

Technological and Organizational Innovation: A Dilemma of Fundamental Change and Participation

Jaap J. Boonstra

*Organizational Studies, University of Amsterdam,
Amsterdam, The Netherlands*

Maurits J. Vink

SANT Management Consultancy, Amsterdam, The Netherlands

This article proposes sociotechnical system theory as a framework for analysing the relationship between technological and organizational innovation and as a tool for managing change as a process of organizational learning. The article focuses on the barriers to change and the way in which the dilemma between expert design and participatory development is approached. The technological and organizational innovation in an automated clearing house for payment transactions has been used as an example. The longitudinal case research focuses on the dynamics of change and illustrates the importance of learning processes during the innovation to realize flexibility and innovative capacity within the organization. The article concludes that sociotechnical system theory provides a basis of knowledge for redesigning organizations as well as developing organizations by learning processes. It indicates six barriers to technological and organizational innovation and offers a perspective on how to integrate design strategies with a participative learning strategy for fundamental change.

INTRODUCTION

An understanding of the development and implementation of technological and organizational innovations is crucial, given the importance of these innovations to the improvement of labour and work processes in organizations. The development and introduction of new information technologies are directly related to changes in business strategy, the flow of information, and the design of business processes. Technological development also creates the potential for new choices in work organization and the quality of working life (Child & Loveridge, 1990; Walton, 1988).

Influenced by technological innovations and higher market demands, organizations strive to enhance their flexibility and ability to innovate and to

Requests for reprints should be addressed to J.J. Boonstra, Organizational Studies, University of Amsterdam, O.Z. Achterburgwal 237, 1012 DL Amsterdam, The Netherlands.

increase their learning capacities. The traditional organizational paradigm of maximal division of labour is increasingly abandoned. Attempts are made to break with the functional structuring of organizations by redesigning business processes on the basis of customers or product flows. Within these flows, self-managing teams are formed. These teams integrate operational tasks with planning, support, and control activities. The teams are to a certain extent autonomous and are expected to improve the execution of assignments while learning (Cherns, 1987; Herbst, 1976).

The realization of technological and organizational innovation is a complex change process and many organizations do not attain the desired outcomes. A possible explanation for these failures can be found in the approach of the change process. Fundamental organizational change tries to create flexible organizations with a high innovative potential, but at the same time most of our organizations lack the learning capacities that are needed for innovation. So, what are the barriers to complete transformation of business and how can traditional organizations learn to become learning and innovative organizations?

A dilemma is that an expert design approach permits a far-reaching break through innovation but it neglects the development of learning capacities, whereas a participatory development approach gives way to learning but the drawback is that it allows participants to fall back to conventional and fragmental solutions in their thoughts and deeds, while innovative and completely new ideas are needed.

This article examines the barriers to technological and organizational innovation and explores the tension between expert design and participative development. In the first section, the relation between technological and organizational innovation will be conceptualized in a system theory of organizations. It will also consider the way in which fundamental change is achieved by business process redesign (BPR) and sociotechnical system theory (STST). The second section presents the results of an in-depth longitudinal case study. The relations between business strategy, information technology, work organization, and the quality of working life will be made clear. The focus of the study is to examine the barriers to change and the way in which the dilemma between expert design and participatory development is approached. In the third section we present some lessons for realizing technological and organizational innovation.

THEORETICAL FRAMEWORK

System Theory of Organizations

For technological and organizational innovation and the integration of change to take place, some unifying framework is needed to guide the process. The open sociotechnical systems theory offers such a framework.

Organizations are viewed as open systems. The production process takes place within socio-economic exchange networks between the organization and its environment. Economic, technological, and social developments form a complex of more or less structured situations that affect the organization and influence its functioning (Emery & Trist, 1965). Interactions take place between the organization and stakeholders within the transactional environment (Ansoff, 1985; Freeman, 1984). In order to survive, an organization has to respond adequately to changes in the environment and the relations with stakeholders. The environment of many organizations is becoming more complex and changes occur at an ever increasing pace, compelling organizations to develop a more flexible and innovative work organization.

The sociotechnical perspective considers every organization to be made up of a social and a technological aspect-system. People working together in an organizational context (the social system) are using information systems, tools, techniques, and knowledge (the technical system) to produce a service or product valued by the environment (the environmental system) (Emery, 1959; Pasmore, 1988; Trist, 1982). The social and technological aspect-systems interact continuously and are inclined towards a dynamic equilibrium in relation to the environment of the organization. Change in one aspect-system directly affects its relation to other aspect-systems (Pava, 1986). The ability of each of the systems to adjust means that the organization forms a flexible system capable of adjusting to environmental changes.

The sociotechnical system theory provides a useful framework for assessing the system-wide implications of information technologies (Shani & Sena, 1994). Compatibility between the technical and environment aspect-systems requires that new information technologies are effective in meeting the needs of the stakeholders. Introducing new technology inevitably requires a redefinition of the relationship between the organization and the environment through adjustment to business strategy. Compatibility between technical and social aspect-systems implies that a balance must be struck between the new information technologies with the social aspect-system to accommodate the requirements of the new information technology (Clark & Staunton, 1989).

Technological and Organizational Innovation

The introduction of new information technology in organizations will involve the development of new ideas about technical and social processes and is related to business strategy and business processes. This perspective contrasts with technological determinism in which technology determines the social aspect-system and organizational choices cannot be made on how to relate the technological and social aspect-systems (Turner & Lawrence, 1965). Swan and Clark (1992) debate that cognitive processes and decision making are important in the process of innovation and the choices to be

made. A question is how the existing organizational paradigm influences the decision-making process on technological and organizational innovation. Weick (1990) argues that people design technology and organizations in keeping with their perceptions and explanatory frameworks. This viewpoint is subscribed to by Child and Loveridge (1990). In a study on information technology in European services they concluded that the opportunities offered for organizational innovation by information technology appear to have been realized very frequently; only occasionally had substantial change in organizational design and tasks structure been introduced. This lack of novelty might be attributed to a delayed process of organizational learning in which existing perspectives continue to dominate. There seems to be a process of organizational conservatism that is shaped and bound by forces of a social and political nature in the sense that those involved have a concern to preserve organizational arrangements with which they are comfortable. Traditions that are long-established and have institutionalized into bureaucratic structures, and strong cultures as a means of ensuring predictability, support the prevailing systems of the division of labour.

Realizing strategic, technological, and organizational change is a difficult process and a lot of efforts fail to realize the objectives. Beer (1988) gives reasons why broad change programmes fail. First, programmes seem to be unidimensional and do not change the technical and social aspect system at the same time. In addition, programmes are seldom targeted at behaviour. Second, programmatic changes are often not connected to the most pressing problems experienced by employees. At best, the programmes are a response to a general diagnosis of business problems. This makes it difficult to learn from earlier experiences and to translate the general themes into action. Third, the programmes are often initiated and managed by top management and experts. This top-down and expert character makes it difficult for employees and line management to feel committed. Swan and Clark (1992) indicate that particular problems occur when employees have inadequate knowledge bases and have conflicting ideas about the chosen innovation. Knowledge and cognitions are important in the innovation process. Organizational as well as technological knowledge bases are important to decisions about technological innovation because its appropriation requires a blending of technical systems with organizational procedures and practice.

Design Perspective on Organizational Change

The term business process redesign (BPR) is often used when redesign of strategy, information technology, and organizational processes is concerned (Davenport, 1993; Hammer & Champy, 1993). In essence, BPR is a fundamental rearrangement of business processes enabling information technology to realize reduction of costs, increase of profitability, and enhancement of performance in quality, service, and speed.

The design philosophy of BPR concerns the radical redesign of business processes. Business processes are rearranged on a customer or product basis. In the customer- or product-oriented process design, process segments are placed in a natural sequence. Teams bear the responsibility for the execution of tasks within a segment and are held accountable for measurable results. Frequently, separate teams are formed for innovation, planning and preparation, and execution of tasks. The operational teams are confronted with an elaborately modelled and automated production method. In the application of redesign principles in the service sector, a distinction is often made between a front office for direct interaction with customers and a back office for administrative processing. In the front office the task is to inform the customer quickly and adequately. Information technology enables decision making while the customer is served. In the back office all activities suitable for automation are subsumed. The technological governance of the work process results in a situation in which people have little influence over their own actions and in which they face considerably increased expectations with respect to their work pace and output. Teams are expected to contribute to the enhancement of a more efficient production method.

The organization of the redesign process is primarily a task of the management. Top management contributes to the motivation for change and is responsible for the designation of goals and the allocation of means. Teams of line managers are responsible for the design of sub-processes. A steering committee of managers develop the strategy for the change process and co-ordinate the course of events. Consultants support the entire process with techniques and resources (Harrison & Pratt, 1993). In the design methodology a number of stages are distinguished. Teams of managers analyse business processes and circumscribe performance criteria for the redesign. With the consultant's assistance, a perspective is developed on the organization of business processes. The analyses of the teams are combined into a blueprint for the organization form, the appropriate technological architecture and information systems. The new organization form is implemented by the line management. Communication about the importance of the new design is seen as a success factor for change. Pilot projects and training programmes could illustrate the significance of change. Finally, team-based activities are built into the entire organization in order to replace conventional management methods (Guha, Kettinger, & Teng, 1993; Harrison & Pratt, 1993).

Development Perspective on Organizational Change

The development perspective on organizational change is based on socio-technical experiences. The sociotechnique was initially preoccupied with the criteria for the design of tasks on an individual or group level. The purpose of this redesign was an improvement of organizational effectiveness, an

improvement of the quality of work life, and the levelling of power. In the 1970s and 1980s, the sociotechnical design principles were further developed into an integral redesign of organizations. In this integral redesign, attention is paid to the relation between corporate strategy, organizational form, the nature of the transformation process, the technology, and labour.

The central design principle of the contemporary sociotechnique can be summarized as the formation of complex tasks within simple structures, instead of the performance of simple tasks within complex structures. What is central is the shift from the maximal division of work in classically structured organizations to the minimal division of work as the leading principle of design for flexible and modern organizations. According to sociotechnical views, the team is the smallest unit of organizing. In the organization, groups are always interdependent. It would benefit the flexibility, the effectiveness, and the quality of work life, if groups can regulate their own tasks, can shape their own work organization, have a high measure of control and the ability to solve problems independently (Ashby, 1969; Cherns, 1987; Susman, 1976).

Management of the change process rests on experience in the practice of the classical organization development and is theoretically founded on theories of group dynamics, learning processes, process intervention, and systemic change (Argyris, 1990; Beer & Walton, 1987; Schein, 1969). Practical experience has led to the conclusion that insufficient results are achieved with the sociotechnical designs when a fundamental change process is based exclusively on the sociotechnical design principles. Van Beinum (1990) states that the change process will inevitably result in some form of "social engineering" when organizational redesign is shaped by external experts who, solely on the basis of a sociotechnical system analysis, prescribe how the new organization must be shaped. The members of the organization are then insufficiently involved in fundamental decisions and little opportunity is left for organizational learning and the incorporation and acceptance of the change process. The designing of organizations which is characterized by autonomy, self-regulation, and participation can, according to Van Beinum, only genuinely take place when all members are actively involved in the shaping of their own work situation and are allowed to experience a learning process during the change process that enhances their understanding of their own situation. A participative approach usually employs search conferences, group discussions, workshops, and the experience gained through team-based work to redesign the work organization (Mohrman & Cummings, 1989).

The Dilemma of Technological and Organizational Innovation

In the design perspective the emphasis lies on the application of new technology and the designing of a new organization. The design starts with the designation of abstract objectives. Particular attention is paid to the desired

output of the organization, the formal transformation process, and the related information process. The change process is singular and linear, and the number of alternatives is restricted. If the new organization is implemented and a stable final situation is attained, the change process has been concluded. Changes are often initiated, co-ordinated, and controlled by the top of the organization. The decision-making process is highly structured and formalized. There is hardly any opportunity for a discussion of possible differences in opinion. The approach is normally supported by consultants who, as experts, primarily focus on the design of the new information technology and work organization. A problem with the design approach is that it hardly contributes to the enhancement of the ability to change on lower levels in the organization. Cultural and political aspects are easily left outside of consideration. There is a great danger that collective norms and values will not develop, power structures are not influenced, and that, therefore, fundamental change cannot be achieved.

In the development approach, organizational problems and shortcomings are analysed first. The organization's ability to change is enhanced by involving members of the organization in the problem analysis. During the process, attention is given to the organization's culture and capability of the people to solve problems. The decision-making process concentrates on attaining shared objectives by consultation and negotiation. There is a phased and progressive change in which ideas from the basis of the organization play an important role. The change process is characterized by rough planning. Members of the organization are involved in all phases of the process. Participation is very possible, because the starting-point is the existing organization, objectives are established gradually, and deliberation and adjustment are facilitated. By participation of all organizational members, an enhancement of the self-learning ability of all members is attempted. A problem with the development approach is that it is difficult to achieve fundamental changes. Because of the existing social and political nature, the grounded values, norms and traditions, and the existing bureaucratic structures, organizational conservatism supporting the prevailing systems of the division of labour and hindering fundamental organizational change can exist.

From an interventionist perspective, two important questions are raised:

- (1) What are the barriers to technological and organizational innovation?
- (2) What are the possibilities of broadening the perspectives of the participants in the decision-making process and overcoming organizational conservatism and simultaneously developing learning capacities?

RESEARCH SITE AND METHODOLOGY

Action research is a method to study dynamic processes and actions that are temporally interconnected and embedded in context. The research is aimed at developing descriptive accounts and explanations through looking

at patterns of events to gain knowledge of problems and the solving of problems in social reality (Argyris, 1983).

The research reported in this section sought to address the dynamics of change over a three-year period in a single company faced with the demands of becoming more flexible and integrating strategic, technological, and organizational innovation. The research is based on real-time longitudinal analyses of the change process and a retrospective analysis of the collected data and the acquired experiences and knowledge. The second author of the study served as a consultant in a team of internal and external employees that facilitated the change process. The first author facilitated the action research process during the study. Data collection involved ongoing semi-structured interviews, the keeping of a diary, questionnaires, conferences, workshops, and quarterly process evaluations.

The research has been conducted in the BankGiroCentrale (BGC), an automated clearing house for payment transactions for the commercial banks in the Netherlands. The product of the BGC is operation services of pre-arranged batch payment items submitted on magnetic tape, diskettes, computer-cartridges, cheques, payment documents, and conversion forms. The BGC is also providing data-networks for cash dispensers, point-of-sale terminals, and telegiro. In addition, BGC is processing and exchanging information about payment transactions between banks and is supporting the standardization and the risk management in information technology for payment transactions. The BGC has two processing centres in the Netherlands and 800 people are employed by the organization.

A CASE OF FUNDAMENTAL CHANGE

BGC as an Open System

The market of payment transactions has become rather turbulent during the last years. The costs of payment transactions has to be reduced under the influence of the demands of the commercial banks and their customers. New forms of payment by credit card, debit card, or data communication require low transaction costs, reliable operation, high performance, and security. Deregulation of the financial services by government offers possibilities for merging bank activities with insurance. The pursuit of a European economic and monetary market by the European Commission influences the scaling of the financial market and an increase of international activities and collaboration by banks and insurance companies. Competition between financial conglomerates is rising. This leads to very strong stakeholders that put higher demands on costs and the quality of services that is offered by the BGC. Banks make high demands on swift and timely processing of payments and settlement of payments between banks. Service levels and customer satisfaction are becoming more and more important.

The availability of swifter and better mainframe computers, the developments in information technology and the application of data communication have resulted in significant shifts in the different types of payment order. Transactions are more frequently presented on cartridges, tapes, and data communication than via paper. These shifts require adaptations in work organization and job qualifications. During the past few years, technological developments have generated all sorts of new services and products, such as cash dispensers, point-of-sale terminals, the development of the chip card, and the possibility of giving payment orders via interactive television. This demands an innovative capacity from an organization.

For the management of the BGC, the analysis of the environment formed the basis for a new business strategy. The environment and the changing market demands from the BGC further cost reduction, improvements in quality and customer service, a flexible attitude towards market developments, and an innovative ability to make optimal use of new information technology. The business strategy results in three projects: (1) the development of a new automated payment system including the renewal of system architecture and the technological infrastructure; (2) the realization of a new technological and logistic infrastructure for high-speed imaging of payment documents; (3) the re-engineering of the business processes and the reorganization of the company into an effective and efficient organization that is compatible with the new information technology.

BGC as a Sociotechnical System

Information technology is essential for the functioning of the BGC. All payment orders are processed by means of automated systems. The information on the production is recorded in automated data files or on microfilm. All the BGC products are highly automated. Administrative organization and procedures are important in order to keep track of the transformation process and to reduce susceptibility to fraud. The existing information systems no longer met requirements because of the high cost of maintenance and the limited possibilities of adaptation. Furthermore, the system was insufficiently capable of coping with the growth in financial traffic and it no longer met the requirements of swift and reliable processing. The new information systems were to be flexible and easily maintained. In the new system, a distinction is made between technical management of the hardware control systems and functional management of the application systems.

To realize compatibility between the new technological aspect-system and the social aspect system, the top management installed task groups of line managers to study the effects of the new technology on the organizational structure. This gradually revealed that the line managers were unable fully to consider the operational processes. The task groups reached a deadlock

in discussions on the adjustment of the boundaries between the existing departments. There proved to be an organizational conservatism in which line managers proceed from the present division of labour and try to protect their own position within the organization. At the same time, employees are worried about the effect of the technological innovation on the quality of working life. A committee for the quality of working life discussed the perils of technological determinism and the possible negative consequences of the new technology with the top management.

The top management, confronted with the limited capacity to change of the line management and the uncertainty of the employees, asked for assistance from consultants in managing the technological and the organizational innovation.

Facilitating the Change Process

The formulated strategic policy induced the innovation of the technical aspect-system. The strategic policy had been limitedly communicated within the organization and only a few organization members had been involved in the technological innovations. So far, little attention had been paid to the social aspect-system. The advisers suggested a clarification of organizational strategy and a formulation of the points of departure for the changing technological and social aspect-system. A conference model was chosen to elaborate the points of departure (Axelrod, 1992; Weisbord, 1992).

In the work conferences, the top management presented the analysis of the environment and market changes and discussed the strategic goals with the line management and the employees. Three work conferences were held, with about 40 participants per conference. The participants were a cross-section of the organization. Besides discussions on the strategic objectives and the development of information technology, pressure points within the existing organization were analysed and an inventory was made of suggestions for improvement. Additionally, success factors for change were charted. The outcome of the work conferences was the basis of the points of departure for the renewal of the technological and social system and of the way in which the change process was to be dealt with. The points of departure were presented during group meetings and discussed with all employees. During these meetings the feasibility of the change was specifically discussed.

In order to further facilitate the change process, a task force of employees and external advisers was formed. The task of this group was to gather information on pressure points within the organization and to organize work meetings to develop proposals for the new set-up of the organizational processes and to formulate ideas for an appropriate form of organization. The task force consisted of employees who collectively had a clear image of the work processes in the different departments and who were considered

capable of guiding group discussions on the future work organization. Top management and the work council were both involved in the change process by means of regular meetings and workshops. Line management was involved in work conferences. Employees were involved in questionnaires and group discussions to diagnose problems in the social aspect-system and in workshops to suggest ideas for problem solving and to develop new designs for business processes, information technology, and work organization.

Problem Diagnosis in the Social System

The points of departure and the reactions to them formed the basis on which a specific form of diagnosis was developed for each unit. Three units are to be distinguished within the production process. (1) *Operations* dealt with the processing of payment traffic. About 450 people, spread over two branches, were active in this unit. The unit had been organized in a linear structure with small processing steps divided over many departments. The processing was to be distinguished into: (a) receipt and unpacking and sorting of tapes, diskettes, and cartridges, (b) control of payment information, (c) input of data, (d) correction and recoding of data, (e) authorization and automated processing, and (f) production and supply of output. Separate service departments in Operations supplied telephonic and written information on the processing. (2) *Commercial Affairs* dealt with the account management of clients and with the product management of payment products. About 50 people were active in this unit. The department also developed specific automated applications for individual banks. (3) *Computer and Network Services* dealt with the technical support of the operations, in particular. About 250 people were active in this unit. The unit supplied computer and network facilities for the processing and took care of the daily control of the applications needed for the processing. Additionally, the unit developed new information systems in accordance with the wishes of the commercial unit.

The diagnosis consisted of interviews, specific questionnaires for all the employees and group discussions to verify and discuss the results of the questionnaire. The questionnaire included such items as contacts with customers, exchange of information and compatibility among departments, pressure points in the work, style of leadership, quality of working life, and barriers to fundamental change. The diagnosis provides a sharp picture of the problems within the various units.

Operations was characterized by a far-reaching division of labour. The number of functional contacts between the departments was very high and a great deal of co-ordination of different tasks is required in order to have the work process run smoothly. The exchange of information and the task

co-ordination took a lot of time, proceeded with difficulty, and caused a great deal of attuning problems and mistakes in the operations. The quality of working life was rather low owing to limited tasks with little responsibility. Employees were given limited information on the achievement of results. Owing to their dependence on others they had few opportunities to solve the problems encountered in their own work. There was a very limited learning potential.

Commercial Affairs was differentiated in account managers, product managers, and customer services. Account managers as well as product managers visited customers but the co-ordination between the two departments was very problematic. The customers' questions about operations were answered by customer services as well as by the service desk from operations. The result was that clients did not know which department to turn to and that they were often referred from one department to another. No systematic survey was kept of the problems, questions, and wishes of the clients. Relations between Commercial Affairs and Operations was problematic because Commercial Affairs made promises to clients that Operations was unable to fulfil.

Computer and Network Services consisted of about 20 departments. Half of them dealt with day-to-day hardware operations and the operating of the information systems for the transactions in the unit operations. The activities of this service unit and the unit operations needed a lot of co-ordination. This co-ordination often proceeded with difficulty owing to distances between locations and differences in time between the detection of problems in the execution of the payment traffic and the control of this traffic by means of automated systems. The departments dealing with the development of systems were all responsible for a separate phase within the system development or for a specific technological subject. For the greater part, the co-ordination of these activities within the unit proceeded with difficulty.

The outcomes of the diagnosis have been widely presented within the organization. For this purpose, general information sessions were organized, as well as presentations to smaller groups. The presentations were given by the management. This way they emphasized that the pressure points that had been indicated in the diagnosis by the employees were taken seriously. The presentations were accompanied by written material in which the outlines of the outcomes had been listed systematically. During these presentations, the employees and the managers had the opportunity to respond to the outcomes and, if necessary, to indicate gaps or mistakes. During the presentations it was also indicated which themes were to be further elaborated. The management had determined these themes on the basis of the outcomes of the diagnosis, in consultation with the heads of the department.

The diagnosis revealed that the high degree of task differentiation within the organization resulted in pressure points in the exchange of information,

in the effectiveness of working by making projects, and in customer service. Task differentiation within the business processes resulted in a strong interdependence between departments and groups, which reduced the decisiveness and efficiency of the organization; moreover, it put a heavy burden on communication and co-ordination. The task division also contributed to the fact that responsibilities were not assigned unambiguously. This limited the swiftness of reaction in case of changing circumstances or problems. The division of tasks also resulted in a limited quality of labour. If the present social aspect-system were to be taken as a starting point for further automation, there is a risk that the deficiencies within this system would be embedded in the technology and that the opportunities for innovation of the entire organizational system would not be realized. Simultaneous innovation of the technical and social aspect-system was indicated in order to realize the strategic objectives and to meet the demands made on the organization by the environment.

Barriers to Change

One of the most important reasons why change programmes fail is that they do not deal with fundamental barriers to the development and implementation of organizational and technological innovation (Beer, Eisenstat, & Spector, 1990). Therefore, three questions about the failures of change were included in the questionnaire. (1) Why were change programmes not successful in the past? (2) What are the barriers to the realization of the innovation as presented in the points of departure? (3) What is needed to solve the problems of this organization? The open questions were answered in writing by more than 60% of all employees. A content analysis of the answers was made by the task force and feedback was given to all the organizational members.

The answers revealed three significant reasons why change programmes had not been successful in the past: (1) because the employees had not been sufficiently informed; (2) because employees had not been involved in the changes; (3) because the changes had not been carried through on account of their possible consequences for the managers. Five significant barriers that may hinder the process were mentioned: (1) the quality of leadership and an autocratic style of management; (2) an ineffective top team and inadequate management skills in a bureaucratic structure with an overload of hierarchical levels; (3) the existing boundaries between the departments and the ensuing "realms", in combination with insufficient co-operation between the departments; (4) poor vertical communication and unclear strategic priorities; (5) the existing power configurations of managers who strive to preserve the existing balances and try to secure their interests, objectives, and positions.

