDI-promotion in the diffusion phase which include EDI-service providers are worth testing.

6. Tables

Table 1: Stage of network development

Name of initiative	Start of initiative/ operation	Status: no. of participants	Growth rate: add. participants per year (average)
SDS	1965/85	122	17.5
EDICOMM	1988/89	300	100
AECOM	1985/90	180	90
HANCOM	1987/90	>90	>45
EDITEX-G	1980/90	10-20	7.5
EDITEX-I	1990	none	-
EDITEX-DK	1993	cancelled	-
EDIDATA	1984/93	pilot planned	-
EDIKOS	1993	pilot planned	-
Phononet	1985/92	150	150

Table 2: Structure of networks analyzed

	Distributor	Manufacturer
SDS	31*	91
EDICOMM	250	50
AECOM	<100	>82
HANCOM	13	>73**
EDITEX-G	6	14
EDITEX-I	-	-
EDITEX-DK	-	-
EDIDATA	1	2
EDIKOS	6	7
Phononet	130	20

* Double count of susidiaries

** EDI-linkages of suppliers with the two largest buying groups with a market share of together 50%

Table 3: Elements of the co-ordination phase[51]

	Data	Format	Carrier	Clear.	HW/SW	Admstr.
SDS	X	X	X	X	-	X
EDICOMM	-	X	X	X	X	X
AECOM	X	X	X	X	X	X
HANCOM	X	X	-	-	-	-
EDITEX-G	-	X	X	X	X	X
EDITEX-I	-	X	?*	-	-	?
EDIDATA	-	X	?	X	-	?
EDIKOS	X	X	X	X	?	?
Phononet	X	X	X	X	X	X

* Decision was withdrawn

51 EDITEX-DK is not presented again.

Table 4: Fixing of documents to be exchanged in the co-ordination phase

	I	II	III	IV	V	VI	VII	VIII	IX
SDS	X	-	X	-	-	-	-	X	-
EDICOMM[1]	X	-	X	-	-	-	-	-	-
AECOMM	X	X		X	-	X	-	-	-
HANCOM[2]	X	-	X	X	X	X	X	X	X
EDITEX-G	-	-	X	X	-	X	-	-	-
EDITEX-I[3]	-	-	X	X	-	X	-	-	-
EDIDATA	X	-	X	X	-	-	-	-	-
EDIKOS	X	-	X	-	-	-	-	-	-
Phononet	-	-	X	-	-	X	-	X	-

[1] Additionally: JIT-retail (DELJIT)
[2] Additionally: CONTROL
[3] Additionally: Technical data (e.g. dye instructions)

I Invoice
II Payment advice
III Purchase order
IV Order confirmation
V Order Change
VI Dispatch advice/bill of lading/delivery note
VII Party information
VIII Product information/catalogue/Master data
IX Price information

Table 5: Identifying intermediaries in the different network initiatives

	I	II	III	IV	V	VI
SDS	CCG	CCG	CCG	CCG	SU/GE	GE
EDICOMM	FEDER-COM	FEDER-COM	EDITER	EDITER	EDITER	GEISCO/ INTESA
AECOM	AECOC	AECOC	AECOC	AECOC	TSI/GSI	TSI/GSI
HANCOM	H.I.*	Govern.	H.I.*	H.I.*	-	-
EDITEX-G	DZE	DTB BBE	DZE	DZE	-	DZE
EDITEX-I	ASTER	ENEA/ FEDER-TESSILE	ASTER	ASTER SOI	?	?
EDIDATA ~~DATAFORM~~	DATA-FORM	VDM	DATA-FORM	CEFEC	DATA-FORM	DATA-FORM
EDIKOS	VKE	VKE	GLI	GLI	GLI	IBM/ TELEBOX
Phononet	BPW	BPW	Phono-net	Phono-net	Inovis	Inovis-media

* H.I.: HANCOM-initiative

I Initiating
II Legitimation
III Control
IV Standardization
V Development/implementation
VI Operation

Table 6: Institutional properties of identified intermediaries

	I	II	III	IV	V	VI
CCG	X	X	-	X	-	-
FEDERCOM	X	-	-	-	-	-
AECOC	-	-	-	X	-	-
HANCOM In.	X	X	-	X	-	-
DZE	-	-	-	-	X	-
DTB	-	-	X	-	-	-
BBE	-	X	-	-	-	-
ASTER	-	-	-	-	-	X
ENEA	-	-	-	-	-	X
FERDER-TESSILE	-	X	-	-	-	-
DATAFORM	-	-	-	-	X	-
GLI	-	-	-	-	X	-
VDM	-	X	-	-	-	-
VKE	X	-	-	-	-	-
BPW	-	X	-	-	-	-

I Horizontal association of distributors
II Horizontal association of manufacturers
III Vertical cooperation between manufacturers[52]
IV Vertical cooperation bwetween manufacturers and distributors
V Lateral cooperation
VI Cooperation between state agencies and industry groups

52 A vertical cooperation between distributors empirically normally exists in the form of buying groups which are treated her as companies.

Table 7: Development problems of the different network initiatives

	I	II	III	IV
SDS	X	-	-	-
EDICOMM	-	-	-	X
AECOM	-	X	-	-
HANCOM	-	-		X
EDITEX-G	X	-	X	-
EDITEX-I	-	-	X	-
EDITEX-DK	-	-	X	-
EDIDATA	X?	-	X?-	-
EDIKOS	X?	-	X?-	-
PhonoNet	X?	-	-	-

I Collision with other network initiatives
II Existence of proprietory networks
III Critical mass not reached
IV No resistance

7. Literature

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The Development of Electronic Data Interchange Networks from an Institutional Perspective

1. Introduction

In our paper we will focus on the economic forces that shape 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 organizations which interact in a - cultural, national or regional - environment but arise from the interaction processes bewtween companies. Thus it is necessary to include these 'network effects' in the theoretical framework which is to be used for analyzing and understanding 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 expanding in the near future considerably. 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 for generalization. It seems as if traditional analytical tools in those disciplines that deal 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.