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10. The introduction of networking technology in organizations: Increasing freedom and control

Abstract

This paper discusses the role of networking technology in modern organizations. The term 'networking technology' refers to tele-transaction systems (e.g. EDI), tele-information systems and tele-conversation systems (e.g. e-mail; and video-conferencing). The interaction between characteristics of networking technology and developments in market relations is discussed. Networking technology appears to support the market-induced trends of both individual empowerment (increased professional autonomy, access to information and widening relations) ánd growing external control. Monotony and bureaucracy are making place for ubiquitous access and stress. The new freedom implies loss of power.

Introduction: The Hydrautech case

Hydrautech is a high tech, medium sized (ca. 200 employees) company in the east of the Netherlands. It produces among other things hydraulic systems for the automotive, health and other sectors. Major products include hydraulic tilt systems for truck cabs and hydraulic systems for hospital beds. These products are assembled at the Hydrautechplant, from parts provided by local suppliers and manufacturers. Hydrautech is part of a US-based holding.

The companies for which Hydrautech produces the hydraulic systems, particularly the companies in the automobile sector, have been and are under extreme pressure of market competition. They have been forced into a major redesign of the production process, implying among other things doing away with large stocks, producing largely on the basis of existing orders and a just-in-time logistics system. While in earlier times, for example, they would send a large order to Hydrautech for a few types of hydraulic systems every six months, nowadays they send a small order or specifications to an earlier framework order twice a week. The variation in required types of products has also increased enormously. Sending orders and invoices at this frequency can only be done efficiently and accurately when using electronic systems for 'Electronic Data Interchange' (EDI). EDI implies the automated exchange of standardized messages between computers. The automotive industry has developed standardized message-types and uniform product characterizations. Organizations participating in such a network obtain the highest benefit of such a system if the data can immediately and automatically be fed into or be produced by their computer systems. Typing orders arriving by electronic mail into the company computer means double work.

Several years ago Hydrautech was required by customers in the automotive branch to develop EDI-links and to adopt the standard message system existing in that branch. Being a high tech and innovation oriented company this process was taken up by Hydrautech. They had a considerable know-how concerning computer systems and logistics and adequate staff to support the new approach.

The production process at Hydrautech is limited to assembling parts produced by a range of suppliers. The pressure towards a higher effectiveness of Hydrautech was translated into a project aimed at EDI-fying the communication with their own suppliers. With the help of Hydrautech's know-how and a government subsidy, an EDI network was developed between Hydrautech and their seven major suppliers. As a result, logistics processes both between the automobile companies and Hydrautech, and between Hydrautech and its suppliers, are nowadays electronically supported and therefore much faster and with less errors than previously. Hydrautech, its custo-

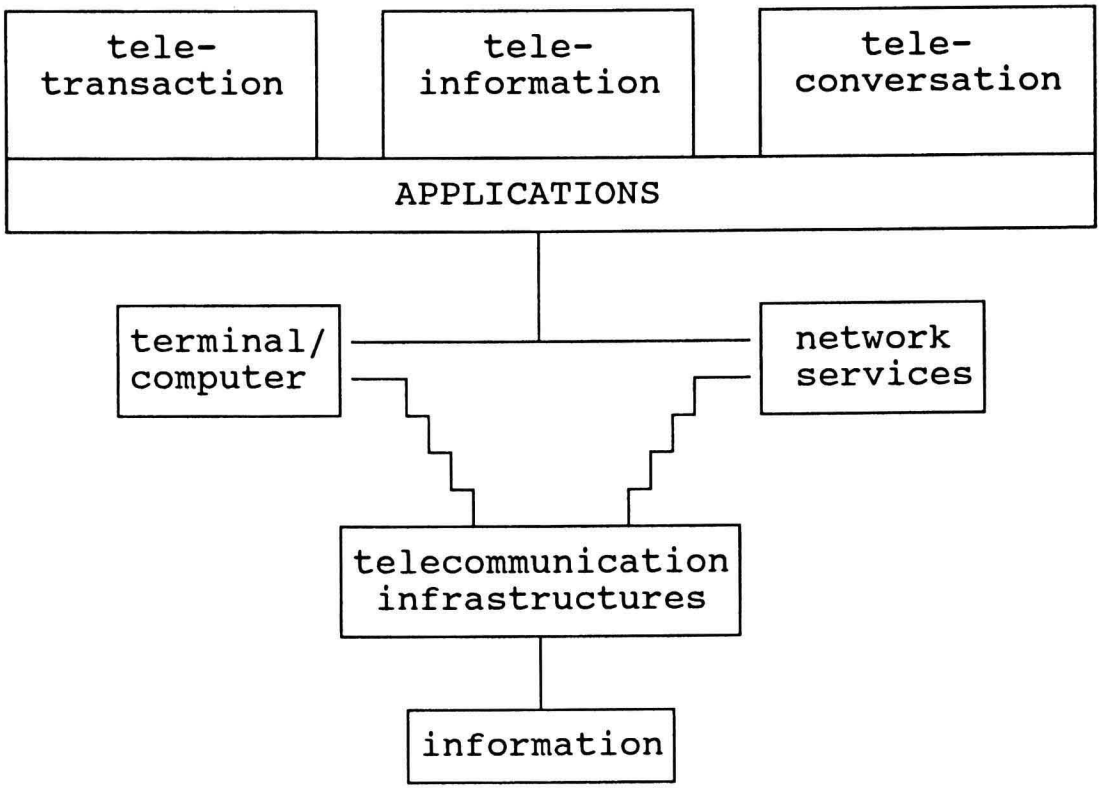

Fig. 1. The field of electronic communication systems

mers and suppliers, form what Miles (in this volume) calls a 'stable inter-organizational network'. Transfer of knowledge to new personnel also becomes much easier because idiosyncratic handling of information exchange is done away with.

Hydrautech has not only introduced EDI but also other forms of networking technology. A videoconferencing unit is available for frequent distance-meetings with the USA-based holding management. An electronic mail network links most of the employees in the dutch and other european sites of the company. These systems support the increased coordination needs of staff and management at the various sites of this geographically widely distributed company. Management and staff of Hydrautech are enthusiastic about possibilities provided by the technology. Access to colleagues and to the other holding partners in the USA and Europe have been made much easier, information exchange and decision-making became much faster than before. However, despite this feeling of 'opening horizons' they, at the same time, experience a loss of control as major decisions are made externally.

What is the role of networking technology in these developments? In this paper the implications of the introduction of networking technology for work organizations are discussed. First, a short overview of networking technology and its applications will be given.

Networking technology

Many people have daily experiences with networking technology: electronic mail (E-mail), telefax, tele-shopping, tele-banking. Soon we will have interactive tele-vision, video-confer-

encing, telework, tele-education, etcetera on a broad scale. Networking technology actually consists of several layers of components (figure 1) i.e.:

- the tele-communications infrastructures (e.g. PTT networks on cable or mobile, satellite systems, relay centres, ISDN etc.),
- intermediate or network-services (e.g. telephone net, datanet, and services such as videotex),
- the more or less intelligent terminals (telephone, monitor, computer)
- specific applications such as electronic mail application or an information service.

The last element in the system is the information coming from all kinds of information sources. Often each of these constituent elements is provided for by a different company. The actual use of a certain service such as an electronic mail service or an EDI system requires the cooperation of several partners, e.g. a national PTT, hardware and software producers, an e-mail (or EDI-) network provider and the company's employees and/or computer files as sources of information (see e.g. Slaa, 1994).

At the level of applications a further distinction can be made between (Andriessen, 1991):

- tele-transaction systems – data exchange between computers.
- tele-information systems – data exchange between human and computerized information source,
- tele-conversation systems – mediated communication between humans.

Although the term 'system' suggests a sharp distinction, in practice these applications may be integrated and accessible from the same workstation.

Tele-transaction systems. This category refers to systems supporting the exchange of standardized logistics or administrative data between (parts of) organizations, sometimes called computer to computer (or better: application to application) communication. It can be considered as interorganizational automatization and is often referred to as 'Electronic Data Interchange' (EDI).

An enormously rapid increase in the use of transactions between firms via EDI systems for the electronic exchange of standardized administrative data can be observed. Doing away with the repeated filling in and filing of forms means a great improvement in efficiency.

Tele-information systems. Systems to support human to database communication can take two forms, depending on who takes the initiative (Bordewijk and Van Kaam, 1982):

- tele-information systems: through information systems large databases become available; if these systems do not only provide general information but can also provide personalized 'advice' for example because the data are organized as an expert system, they may be called 'tele-consultation systems'.
- *tele-registration* systems through which central databases gather information from humans or from non-human sources: tele-surveys, tele-ordering, tele-shopping, tele-banking.

These systems are already widely used. Almost every industrial sector has its share of more or less publicly accessible databases and tele-ordering systems.

Tele-conversation systems. Systems to support mediated communication between humans can be distinguished on several dimensions. Very important is the difference between unilateral and bilateral communication:

- unilateral information distribution to an audience, called 'allocution', e.g. radio broadcasting, or company video;
- bilateral exchange of information, with the function of coordination, and cooperation in human activities in organizations; examples are services for electronic mail, computer conferencing, voice messaging.

Secondly, the difference between synchronous ('real time' such as telephone, video) and asynchronous systems (e.g. e-mail, voice mail) is relevant for human interaction.

For practical reasons it appears to be fruitful to distinguish three groups of systems:

1. Electronic message systems (asynchronous), i.e. a) the relatively simple systems for fax, electronic mail, voice mail,, and b) the complex multi media systems (which combine e.g. text, voice, graphics and images).
2. Audio/video systems (synchronous), i.e. both the two way telephone and videophone, and multi point audio and video conferencing systems. Recently, various mobile telephone systems have become popular.
3. Cooperation supporting systems (potentially both synchronous and asynchronous), i.e. complex systems with many functions, supporting coordination and decision-making in more or less distributed groups of people, e.g. Group Decision Support Systems. Most systems are still in the experimental stage.

The afore-mentioned technical applications are interesting from an organizational point of view because, increasingly, they support new work arrangements: such as Tele-teamwork, Telework, Mobile work. Also, new organizational forms are developing based on this technology. The fastest growing form is the inter-organizational network based on electronic data interchange (EDI).

Effects on interaction

The above mentioned applications of networking technology are introduced because they are expected to provide faster communications at a distance, permanent and better access to information. Indeed, e-mail and computer conferencing increase the possibilities of communication of people who are already in contact with one another. Moreover, they also foster the growth of new contacts and groups (Andriessen, 1991; Van Veen, 1993). Because a widespread exchange of information becomes possible where nothing existed before. Both effectiveness of organizational communication and efficiency are increased. Individuals and groups who are far apart geographically, and who work asynchronously, can now interact and coordinate their activities effectively (see also Andriessen and Van der Velden, 1993). Since the Gulf war, when suddenly international travel became dangerous, video-conferencing is booming. Both professional teamwork and top management coordination are strongly supported. Through these media the necessary flexibility in organizational collaboration can be enhanced, despite spacial and time constraints. Moreover, through mobile telephones and portable computers a growing number of employees can now become mobile and work more or less regularly outside the confines of their organization, either at home or elsewhere. Many of these changes are accompanied by a 'fading of boundaries', i.e. traditional bureaucratic boundaries are disappearing or becoming less relevant: boundaries between functions, between departments, between geographically distributed workplaces, between continents, between private and working life.

Since EDI is a system to link organizations rather than a system meant to link individuals, its effects are most prominent at the level of organizational functioning. Nevertheless effects of the introduction of EDI systems on the organization of work can also be found.

Boonstra (1994) studied the introduction and effects of EDI systems supporting the logistics in supermarket chains. Via EDI, information about sales, stocks and orders is exchanged between a central organization and chain stores, or a central organization and franchized stores.

The effects on the organization can be quite varying. A major differentiating factor appeared to be the general management strategy, oriented towards centralization or towards decentralization. The latter trend dominates in the Hydrautech company, where employees tend to become more responsible for interpretation and management of data and production flow than for correct data entry and filing. Workflow processes tend to become more process oriented and less department or function oriented. This is also found in other studies

(e.g. Dijkstra and Van Niekerk, 1991; Van Halem, 1991).

Many of these implications appear to be quite positive from a quality-of-work-and-organization point of view: the breaking of bureaucratic barriers, access to information, enriched jobs and less hierarchy. However, there is a second part to the Hydrautech story, which points to a reverse side of the coin.

Hydrautech, part 2

The introduction of EDI was to some extent imposed upon Hydrautech by the automobile companies. Hydrautech itself is an innovation oriented company with the experience, staff and intentions to use informatics applications to support its logistics and other processes. The company could therefore deal with the external pressure adequately.

The majority of Hydrautech's suppliers, however, consists of small firms with limited expertise concerning computer systems and hardly any staff to organize the introduction of EDI. Nevertheless, they had to go along with this project if they wanted to remain supplier of Hydrautech. The help from Hydrautech and the government subsidy made the project less burdensome, but the change-over from the traditional situation was quite difficult. This change did not imply developing and purchasing soft- and hardware but often also changing the internal logistics process, and automating the administration. This, in its turn, often required newly trained personnel and, in most cases, the lay off of clerical and warehouse personnel. Typework and data entry was replaced by monitoring and file control. The remaining clerical staff felt a loss of control because they now had to do everything via the computer and no longer 'see the invoices and feel the orderbook in their hands'. Whether the companies involved liked it or not, they had to go along with all these changes.

Another major problem both at Hydrautech and in the small supplier firms is the increased intensity and uncertainty concerning interaction between customers and suppliers. Orders have to be processed in a very short time, the variety of specifications is steadily increasing, and the threat of loosing orders when not living up to the requirements is becoming greater. Management and staff are under heavy pressure to meet short term deadlines. Since the stream of orders varies quite strongly Hydrautech decreased the number of permanent employees and developed a pool of temporary contract workers that can be hired on short notice. In several of the supplier firms the same occured.

What we see here is not only the 'normal' lay off of personnel through automation. More remarkable is a dual development of, on the one hand, an increase in horizontal communication, disappearance of bureaucratic boundaries, wide access to information, and, on the other hand, increasing control and pressure, more dependencies, more stress. Some of these trends are the result of the technology introduced, others of the context. The analysis in the next sections will illustrate this dual effect.

Decision-making

Hydrautech, its customers and suppliers, are in a situation in which many other companies find themselves. Increasing competitiveness forces organizations to become both more efficient and more flexible. They shorten time-to-market of their products, reorganize logistics processes, decentralize decision-making and internationalize production processes.

An illustration of this last trend are companies that relocate some of their information handling processes to countries with lower wages such as Eastern European countries or the far east. An example is the dutch software company Cyco, which has established a small subsidiary in one of the russian research cities. Russian programmers develop software modules according to the specifications given by the dutch system developers. Coordination is realized through telephone and electronic mail, while the feasibility of a videoconferencing facility is presently studied.

Communication, coordination and information exchange in and between decentralized and distributed organizations becoming much

more complex. Networking technology is expected to solve this problem. National and international governments (such as the European Community) try to influence these developments through subsidies, platforms, standardization committees and (inter)national rules. They aim at the breaking of national monopolies and at the same time for the protection against competition from other parts of the world. The various networking applications, however, follow quite different paths and have different implications. This can be illustrated through the Hydrautech case.

Direct external pressure. The Hydrautech case illustrates an important development in the relations between organizations: Larger or more powerful organizations force smaller and dependent firms to adopt new technology for the exchange of logistics information. EDI must be introduced and specific standards must be accepted. If these smaller firms do not follow, the supplier status will be terminated. The Hydrautech case is not an exception. A recent study (Schultz, 1994) showed that the same has happened in several networks that adopted EDI systems.

The Hydrautech case also illustrates the fact that the introduction of EDI is not the prime originator of increased dependence. It is the market pressure to cooperate, not only at operational but also at a tactical or even strategical level that binds organizations together, no matter which technology is involved. On the other hand, EDI systems themselves can also be more or less 'binding', depending on the type of protocols and hardware chosen (Ekering, 1992). This choice is often made in supra- or inter organizational bodies.

A major problem concerning networking technology and applications is standardization. The existence of many different type of systems, protocols, machines etc. prevents easy connectivity between individuals and between organizations. In itself this is not a disaster. However, the consequence is that when different organizations decide to exchange data or messages electronically, they often have to agree on mutually accepted detailed protocols concerning message-type, channels, information categories and all the other earlier mentioned levels and elements of electronic messaging. International organizations have developed standard protocols (e.g. the OSI layer model) and standard message formats (e.g. EDIFACT). However, worldwide acceptance is still a far cry and even the same standard, such as EDIFACT, allows for many varieties.

In the EDI world three types of EDI systems are distinguished:

1. closed community systems, i.e. a standard developed by a few business partners, that have their own EDI network.
2. open community systems, i.e. a standard for e.g. an industry or sector; all organizations in that industry or sector can join the system, but it is not open for everyone outside the sector.
3. global systems, i.e. world wide standards.

Many EDI network are (closed or open) community systems with specifications geared to their own purposes. The consequence is that network partners are bound to each other, or rather, the weaker partner is bound to the stronger one. The dependence of certain partners on others increases, even apart from the existing market relations.

Several reasons for this dependency can be given:

- partners have to develop many detailed procedures for the interaction.
  This development process appears to be quite difficult as representatives of diverse organizations need to agree on precise protocols, such as concerning message types and product categorization (Schultz, 1994).
- development of such networks with separate groups of partners is very difficult.
  Whereas previously a small electronics firm could choose between several retailers when placing a particular order, the development of an EDI network with a particular retailer practically monopolizes his purchases.
- switching costs become greater.
  To switch from one supplier or customer to another one is quite expensive if this im-

plies developing a new electronic network application.

It is not uncommon that organizations are forced by the market or by the parent organization to take certain decisions. However, the development of organizational networks supported by networking technology adds a new dimension to this issue. The boundaries between organizations are permeated to a new degree, the development of an effective network requires uniformity and agreement concerning all kinds of details of the production and work process and decisions concerning these issues are taken at levels over which the individual firm has little control.

Indirect external pressure. In other cases the introduction of networking technology is not a matter of direct external forcing but of indirect self-pressure. Although many firms cannot draw upon a clear cost-benefit analysis, they feel more or less forced to adopt networking technology, because they are afraid to be out of competition if they do not join the crowd. This applies not only to industrial companies but also to organizations in service or other sectors. The introduction of a digital (radiological) 'Picture Archiving and Communication system' in an academic hospital is also an illustration of this phenomenon (Andriessen, 1994). Small wonder that in many cases the cost-effectiveness appears to be much lower than expected and the development process is often full of misery.

Internal pressure. At the same time that organizations are forced from outside to invest in networking technology, they are 'forced' from inside to adopt other types of such as electronic mail systems or new PC-applications. Although this is a less explicit power game it is again not a planned and strategically chosen process. E-mail systems are often introduced as an addition to larger information systems. Nowadays it is fashionableto have E-mail at every workdesk in administrative organizations, even if it does not support the work processes. Van Veen (1993) did research in several large organizations and came to the conclusion that in some of these the E-mail system was nót a real support for the communication processes. Nevertheless, the computer freaks in the company start using E-mail for sending messages to each other. The same applies to certain new text processing-, CADCAM-, database- or other computerprograms. Higher level management is quite often confronted with a plethora of applications which are not compatible, cost a lot of money and all have their separate champions. The employees, who are first persuaded by their freak colleagues to use that ultimate system, are soon forced to adopt a new update every few months.

Workers participation. The evidence of the Hydrautech case and other material (e.g. Streng, e.a. 1992) shows that both in small and large organizations certain decisions – such as the introduction of networking technology and concomitant organizational changes – are increasingly forced upon the organization from the outside or from the work floor. The importance of the formal level of strategic decision-making, i.e. the company level, where management and workscouncil or union representatives exerted their influence more or less explicitly, appears to be decreasing steadily. Not only the role of management, but also of workers representatives in unions or workscouncils becomes limited.

A few years ago the Dutch trade union federation made an extensive study of the development of a large EDI-type electronic information exchange system called Cargonaut. It links the majority of companies involved in air-freight to and from Schiphol, the major Dutch airport. Data concerning freight items are exchanged between airline companies, cargo handlers, trucking companies etc. The development of Cargonaut, and the choice of the characteristics of the system, was largely controlled by supra-company bodies. They made decisions in which neither the company works councils nor the sectorial unions were or could be involved. Individual companies had the choice to team up with the system or not, but non-acceptance probably meant that the company would soon be out of business (Van Halem, 1991). The conclusion of the trade union federation was that their role in the development of networks would probably be minimal,

although the potential impact on the organization of work could be very important.

Effects on the quality of working conditions

Roughly speaking, two types of development have been traced. On the one hand there is the development of electronic logistics systems linking work places and companies. The effect on working conditions is to a large extent dependent on the level of internal company automatization. On the other hand tele-conversation systems are rarely considered to be strategic issues and in the beginning often only pushed and used by certain professionals. Users often appear to be enthusiastic about these applications, because they open new channels of direct communication. These effects, however, are not the only ones. Network technologies serve the coordination need of organizations, including the often dysfunctional but irrepressible need to monitor the behaviour of employees. This means that tele-conversation systems are also used for worker surveillance. Camera's in the workplace, telephone tapping and E-mail checking by supervisors are becoming common place. The same applies to the development of mobile communication systems and home applications. The modern trucker can be contacted permanently by his fleet manager, the modern office worker can permanently be traced through the 'active batch' in his pocket which shows his whereabouts to anybody in the building. The modern manager has telephone in his car and a fax and E-mail added to his home telephone. All these applications demand immediate response, overriding other activities. This is even more important because products can now be delivered 'just-in-time', before the deadline. These applications can represent a growing pressure on the user and on his environment. Increased attainability at work, in the car or at home implies that employees are accessible and on duty 24 hours a day. Through these systems employees are tied to a production system and to market dependencies, which imply frequent order changes, tight deadlines and permanent alertness even stronger.

The management of Hydrautech is enthusiastic about the way the company reacts to changing market relations. They are proud of their modern hi-tech communication system, which allows for intensive interaction with colleagues all over the world. However, they are afraid at the same time that this will go on and on, and never allow any relaxation'.

Conditions

The intensity of use and the effects of networking technology depend on various factors. The following two dimensions – related but not identical – are of great importance:

Indirect vs strategic introduction

The introduction of a tele-matic system is propagated as a strategic choice to gain competitive advantage. 'Tele-communications can be harnessed as a major new force for organizational design and redesign, and all large organizations need to exploit the opportunities it opens up' (Keen, 1988). However, at least most tele-conversation systems are not regarded as such, and even large scale EDI systems are sometimes considered by management as a necessary, but not a strategic issue. Among the cases studied by Van Veen (1993) several organizations had introduced E-mail as an add-on to other automatization systems. In those cases the use and success of the E-mail system depends among other things on geographical distribution, task dependency, critical mass and adequate integration with other computer tasks. According to Van Veen, the same applies to other tele-conversation applications.

However, when networking technology is introduced for strategic reasons, the probability that it will be used intensively is high. Many cases of the introduction of transaction systems belong to this category, and also some concerning E-mail systems. Van Veen (1993) studied an international trading company where the E-mail network between its agencies all over the world was seen as the very backbone of the company and was widely used and appreciated.

Bureaucratic vs organic organization culture

Many studies testify to the fact that the prevailing organizational culture and management philosophy are highly relevant to the introduction, the use, or the effect of new technologies. Amongst many others Zuboff (1988) and Ciborra and Lanzara (1994) report about a company were the use of E-mail and computer conferencing was curtailed by management, because they began to feel that they were losing control of ongoing communication. A similar phenomenon is often reported as the reason why telework is not accepted. Many managers who controll their workforce by direct supervision cannot (or dare not) switch to 'management by objectives', i.e. control on the basis of output.

In contrast with these examples there appear to be cases in which e-mail and conferencing systems are widely and rather unrestrictedly used with considerable success, because of a management strategy of maximum openness and personal networking. Various other examples show the same phenomenon happening in large computer firms (e.g. Skyrme, 1989) and in certain French industries (Cambra, 1987; Craipeau, 1991). These findings indicate that the innovative benefits of networking technology can only be reaped in (parts of) organizations with a culture and structure that is characterized by de-bureaucratization and by 'organizational learning' (Köhler, 1991).

Conclusion

Networking technology, and particularly interpersonal conversation applications (E-mail, mobile telephones etc.), allow for faster and more efficient horizontal communication. They enhance the breakdown of bureaucratic rigidity in organizational structures. They provide users with a easier access to people; company wide or even world wide. The results are increased connectivity, availability of information, ubiquitous attainability and individual empowerment. This however implies a possible threat. Users are not only the subject but also the object of this access, not only the initiator

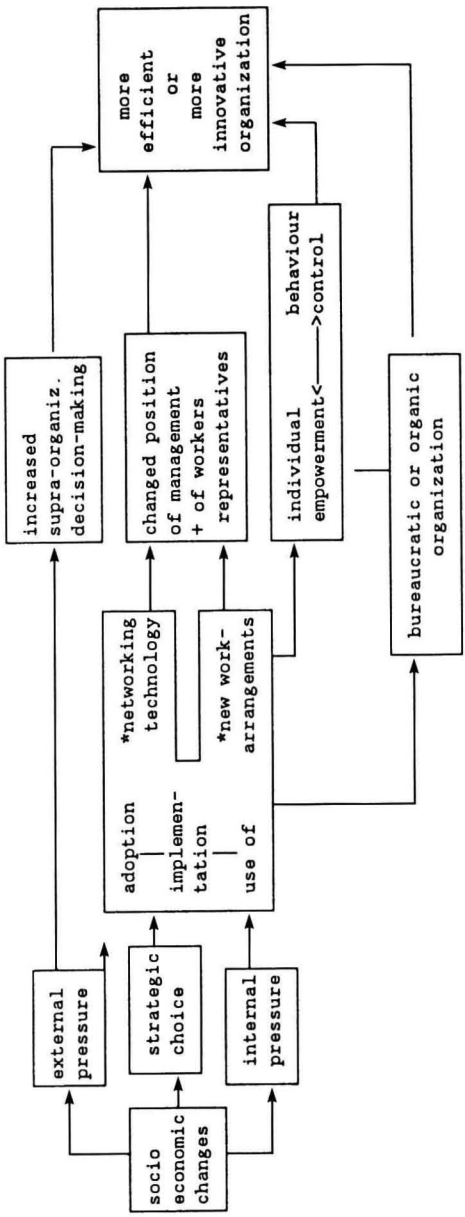

Fig. 2. Choises and consequences of telematic applications in work organizations. A model

but also the victim of permanent contact. Electronic transaction systems are introduced to support the interaction and dependence between organizations. They allow for a much more efficient exchange of information, but also for 'just-in-time' relations which capitalize on permanent flexibility, alertness and control.

Introduction of such a system warrants very careful decision-making within the organization based on comprehensive cost-benefit analysis. However, it is the very nature of networking technology that the centre of decision-making is external to each of the individual participating organizations.

Traditional boundaries are fading, organizations become (more) decentralized, individual autonomy is increasing, more and more contacts and information are within direct reach. These are partly the intended and partly the unintended results of certain networking applications. But at the same time new organizational dependencies are growing, diffuse external decision-making is replacing internal control, market conditions require a permanent just-in-time culture and communications technology make people alert twenty four hours a day. Through networking technology individual empowerment and increased control are both enforced *at the same time*. The actual outcome depends on organizational strategy and culture (see figure 2).

In the past we have been analyzing and fighting loss of power in, and loss of control over the work situation through monotonous work, lack of autonomy, bureaucracy and isolation. We have been fighting under stimulation, skill under utilization, and alienation. This threat as smaller and smaller, because the number of employees in such situations decreases. A major research question is now: Are we facing a new type of loss of control through new interdependencies, connectivity, access, information and stress?

Is networking technology a blessing or a curse? This paper shows that that is the wrong question to ask. Market relations and networking technology push for both freedom ánd control. The issue is to design work-situations-with-networking-technology in such a way that the criteria of societal survival, organizational effectiveness, personal growth ánd personal stability can be realized.

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