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A BASIC TECHNOLOGY AT THE THRESHOLD OF A BREAKTHROUGH

EDI – A NEW DIMENSION IN COMMUNICATION

EDI (Electronic Data Interchange) has become a much discussed technical miracle a well as sometimes a problem child of the dawning telecommunication era. Whereas the enthusiastic supporters advocate it as the solution to many urgent problems or even as a cure-all, others see it as a not very relevant fringe technology. Due to the lack of information, EDI remains for many an incomprehensible phenomenon. In its present form, there exist consequently enormous variations in the perceived significance.

EDI signifies change of the information world and its communication infrastructure. And it also signifies evolving markets with corresponding products and services. In brief: EDI is

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growing into a significant line of business. This report concentrates primarily on the functional and application-oriented aspects.[1]

Conventional conception of EDI

The electronic document

An analysis of the currently prevailing definition of EDI clearly reveals its original philosophy: EDI is a technology of structured, electronic message exchange between EDP applications. This means that worldwide intelligible documents, business activities can be better coordinated with respect to intracompany and intercompany requirements.

The EDI standard UN/EDIFACT (Electronic Data Interchange for Administration, Commerce and Transport) – sponsored by the United Nations – is becoming the worldwide standard. The UN has accepted the challenge of developing this standard because of the important objectives it pursues within its own organisation: EDI as a global standard shall enhance the worldwide prosperity, the structuring of institutions and processes in democratic societies, and advance the integration of countries and continents.

Electronic document exchange becomes an established technology

After its initial shortcomings EDI has developed into an established technology. A number of factors have made this possible:

- Communication infrastructures and information applications offer greater functionality, range (reachable partners), reliability, and security.
- UN/EDIFACT as a standard is maturing and gradually penetrates the entire business world and society. In most places where structurable communication can be used, electronic documents are now being standardised.
- Conventional regional or 'proprietary' standards increasingly migrate toward UN/EDIFACT.

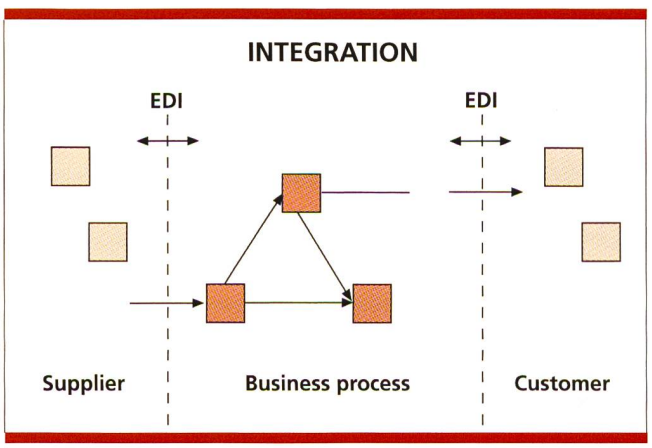

Fig. 1.
EDI links the goods and information logistics of suppliers, producers and customers.

[1] The technical characteristics of the EDI or EDIFACT standards have already been described and discussed in earlier editions of 'Technische Mitteilungen PTT'. Orla Greevy: Current Trend in EDI and X.400 ('Technische Mitteilungen PTT' 11/1992); p. 472 ff.), Orla Greevy: Security and EDI ('Technische Mitteilungen PTT' 2/1994, p. 99 ff.).

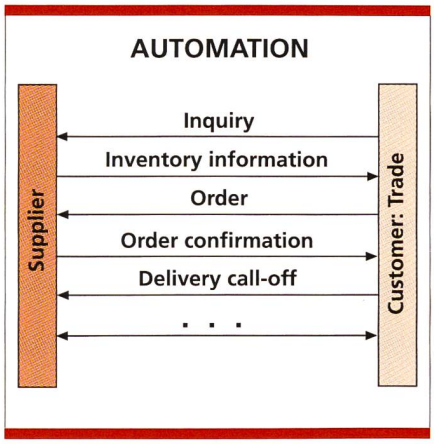

Fig. 3.
EDI defines staggered information exchange phases for two communication partners.

SIGNIFICANCE AND MOTIVATION

Significance of EDI in the economic area:
- EDI is integration of the value addition chain *(Fig. 1).*
- EDI is structuring of the economic relations *(Fig. 2).*
- EDI is automation of the economic processes *(Fig. 3).*

Motivation for the development and implementation of EDI:
- transition from paper handling to electronic information logistics
- lower costs and higher work accuracy through the reduction of redundant data capture
- potential for using more personnel in interesting, direct value addition activities
- prosperity enhancement through the standardisation of information and communication (with respect to the national economies as well as to business management)
- acceleration of the work processes
- feasibility of 'just-in-time' principle
- competitive edge through new functional capabilities
- refinement of the means for information management, control activities and for entrepreneurial decision support

- UN/EDIFACT is enhanced through its standardisation committee as well as the research and development activity of the European Union. The integration of technical data (for example, CAD) as well as multimedia representations in EDI documents will be possible. Also the design of interactive functionalities (interactive EDI) is progressing.
- New, supporting infrastructures such as Trusted Third Parties are beginning to significantly enhance the user convenience, application potential, and security in EDI communication (see box: 'Definitions'):
  - Registration Authorities define and certify parameters for the purpose of retrieving, evaluating and handling of communication partners.
  - Worldwide Directory Services such as X.500 will make corresponding parameters available in the world-wide access network.
  - New security technologies enable the user to master critical factors such as Authentication, Confidentiality, etc.

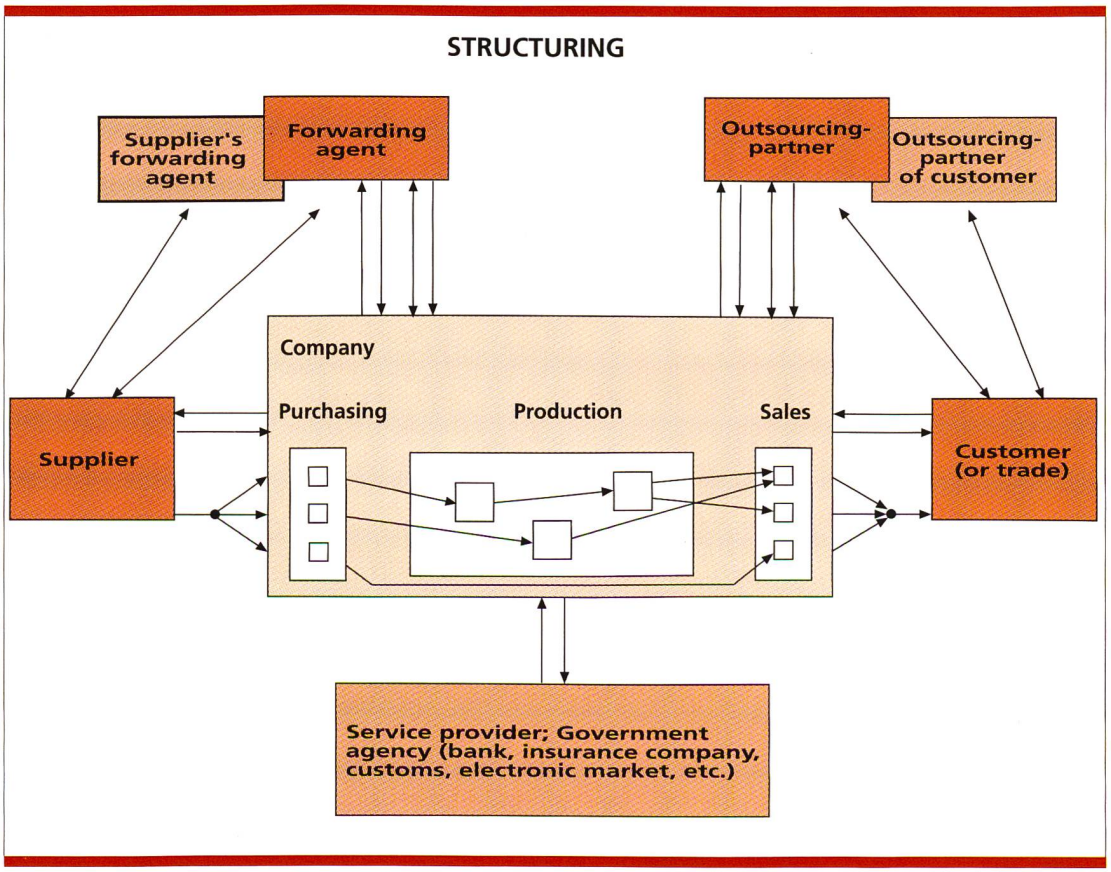

Fig 2.
EDI structures relationships and forms of cooperations between the institutions of the economy.

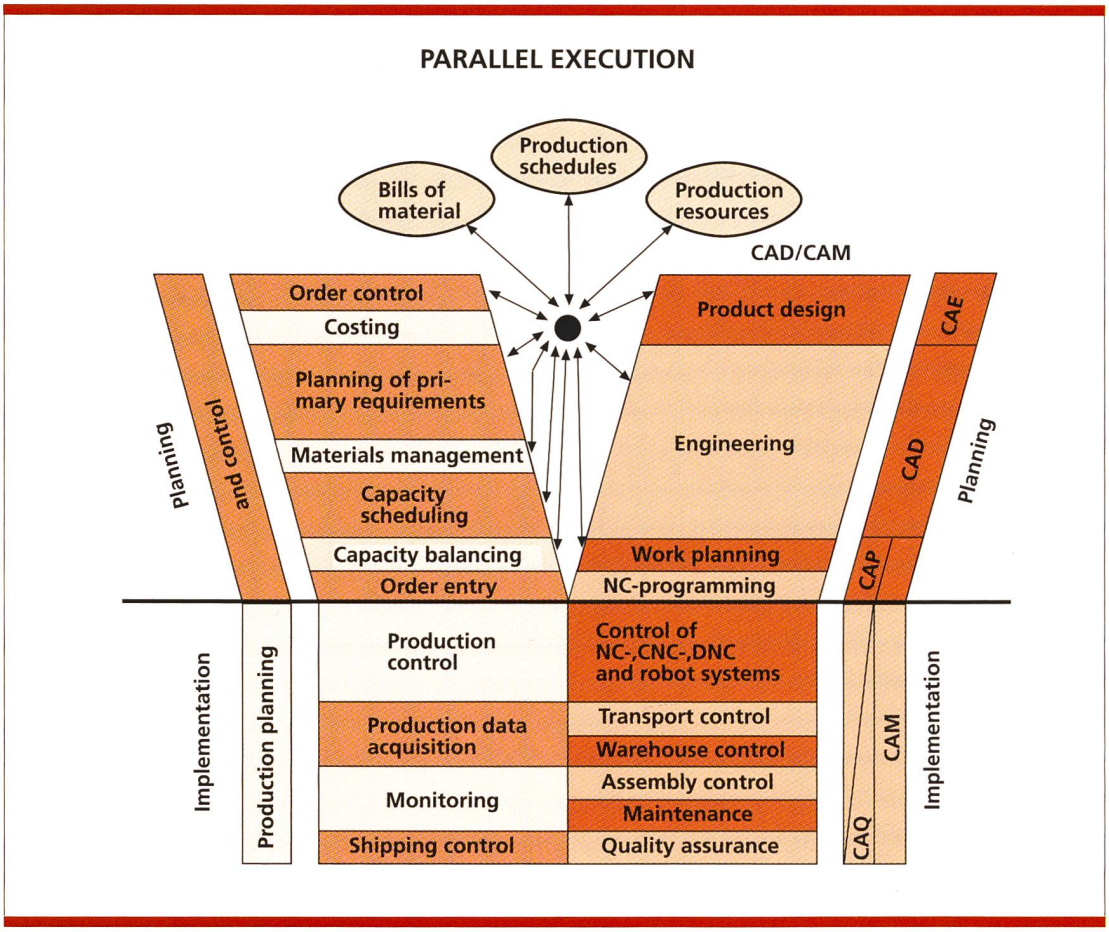

Fig. 5.
Parallel execution of technical planning (CAD) and production planning and control (PPC) saves time and allows the exploitation of synergies. Both paths flow into computer-aided manufacturing (CAM).

The computerisation of our society is continually progressing. Computers become more affordable, more powerful, and easier to use. The possibilities of EDI for improving the value addition, the quality of work and life are becoming apparent. A continually growing number of potential users learns, understands, wants to use and begins to invest. Another segment is forced by key customers, suppliers, associations and established business practices to interact with EDI.

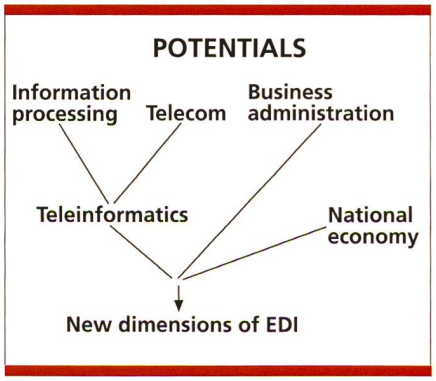

Fig. 4. The fusion of EDI technologies with concepts from business and social activities opens new worlds.

Gradually we will approach the vision of a widely used 'open EDI':
- We will have the ability to use a broad, globally accepted selection of EDI standard documents.
- We will be able to identify and understand the (tele)communication characteristics of our partners via worldwide public infrastructures.
- For this purpose we will have a large choice of electronic transport facilities in the future integrated information highway.

Marketability and process optimisation

Is EDI just the means for enhancing efficiency and improving coordination? On close examination there is also a strategic relevance to be recognised. The 'traditional' apprehension related to the practical implementation of EDI will disappear due to the increasing stability of the standards and the growing quality of the available infrastructures. Problems such as message design, conversion, enabling, etc., will be displaced by questions of sensible exploitation of the capabilities:
- What are the new capabilities of the EDI technology in my field of activity?
- What shall the result of my activity look like?
- How shall my activity be optimised for this purpose?
- How do I best implement the selected technological capabilities?

New market segments, quality enhancement of products and services, improvement of work procedures, integration of value addition processes, etc., harbour questions that must be of interest to all levels in business, administration and government up to the topflight managers.

EDI in the concept of tomorrow

Dimensions of an idea in development

In many areas new infrastructures are being prepared, be it for solving existing problems in society or environment, or for maintaining the competi-

DEFINITIONS

- **Trusted Third Party (TTP)**
  The TTP is a hypothetical legal entity that assumes binding responsibility in the generation, certification (ÆCA) and registration (ÆRA) of transaction parameters (such as communication identifiers) and transaction tools (such as public keys).
- **Registration Authority (RA)**
  With its technology and through its access to legal background information the RA can assign transaction-relevant parameters to the users. A currently important example is the 'Identifier' in EDI.
- **Directory Service (DS)**
  The DS organises and supplies transaction-relevant parameters such as addresses, identifiers, certificates, etc. The DS are usually designed by the service providers in accordance with their own business requirements.
- **Security**
  Security refers to the technology that counteracts the risks and legal deficiencies that arise from criminality or technological weaknesses. Security within the framework of telecommunicative transactions is required at all levels: protocol, document level or metalevel (for example public key management).
- **Certification Authority (CA)**
  For asymmetrical encryption methods the CA validates and guarantees the correctness of electronic keys at the time they are generated and utilised and issues corresponding certificates.
- **Electronic Markets (EM) in the narrower sense**
  EM in the narrower sense are electronic hubs that serve as contact points of economic actors. Through coordination mechanisms they support the matching of supply and demand as well as the execution of market transactions in all their phases.
- **EM in the broader sense**
  EM in the broader sense comprise services and infrastructures related to central market mechanisms. They can integrate all imaginable telecommunication and information-processing applications and organise or offer corresponding product or service packages. A typical example could comprise: selection, consumption, invoicing and payment of video on demand through a single infrastructure.

tiveness of nations, industries or entire economic regions. To accomplish this, EDI can be useful in certain areas. The fusion of different technologies with concepts from business management and economics gives it such potential *(Fig. 4)*.
Market mechanisms, research and development activities as well as governmental support policies provide the impulses for corresponding innovation. This will result in concepts with high-quality standards and products for implementation. And they will redefine the economic structures and methods.
Two examples are given that illustrate the emerging innovation and the new concepts:

First example:
EDI in production industries

The questions concerning the possible benefits of the EDI technology in production can be formulated approximately as follows:

- How can the comprehension of all details of a product be enhanced for its developers, its producers and its users?
- How can the comprehension of the requirements, ideas and activities among all parties involved in value addition and utilisation be enhanced? How can their methodology and communication be harmonised? How can the language barriers be overcome?
- How can institutions that are only indirectly involved in production processes be better integrated (transport, funds transfer, insurance, customs)?
- How can development and production be accelerated and made more flexible?
- How can the costs be lowered?
- How can the reliability in production and utilisation be enhanced?
- How can the user's handling of the product be improved? For example, how can heavy manuals be converted to an electronic form that is retrievable from a mobile device? How can important information be made accessible quickly from a mobile terminal?
- How can the supply logistics for service and repair be organised, so that it becomes faster and more efficient?

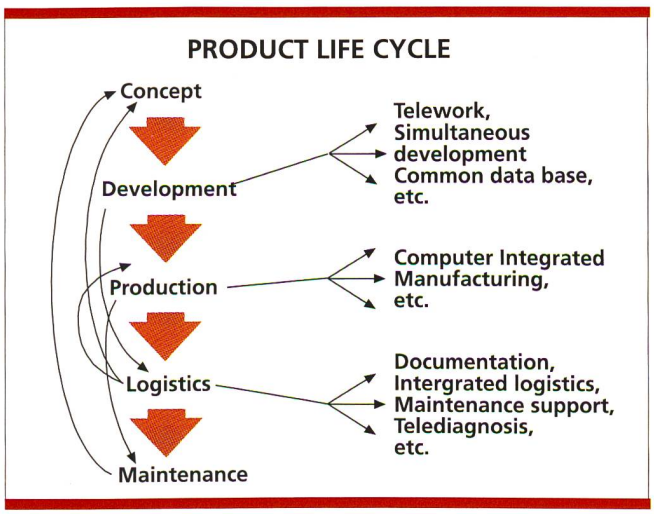

Fig. 6.
The product and project integration and standardisation of the cooperation of all parties involved takes place for all phases of the product life cycle.

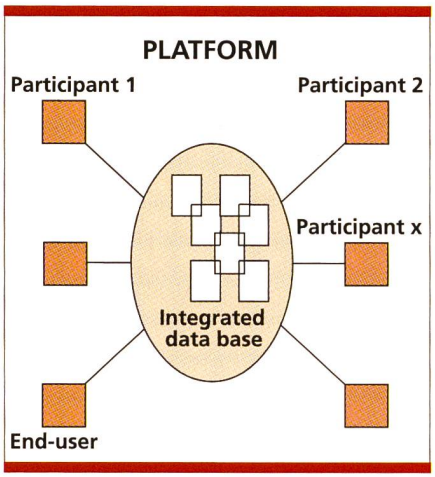

Fig. 7. Common data bases are essential for development and production coordination as well as optimum documentation for the end user.

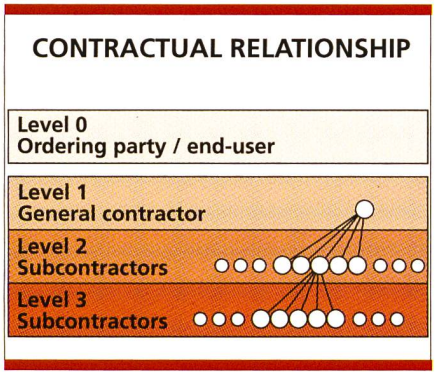

Fig. 8. Through a clear definition of the responsibilities in the value chain, also complex production operations can be efficiently managed.

- How can inefficiencies and occasional absurdities, particularly in stock keeping and freight transport, be alleviated?
- How can the recycling, which is important for an ecological future, be supported? For example, how can the reutilisation of parts or the recycling of base materials be better organised?
- How can technical or chemical information on product elements be provided more efficiently? How can recycling locations, capacities or requirements be announced?
- How can certain products with built-in information technology be enhanced with respect to their (utilisation) quality.

In a somewhat more general vein, the questions can be formulated as follows:

- Can the different contents of electronic communications be further structured and standardised?
- Can the communication procedures be better harmonised?
- Can the customs in commercial transactions be better defined, for example via functional standards?
- Can the synergies in the diverse aspects of value addition be better exploited?
- Can other, general benefits be achieved through corresponding enhancements?

The answer evolving from practical experience consists of a comprehensive concept which can be formulated as a recipe that contains the following elements:

- Start with the fundamentals of integrated production such as computer integrated manufacturing (CIM) *(Fig. 5)*.
- Review the entire life cycle of the product and standardise the language for describing its materials, its forms, its behaviour, etc. *(Fig. 6)*.
- Integrate the information infrastructures involved in the product life cycle more deeply. This means, integrate all relevant applications and build common central hubs (data bases) *(Fig. 7)*.
- Model and define the competence and responsibility of the individual cells in the entire value addition process by standardised procedures.
- Look at the structured value addition process as an 'enterprise' and define the binding agreement between the ordering party and the supplier *(Fig. 8)*.
- Define an overall telecommunications concept that is valid for whole groups of industry: information exchange profiles with sets of communication protocols and syntaxes, etc. *(Fig. 9)*.
- Develop an integrated supply and logistics concept with respect to production, utilisation, maintenance and recycling. For this purpose also functional standards that accurately define the activities of the 'enterprises' are to be created.
- Determine the binding quality standards also for organisations, their work, and their products (ISO 9000, TQQ, etc.).
- Spread this information and support its implementation through manageable processes and products. In this way the quality of the value addition improves, and the integration into the environment is enhanced!

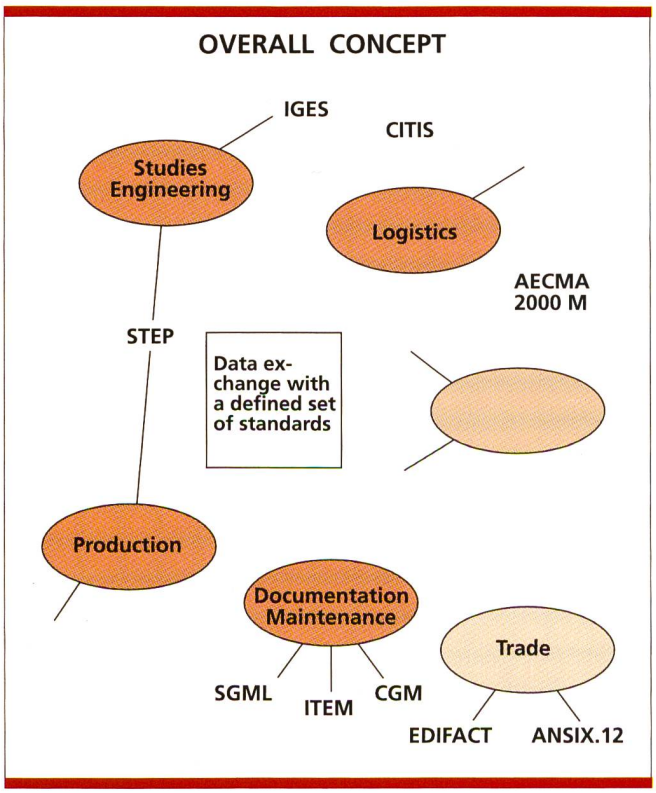

Fig. 9. Industry profile with binding standards are the basis for efficient and reliable communication.

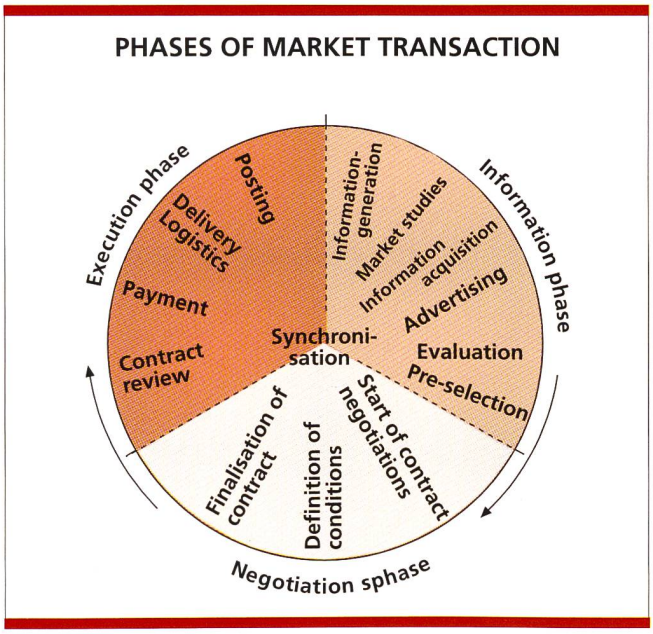

Fig. 10.
The electronic market with its phases coordinates supply and demand and supports the execution of the negotiated transactions.

What sounds like a cookbook style recipe is already becoming reality in many places. Particularly in the North-American region, large-scale initiatives have been launched. These concepts are mainly being implemented in large production projects with certain characteristics. These characteristics include:

- high complexity in production
- high potential for future product evolution
- intensive maintenance and intensive logistics in production and utilisation
- large high-tech content (IT, electronics)
- high significance of good quality characteristics (incl. safety)
- fast and flexible development and production
- specific customer requirements

This is becoming reality not only in the US and in Canada, but also in Europe, Asia, etc.

Second example:
Electronics markets and coordination mechanisms

Markets are mechanisms for coordinating transactions. A typical example is the matching of supply and demand in economic processes. In this connection the questions concerning the benefits offered by the EDI technology can be formulated approximately as follows:

- Can the economic mechanisms such as information and coordination in the market be improved by technological means? Can partners with complementary requirements (for example supply and demand) be better matched through differentiated information and methods?
- Can the efficiency and efficacy of exploration and execution of market transactions be improved (purchase, sale, services, etc.)? Can misunderstandings, lacking communication possibilities as well as wasted efforts be generally prevented?
- Are general qualitative improvements possible in a country's economy and its institutions? Are new valuable fields of activities or markets emerging?

Of specific interest are the following aspects:

- How can business and social institutions or private persons manifest their requirements more precisely (for example supply and demand)?
- How can they formulate their requirements in a structured form as well as in a standardised language?
- How can interested parties for a corresponding exchange be found?
- How can important information such as terms and conditions, creditworthiness or availability of communication infrastructures be formulated more simply?
- How can such information be gathered, managed, and disseminated to locations with actual requirements?
- How can the important synergies of the different activities involved in a commercial transaction (information → contract negotiation → execution) be better exploited *(Fig. 10)*?
- How can complementary or supporting services for market transactions (for example expert's opinions) be designed for spontaneous consultation? How can such services be accessed at any time and from any place?
- How do electronic platforms have to be designed for achieving a higher communication quality and transaction efficiency?
- How can services that become available through new technologies be optimally integrated?

The comprehensive concepts that emerge as possible answers can be described according to the following recipe:

- Create information platforms with communication networks and integrated EDP systems. On these platforms, communication partnerships can be easily designed, and the processing of standardised forms of information is readily possible.
- Design the functions of the platforms in such a way that the information can be forwarded, held in storage, processed or consulted.
- Assist in the formulation and communication of needs.
- Help in the search of optimum suppliers, customers, service providers, etc. This can be achieved through market segmentation, coordination mechanisms, information data bases, notary functions, etc.
- Design or offer interfaces for all partners involved – also for new types of service providers.
- Design special techniques for quality enhancement, reliability and binding force. They support the entire information processing and the information transport. They also monitor the correct behaviour of the subscriber connected to the platform.

In brief: Build electronic markets (see box: 'Definitions').
For designing electronic markets, a growing number of technical, functional or legal standards as well as

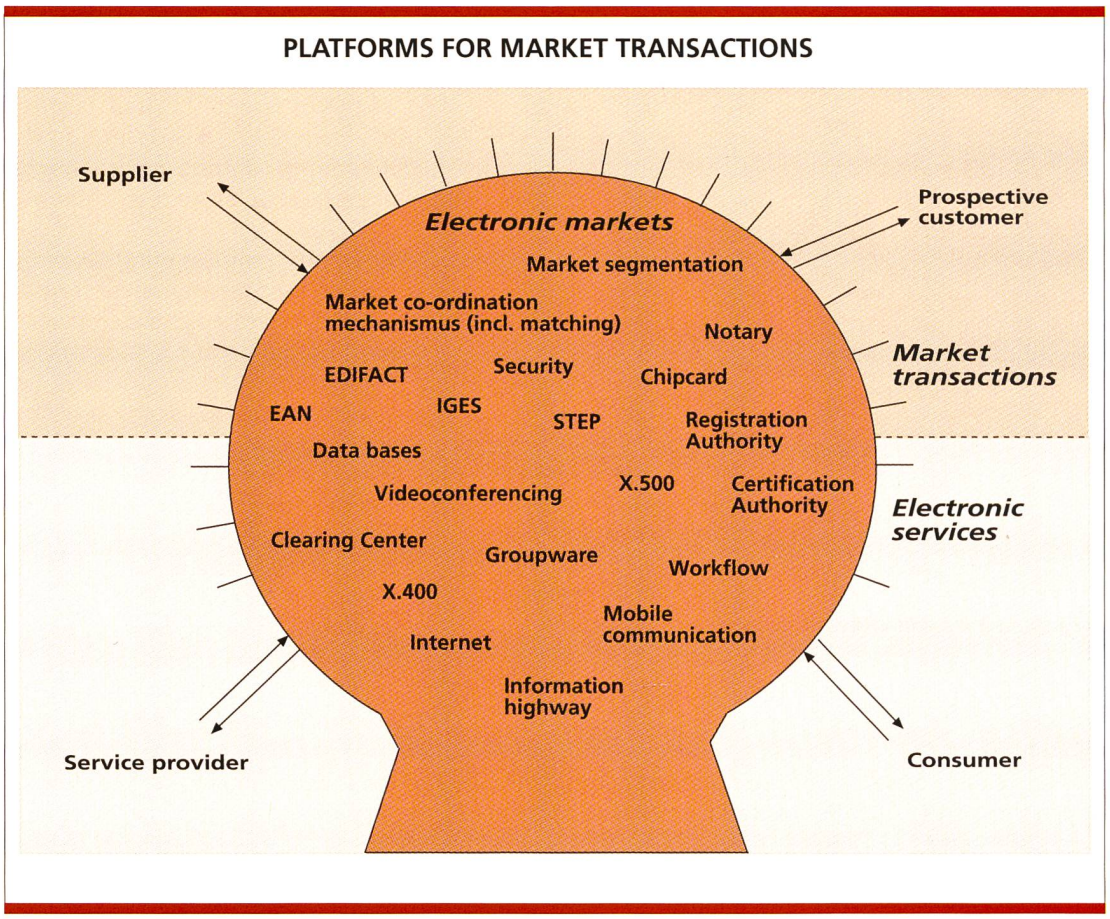

Fig. 11.
Electronic markets are hubs for market transactions or media for providing electronic services.

telecommunication and information technologies are available. Where these do not exist yet, entrepreneurial developments will fill the gaps.

Electronic markets are mosaics that contain many pieces *(Fig. 11)*. In an integral approach, these mosaic pieces are assembled into a comprehensive infrastructure. Most of these have achieved high levels of maturity and acceptance:

- Communication protocols of the future information highway, particularly protocols of the upper layer in the OSI model, such as X.435 for E-mail and EDI services:
  → They are used for worldwide communication (with network gateways and message-handling functions)
- Elements of Internet as a cheap worldwide net:
  → Internet can be considered as some kind of preincarnation of the future information highway. It will contribute some standards.
- X.500 for directory services for addresses and attributes in general:
  → These are used for locating communication partners and the relevant communication characteristics.
- Modern standards for open distributed EDP systems, modern program and data base technologies:
  → These are used for designing market segments, process controls, information offerings, etc., in the electronic market service.
- EDIFACT, IGES, STEP, etc., as standardised forms of messages or product descriptions:
  → They are essential for worldwide intelligibility of the information content and the portability between EDP applications.
- Clearing Centre functions with protocol and document conversion, media conversion in the multimedia world:
  → They help to overcome the lacking openness in communication.
- Functions such as auditing, logging, tracing/tracking, version management, etc.:
  → They ensure the traceability, reliability and binding force of communication and procedures.
- Symmetrical and asymmetrical encryption processes, methods for generation, registration, certification of keys and making them accessible:
  → They are essential for authentication, confidentiality, nonrepudiation, etc., of communication partners and messages.
- Notary functions:
  → These are used for qualifying partners, products, services, etc.
- Possibilities for individual definition of specific standards such as contract specimens, procedural typologies, security concepts, etc., in the EM service:
  → They simplify and structure the practices and consequently the assessability, planability and reliability in communication. Also the legal relevance can be assured in this way.
- Mobile communication methods (for example, telephony or electronic mail on modern portable PCs):
  → They enhance the flexibility and spontaneity of the participation in electronic market platforms.

- Worldwide coding procedures for unique retrievability of products, services, locations, etc. (for example EAN):
  → They ensure the accuracy and the description and communication efficiency.
- Multimedia, workflow, groupware and conference infrastructures for general work support:
  → They allow simultaneous or time/location-independent coordination of cooperations in all areas and in all work phases.
- Chipcard technologies:
  → They are used for handling debit or credit card transactions, security coding (keys, PINs, etc.), personal data (for example emergency medical data), etc.
- New forms of supporting service such as electronic cash:
  → These are used in new forms of funds transfer (netting, factoring) or as transaction guarantees by third parties.
- Infrastructures or interfaces for the outsourcing of information services or for the accessability of new services in general:
  → They provide access to services or functions that would be unaffordable to small companies or individual persons, if they had to build them of their own. They allow concentration of key business activities.
- Fusion of services with complementary elements:
  → They allow the integration of work processes (for example transport logistics, insurance) or the handling of different services via one medium (for example video on demand, information on demand, or software distribution through electronic market).
- Assistance by means of artificial intelligence, hypertext, hyperlink, or data bases in general, etc.:
  → These assist in the formulation and handling of needs or in the pinpointing of relevant information in general.

Theoretically all goods or services can be communicated or traded via electronic platforms. Products with a simple description and frequent utilisation are generally better suited. Business with intensive computer utilisation accept corresponding services more quickly.

Additional examples

A variety of EDI applications for entire sectors of our society is emerging. In the assessment of such new technological worlds, two facts are recognisable:
First fact: The new technological worlds often have multiple interfaces. When activities are conducted in one area, other areas can be accessed at any time. Typical examples are:
- spontaneous utilisation of an electronic market in the production process, for example for purchasing resources or selling excess products or capacities
- access to freight-poding service, distribution centres, city logistics infrastructures during the goods logistics
- utilisation of published recycling capacities for the disposal of waste materials

The existing infrastructures which have characteristics of electronic markets are being improved or interlinked. New electronic markets will develop. Modular elements of the one can also be used by the other. Segmentations, procedures or information support are generally very similar. Major scaling effects can be achieved through integral development approaches, from which not only the service operators but also the users will benefit.
In principle: Networking and integration of social activities and cycles will become more recognisable and easier to handle.
Second fact: New technological worlds are in development in almost all areas of human activity.
There are many examples where a carefully conceived systematic implementation of communication techniques can be of value:
- research cooperation in medicine, environmental technology and similar fields
- utilisation of the personal chipcard for fast access to medical data (patient history, allergies, treatments) in emergency situations
- infrastructures for enhancing the quality of life of disadvantaged or handicapped persons
- interactive multimedia communication infrastructures in private households
- cooperation of communities and nations in all their fields of responsibility (motives such as prosperity, security, synergy exploitation)
- environment observation and management
- electronic forms of systematic information distribution (interactive television, video on demand, information on demand)

COMMENT

The EDI concepts presented here are at different levels of implementation. Some are nothing more than ideas, whereas others are fully 'assembled down to the last screw'. One thing is sure: the visions and goals are recognisable and tangible. The processes of economic innovation and social renewal are in progress. The resulting infrastructures and activities will be an important element of the dawning information age.

Change as an opportunity and risk

The transition to EDI as well as the continuous evolution of EDI imply changes. Changes always involve opportunities and risks. It does not suffice to simply grasp their technical and functional dimension. Also the question of economic, ecological and social ethics are of central importance. The key issue is responsibility, which permeates the entire concept: responsibility in technological research and development, in business, in jurisprudence as well as politics. This responsibility can only be met through an integral approach, which, in view of the rapid development, must be taken now.

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