

# Action research for international information technology transfer: a methodology and a network model

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## Abstract

*The objective of this paper is to present a methodology for action research to support information technology transfer in a context of national development. One approach to this problem is to consider new technology implementation and organization redesign as parallel processes and to develop managerial roles for action research in an interactive network model. The action research methodology proposed here is conceived to complement technical system development with identification of requirements and constraints of organization culture and behavior. The fundamental principles of this methodology serve as a basis to formulate recommendations for future research and practice. Copyright © 1996 Elsevier Science Ltd*

## 1. INTRODUCTION

The purpose of this paper is to present a methodology for action research to support information technology transfer in a context of national development (Reddy and Zhao, 1990). Models for the introduction of information systems generally have focused primarily on technology, with little attention given to the necessary systemic adaptation of organizational culture and behavior (Quang and Chartier-Kastler, 1991; Hammersley, 1991). One possible approach to this problem is to consider new technology implementation and organization redesign as parallel processes and to mobilize managers as researchers, facilitators, and organizational change agents (Chisholm and Elden, 1993). The definition of information technology appropriate to this approach is a broad one, encompassing the technology itself and human behavior as well as work and organizational arrangements associated with its implementation (Boaden and Lockett, 1991). This definition includes four components: the technique or hardware itself, know-

ledge and expertise associated with the technique, institutional arrangements for integration of technique and knowledge, and products or outcomes resulting from the above elements (Barnett, 1994). International transfer of information technology is defined as the process of its acquisition, adaptation and improvement through cooperation across national boundaries (Cusumano and Elenkov, 1994).

Information system development methodologies such as MERISE or the Jackson System Development model, for example, include specification of critical decisions or actions, identification of significant organizational actors, financial assessment of system function, and work redesign (Avison, 1991; Avison and Wood-Harper, 1991). The methodology proposed here is conceived to complement technical system development considering organizational culture and behavior.

Global economics and the necessity of regional development in less developed countries have created

a complex environment posing new challenges for management (Weiss, 1992; Howells, 1995). Strategies for organizational management of scientific, socio-economic, and cultural turbulence include (Weiss, 1992): (1) early diagnosis of environmental trends and their significance for organizational effectiveness, (2) flexible adaptation of programs and policies to rapidly changing contingencies, (3) consideration of a variety of alternative problem solutions, (4) continuous individual and organizational learning to cope with increasing flows of information, (5) research and development to create competitive innovation potential, and (6) self-organization and reduction of administrative and bureaucratic structures. Critical to these strategies are continuous learning for information systems management and the reduction of administrative structures, especially those defining the boundaries between national and global economic affairs. These components of organizational survival strategies suggest the importance of managerial training and the increasing usefulness of networking across organizational and national boundaries to foster a continuous learning process. One of the major barriers to development is the inability to generate science and technology and the tendency to rely on imported technology with seemingly passive acceptance (Salomon, 1995). Thus training, including acquisition of technical, organizational and cultural skills, can no longer be viewed as a linear, top-down process yielding mastery of a skill to be applied in organization context; but such learning takes place continuously in the work setting through participative implementation and critical monitoring of new information technologies as well as creation of innovative organization forms to support such technologies (Liang, 1993; Myers, 1994; Clark, 1995).

These evolutionary tendencies in information system development and implementation have important consequences for managerial roles. The fast pace of technological change means fewer formal, standardized training programs and greater reliance on consultation and coaching relationships with internal and external experts and technicians (Clark, 1995; Berlin and Jeffries, 1992; Bessant and Rush, 1995); increased managerial use of strategies to develop participation in organizational change, including focus groups and the nominal group technique; emphasis on constructive management of interpersonal conflict and acquisition of conflict management skills; and emergence of a new research role for managers to monitor and control new information technology.

This paper is organized and presented in the following structure:

1. Introduction
2. Networks of innovators and international technology transfer
3. Action research for information system design
4. Culture and methodological considerations
5. Ethics and values: implications for international technology transfer and development
6. Conclusions and recommendations.

## 2. NETWORKS OF INNOVATORS AND INTERNATIONAL TECHNOLOGY TRANSFER

A network of innovators is defined for this discussion as a configuration of institutions and individuals including governmental agencies, universities, research centers and laboratories, and public as well as private firms working together for the creation and transfer of new information technologies (Cusumano and Elenkov, 1994; DeBresson and Amesse, 1991; Gurbaxani *et al.*, 1990; Howells, 1995). Diverse examples of such networks of innovators include joint ventures and research corporations; joint research and development agreements; technology exchange agreements; direct investments motivated by technology; licensing and second sourcing agreements; sub-contracting, production sharing and supplier networks; research associations, government-sponsored joint research programs, computerized data banks and value-added networks for technical and scientific interchange; and a wide variety of informal agreements (Freeman, 1991). Thus, networks are basic institutional arrangements for systemic innovation and risk reduction, an interpenetrated form of market with organization characterized by cooperative relationships. Freeman (1991) identifies a strong increase in numbers of such arrangements during the 1980s and the less hierarchically structured, more egalitarian nature of their exchange relationships. These trends are particularly apparent in networks involving international cooperation (Cusumano and Elenkov, 1994). Networking is becoming a more and more prominent form of an organization and its role in technology transfer through interpenetration of organizations and markets will increase, particularly since technological transactions including innovations, technological transfers, and simple adoption appear to be organizationally embedded (DeBresson and Amesse, 1991). Reasons for this include the existence of strong technological and market uncertainties, the systemic nature of information technologies, and the potential synergies of technological cooperation.

Information technology in the context of network structure reduces coordination costs associated with information accumulation, inventory and communication (Clemons and Row, 1992), with the result that coordination may replace certain slack resources and highly cooperative integrated relationships may emerge (Malone and Rockart, 1992). These effects are particularly critical to networks for international technology transfer. Transaction costs associated with integration of diverse cultures can be reduced by flexible standards and modularity of expertise, facilitating adaptation of such expertise to new situations. Intuitive interfaces and support for their conversion and translation reduce training and communication required to integrate diverse cultures (Clemons and Row, 1992).

A problem specific to institutional cooperation for technology transfer is the control of opportunistic

behavior among beneficiaries of the research and development process (Tripsas *et al.*, 1995). Many factors motivate R&D collaboration, including economies of scale and scope in research activities, reduction of financial costs and duplication of research results, access to new knowledge and expertise, and exploitation of complementary capabilities of research partners as well as research spillovers from collaborative projects. These positive factors can be negated by fears of exploitation, particularly in a network structure characterized by power disequilibrium between highly industrialized and less developed national economies. Such opportunistic behavior needs to be managed through elaboration of appropriate mechanisms for monitoring and control. Government presence and participation can contribute to control of opportunistic behavior through definition of legal frameworks for international cooperation, membership in governance bodies such as steering committees, and promotion of long-term institutional and organizational relationships (Tripsas *et al.*, 1995). The formation of R&D consortia within a network structure can facilitate a more active role of government in public R&D funding by supporting wider diffusion of research results. Monitoring can also be facilitated by vertical integration within a single industry between buyers and suppliers (Robertson and Longlois, 1995). For example, a producer may have access to inventory data maintained by a distributor to monitor sales and deliveries (Clemons and Row, 1992).

These capabilities reduce risks of opportunistic behavior and create potential network economies of scale and scope and incentives which, in turn, reduce the risks of opportunistic behavior by individual firms. In the context of individual and organizational learning, affiliation in a network reduces the cost of information and assures access to diverse technical and organizational knowledge and experience essential to successful technology transfer (Englestad and Gustavsen, 1993; Tiarniyu, 1993; Renn, 1995). Thus, the institutional network of innovators constitutes a vehicle for international technology transfer and development and a potential competitive advantage for nations (Rugman and Verbeke, 1993).

It is important to emphasize the usefulness of the institutional network concept to planning methodologies and institutional mechanisms for international technology transfer and development. This concept is especially pertinent in light of the transition from centralized government control and resource allocation to the design of indirect incentive systems for national development (Weiss, 1992). Weiss also cites the Japanese model of strategic consensus among networks of government agencies, industrial associations and manufacturing firms as an effective basis for national planning in a turbulent global environment; such strategic consensus orients and guides the plans of a loosely-coupled system of diverse institutions towards coherent national goals. The focus for national development is on problem solving method-

ologies and market mechanisms, including training policies, rather than detailed mechanistic regulations (Clemons and Row, 1992; Meyer, 1988; Justman and Teubal, 1995; Renn, 1995).

Another mechanism for international R&D network control is the epistemic community, a network of professionals with recognized policy-relevant expertise and competence in a particular domain, considered instrumental in the emergent process of international policy coordination (Haas, 1992; Russell, 1995). Such policy-level communities possess shared values, causal beliefs related to policy models in their domain, criteria for evaluating and validating knowledge, and professional practices based on interpretation of social and physical phenomena. The epistemic community in a context of international transfer of information technology helps to explain how the process of international policy coordination emerges from individual, institutional and systemic dynamics by analysis of uncertainty, interpretation of economic environments and institutionalization of community behavior.

The foregoing discussion has highlighted some of the dynamics of network structure for international technology transfer. In particular, cooperation in a culturally diverse institutional context has been examined to show in a 'transactions costs' framework how information technology reduces investments required for multi-cultural collaboration, and how the risks of opportunistic behavior are offset by incentives to collaborate generated by network structure and dynamics. The next section of the paper considers individual managerial and research roles critical to the behavioral and social process of international technology transfer.

### 3. ACTION RESEARCH FOR INFORMATION SYSTEM DESIGN

This section of the paper will show the critical managerial role in participative action research and its consequences for organizational learning and technology transfer (Chisholm and Elden, 1993) in an institutional network context. Action research in information systems provides a considerable opportunity for user participation and collection of information concerning the natural setting of the organization. The integration of the roles of researchers, managers and organization participants has the advantage of facilitating the rich synergies between theory and practice, but presents the risks of lack of objectivity, scientific rigor and generalizability. Avison and Wood-Harper (1991) point out that action research results are primarily qualitative in nature but they do offer a degree of external validity through interpretation and adaptation to other organizational settings.

Managerial roles are particularly critical to the system-level processes of work redesign, system implementation, and evaluation (Noble, 1991).

Organization and work redesign as well as strategic analysis are aspects least incorporated in information systems methodologies (Noble, 1991; Poo, 1991). Avison and Wood-Harper (1991) also point out that computer scientists, programmers and technical analysts continue to be primarily interested in technical specifications of information systems and their performance of information processing functions, while neglecting the important questions regarding (1) the relation between information systems and organizational goals, (2) the fit between information systems and the working lives of users, and (3) the human-computer interface. Rather than defining information systems as technical systems with behavioral and social consequences, they should be viewed as primarily social systems founded increasingly upon information technology (Avison and Wood-Harper, 1991; Sutcliff and Wang, 1991). Exclusion of system-level managerial considerations in favor of the individual user's perspective, particularly in office systems development (Noble, 1991), has contributed to an excessively technical emphasis in existing models. Where individual work is emphasized, little attention is focused on the relational dimensions of job design, and activities not to be automated are excluded from the analysis (Sutcliff and Wang, 1991). A European methodology, MERISE, allows for participation of upper management, primarily in decision validation, and emphasizes critical decision points rather than actions (Avison, 1991). These decisions relate to technical and processing choices, the human-computer interface, identification of organization actors involved in the process, financial evaluation of costs and benefits, and functional analysis. MERISE provides for consensual decision-making and conflict resolution to a greater degree than other methodologies, and thus allows expression of organization culture through collective norms. While organization culture is implicit in system development, no methodology presented in the literature considers this construct as an explicit dimension of organization or job design, and issues of generalizability of these methodologies to varying organizational cultures in developing economies remains to be addressed.

The role of managers as action researchers in the ongoing process of information system development offers a potential strategy for explicit consideration of organization culture and creation of cooperative networks of innovative institutions for international development. This strategy could be designed within a cooperative institutional network, defining coaching or consulting partnerships across national boundaries linking university, governmental or private enterprise experts in industrialized countries with policy-makers and managers in their organizational contexts of national development. The resulting loosely defined expert matrix structure would foster mutually beneficial exchange relationships for information technology transfer and would support organization managers in developing economies to create models for such transfer which would include organization and

work design principles embedded in specific organizational cultures.

The primary form of learning in this approach is coaching and consultation in network relationships (Berlin and Jeffries, 1992). The emphasis here is on learning to promote the managerial roles of a facilitator and a researcher in new technology transfer. The facilitator role requires understanding of behavioral and cultural aspects of organizational processes and competence in intervention for participation, teamwork and conflict management including delphi and nominal group techniques, focus groups and team-building. The critical managerial role of organizational researcher reflects the convergence of the domains of research and practice. Research methodology is essential to processes of individual and organizational learning, uncovering organizational culture, redesigning work and organizations, managing and controlling change, as well as evaluating information technology transfer. The process of learning is increasingly integrated in the accomplishment of work itself and the practice of management.

Rapidly evolving technologies and the complexities of an emerging global economy bring a fusion of the interrelated activities of managerial learning, practice and research best expressed in the principles of action research (Chisholm and Elden, 1993). In an analysis of recent action research cases on dimensions including research objectives and researcher roles, several emergent trends were identified (Chisholm and Elden, 1993). First, the presence of networks is increasingly prevalent in action research interventions due to the complexity of change and the recognition of the critical importance of organization linkages to foster a process of continuous system-level learning. Second, action research models guiding intervention are increasingly developed with the participation of organization members. Third, the use of data generated within the organization provides a unique, context-based perspective for interpretation of general organizational realities as well as specific action research results. The unique context also provides a framework for value judgements concerning appropriateness of various behavior and attitudes.

Research tools useful for information system development include qualitative and quantitative data collection and analysis techniques. While quantitative methods may seem more consistent with technical objectives of systems development, qualitative methods yield a 'deeper' description of work, organizational context and cultures (Weiss, 1992). Some promising approaches to integrate the knowledge of organization members and facilitate their participation in system development and implementation include use of metaphors, participant observation and ethnography (Walsham, 1991; Yin, 1994).

Metaphors are a rich device for description of organizations; they may provide a common perspec-

tive held by organizational members as well as insights into the nature of organizational actors. Morgan (1986) elaborated eight metaphors which can be useful to information systems development and research (Walsham, 1991): organizations may be viewed as *machines* characterized by formal goals, procedures and administrative structures, living *organisms*, regulating *brains*, shared systems of meaning or *cultures*, *political systems* animated by power, *psychic prisons*, or *instruments of domination*. Each of these metaphors suggests organizational goals and objectives as well as cultures and ways of doing things. The mechanistic metaphor is implicit in many technically oriented information systems development methodologies and may help to account for their frequent failures.

Little research has reported the use of explicit metaphors in system design. One example was identified in a project to develop a computer-supported cooperative work system for air traffic control composed of computer mediated as well as manual elements (Hughes *et al.*, 1992). The project objective was to create an electronic replacement for the paper flight progress strip. Metaphors for the flight strip included work site, history or memory, and visual 'schematic'. In addition to illuminating the nature of the work itself, these metaphors suggest complex and subtle interdependencies among the 'active' controller and others in the process of air traffic control.

This study and another in the same research program (Bentley *et al.*, 1992) employed 'ethnographically informed' system design for air traffic control. Although full details of the methodology are not presented, the approach involved observations of workers by a trained sociologist in their natural organizational setting over a period of several months. The objective of these studies was to obtain a 'deep' understanding of actual work context and behavior, and to apply this ethnographic understanding to information system design. Important conclusions included the necessity of conducting ethnography and systems development as concurrent activities and the role of debriefing meetings to focus the attention of the ethnograph on questions raised by system developers. These questions related to identification of manual activities for automation from the point of view of the user. Some of these activities should remain unautomated as implicit methods of communication and cooperation, while others are accessible to replication or redesign in the automated system. The most significant problem was the translation of ethnographic observations of work into information useful to system analysts. In this example of system development, the ethnographer played a role of substitute user; but this role could be extended to include a managerial perspective and a systemic view of the social requirements of information system and organization design.

The preceding discussion has highlighted the use of metaphors and ethnographic methods in the context

of a managerial role of action researcher. These methods contribute rich qualitative data to the action research process concerning implicit functions of communication and cooperation in work and organization for integration of human requirements and cultural systems design. They also contribute to a systemic view of the managerial context of organization.

The next section of the paper focuses on methodological difficulties posed by cultural differences in information systems design and possible solutions in action research. Culture is discussed as the foundation of systems development methodologies and as a critical factor in international information technology transfer through institutional networks.

#### 4. CULTURE AND METHODOLOGICAL CONSIDERATIONS

Information systems development methodologies often assume a common culture and a mechanistic view of organizations. Some scientific effort has been focused on the important variable of culture and how it may affect information systems design, but the results of such studies appear inconclusive, especially as they might apply to technology transfer in the complex context of national development (Cooper, 1994).

Culture may be defined as a system of shared meaning (Morgan, 1986). Cooper (1994) has identified concepts of culture useful in analyzing organizations and their responses to information technology implementation. Culture includes a set of implicit assumptions shared by social groups for purposes of internal integration and adaptation to external environments. The strength of any culture is related to the stability and history of the group, the degree of environmental hostility, and the consistency of its leadership. Different cultures require different information and process such information differently. These definitions serve to underline the necessity of translating action research and information systems development methodologies into adapted models appropriate for application in diverse cultural contexts, especially organizations in developing economies. Little research has conclusively demonstrated how underlying cultural orientations affect the success or failure of national technology policies as well as interventions for organizational change and development.

Two major theoretical approaches have been applied to the study of the effects of culture on interventions for organization change generally defined and information technology transfer or implementation in particular. Hofstede's (1980) four cultural dimensions have frequently served in identifying cultural variation (Jaeger, 1986; Johnson and Golembiewski, 1992) and the competing values view of organizational culture based on work by Jung (1923) considers competing tensions or conflicts characteristic of human systems (Cooper, 1994). Major con-

licts pertinent to organizational cultures occur on the dimensions of (1) order–flexibility and (2) internal–external system requirements.

Cooper (1994) found empirical support for the identification of four cultural archetypes derived from the competing values view of culture useful for interpretation of information systems (IS) in their organizational contexts. Information systems consistent with the *survival* archetype support organization coping abilities in complex, turbulent and highly politicized external environments. The *productivity* archetype is associated with IS to reduce uncertainty by facilitating the organizational roles of planning, directing, and goal setting. Information systems in the *stability* culture focus on measurement and control under relatively low uncertainty, while in the *human relations* culture, IS foster organization member dialogue, participation, cooperation, and training. This theoretical framework, validated by Cooper (1994), can serve as a tool to assess potential conflicts resulting from incompatibility between organization cultures and management information systems (MIS).

One empirical study examined organization development success rates as a function of the fit between intervention values and national culture (Johnson and Golembiewski, 1992). National cultures were characterized by Hofstede's (1980) four dimensions: (1) *power distance* associated with social egalitarianism, (2) *uncertainty avoidance* associated with degree of tolerance of ambiguity and lack of structure, (3) *masculinity–femininity* associated with the polarity between orientation emphasizing results and performance vs feeling and relationships, and (4) *individualism–collectivism* associated with emphasis on individual or group identity. The results of the study by Johnson and Golembiewski (1992) are inconclusive regarding the fit between intervention values and national cultures, but there are several alternative explanations for this conclusion. Very diverse projects were included in the sample, and distinctions were not made among purely indigenous efforts, projects with large-scale funding, and multinational efforts. The locus of interventions is identified as significant in differentiating higher success rates in Western settings in contrast to third-world settings. This finding points to the role of culture in intervention success, but does not substantiate the hypothesis of a necessary fit between national cultures and values associated with organizational development efforts. Intervention success may be founded upon effective translation of methodological principles into actions consistent with the standards and values of diverse cultures.

According to Jaeger (1986), organization interventions for change and development are founded on values for low power distance, low uncertainty avoidance, feminine emphasis on feelings and relationships, and tolerance for individualism in a context of collaboration and teamwork. Jaeger (1986) suggests the design of intervention methodologies consistent

with national culture based on assessment of critical cultural dimensions as defined by Hofstede (1980) and consequent adjustment of intervention methodologies to their cultural context (Jaeger, 1986).

The suggested adjustment of intervention methodologies emphasizes consistency between intervention behavior and the cultural values of intervention context, rather than a fit between diverse sets of values. The foregoing steps can be applied to information systems development methodologies in differing cultures, particularly for technology transfer in a context of national development. The managerial role in institutions and organizations receiving technology transfer is critical to assure adaptation of system development interventions and their subsequent success (Trott *et al.*, 1995).

Although Hofstede (1980), Cooper (1994) and others have identified dimensions useful for the analysis of cultural profiles, qualitative research and intervention techniques may contribute to a definition of other dimensions descriptive of a particular cultural context. Sackman (1991) suggests a 'midrange' methodology for the identification of culture which integrates both insider and outsider views with the following objectives: (1) to surface the tacit components of culture from the insider's perspective, (2) to be sensitive to specific structural characteristics such as subcultures, and (3) to enable comparisons across individuals and social settings. Key elements of the methodology include its issue-focused interviewing technique and phenomenological orientation. The *issue focus*, for example, on information processing or communication, fosters the surfacing of tacit components of culture and provides a framework for comparisons among individuals and organizations. The issue is in effect a stimulus to elicit an interpretation based on the organization or network cultural framework. For example, to uncover dimensions of culture salient to information systems development, issues related to information, communication as well as organization and task design are appropriate for analysis by organizational teams affected by the issue. Within the selected issue, the informant is encouraged to explore individual understandings from which cultural values can be identified through interpretation. Cultural values identified may prove a valuable contribution to the process of technology adaptation to a specific intervention context.

The methodological considerations raised in this part of the paper are intended to demonstrate the complexity of the concept of culture, its critical importance to information systems development, and the important managerial role in action research. The manager's research role in identifying cultural factors contributes to adaptation of information systems development methodologies both to specific organizational contexts and to organization and task redesign as a result of introduction of information technologies. The next section will consider some of the

implications of ethics and values for international technology transfer.

### **5. ETHICS AND VALUES: IMPLICATIONS FOR INTERNATIONAL TECHNOLOGY TRANSFER AND DEVELOPMENT**

In the context of institutional networks for information technology transfer described here, models for information system design may be imposed on organizations of very diverse cultures. The relation among action researchers, managers, information system analysts, and the network involved in technology transfer represent a complex power equilibrium, especially in the context of international development characterized by economic and political inequities. This power equilibrium poses the need for some ethical principles and guidelines to protect the interests and integrity of social systems and individuals (Weiss, 1992). The process of international technology transfer creates significant potential for conflicts among institutions, organizations and national governments with differing objectives (Reddy and Zhao, 1990), particularly between host and home countries and between organization strategy and national goals. According to Cummings and Worley (1993), ethical issues are related to intervention inconsistencies among goals and strategies of organizations and individual values and norms, and between intervention behavior and concepts of fairness, professional standards and norms, as well as fundamental values associated with organizational interventions. It is also important to remember that information technology transfer in any organizational context may have unforeseen consequences as well as planned results.

The following ethical considerations apply generally to research on international management and particularly to cross-cultural interventions for information system development and technology transfer (see Warwick, 1980):

- All collaborators should participate in initial conceptualization and design of the intervention as well as its execution. The intervention should be flexible in both content and methodology for adaptation to the circumstances of a particular cultural setting.
- Methodological efforts should be made to identify ethnocentrism and political biases by seeking external review and criticism.
- Participants in interventions for technology transfer should be fully informed of sources of funding and sponsorship and the objectives of these financial contributors.
- Funding and sponsorship should not be used to manipulate collaboration in technology transfer.
- Integrity of ethical standards and cultural understandings of a particular context should be

respected at all levels of collaboration. This can be fostered by a process of validation at every intervention phase.

Awareness of these ethical considerations, particularly in the managerial perspective, can contribute to the effectiveness and integrity of international collaborative interventions for technology transfer and information system development.

### **6. CONCLUSIONS AND RECOMMENDATIONS**

This paper has addressed issues associated with international transfer of new information technologies. The development of managerial roles of facilitator, researcher and organization change agent is framed in an action research perspective on information systems development methodologies. Information technology transfer takes place in an institutional network fostering partnerships for mutually beneficial technological exchange and consulting relationships for organizational and individual learning. Managerial roles in this model embody the convergence of research, practice, and learning. In the action research model the manager assumes an active research role to monitor information technology transfer and support organization and job redesign in a process of continuous exploratory experimentation. Where international technology transfer with participation of organizations in developing economies is the objective, managers need to acquire, through training and practice, competencies in evaluating diverse cultures and their effects on the success of such technology transfer. These competencies include quantitative and qualitative methods such as the use of metaphors, observation and ethnography to define culture, develop information systems, and integrate new technology in organizations.

Other important managerial competencies include behavioral techniques to foster participation, collaboration and conflict resolution including focus groups, delphi and nominal group techniques, and team-building. These intervention techniques reinforce organization members' contribution to information technology transfer both within organizations receiving such transfer and throughout collaborative networks.

Managerial research roles contribute to ongoing experimentation required for technology transfer and its successful appropriation in organizations of diverse cultures. The manager as a key actor in the action research model contributes to effective strategies to meet the turbulent economic environment of the 1990s (Weiss): early diagnosis of environmental trends, flexibility to adjust organizational policies to rapidly evolving contingencies, continuous organizational and individual learning to cope with increased information, and development of technical and scientific potential to face future competitive environments.

The action research principles identified in this paper are the following:

1. Definition of information technology transfer in the context of an innovative network of institutions linking research centers, universities and business enterprises and other actors across national boundaries.
2. Multilateral commitment to technology transfer engaging policy-makers, researchers, and organization management as well as technical operators in conceptual and implementation phases of technological innovation.
3. Interactive processes among institutional network members and organizational actors to generate a multilateral consensus on technology and work organization to foster validation of conceptual and operational models, and to control the collaborative process of technology transfer.
4. Definition of organization change as a continuous experiment to ensure critical evaluation of new organization arrangements and an ongoing process of innovation.
5. Recognition of organizational culture as a foundation of technology transfer and organization change through research techniques integrated in the information system development methodology such as issue-focused interviews, and metaphors to describe organizational structures and processes.

Future research on networks for international technology transfer should focus on elaboration of these principles and the dynamics of effective institutional networks for processes of continuing system learning, innovation and technology transfer across cultural boundaries.

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zept der Technologieentwicklung gegenübersteht? Warum sind Wissenschafts- und Technologiepolitik trotzdem in ihrer Absicht ein und dasselbe?

Die neue Verbindung zwischen Wissenschaft, Technologie und Gesellschaft, ihr neues Konzept, wird vorangedrängt, da das Entwicklungsmodell, welches wir in Europa benutzen, immer noch sowohl Wissenschaft als auch Technologie als endogene Wirtschaftsfaktoren betrachtet, was sie nicht sind. In dieser Arbeit stellen wir die Frage, ob die wissenschaftlichen und technologischen Fortschritte auf der höheren Ebene der sozio-technischen Evolution wirklich als innere Ressourcen der wirtschaftlichen Entwicklung betrachtet werden können und die Produktion von Kenntnis und Wissen als eine Funktion der Kapitalanhäufung.

Es wird argumentiert, daß die Frage des technischen Ansatzes zur Schaffung und Durchführung technologischer Vorteile und die Frage der wissenschaftlichen Erkenntnis entweder auf unternehmerischer oder staatlicher Ebene konzeptuell eins sein sollten in ihrer Absicht, aber wegen ihrer unterschiedlichen Richtung getrennt in ihrer Leistung. Das Konzept der Wissenschafts- und Technologiepolitik sollte neu betrachtet und entsprechend getrennt werden. Copyright © 1996 Elsevier Science Ltd

### ¿La ciencia-política contra tecnología-política?

#### Resumen

En la etapa más elevada de su evolución cognitiva el concepto de la gestión de la innovación se convierte en un diseño estratégico del movimiento evolucionario consciente socio-técnico. En este documento se investiga la cuestión de ¿por qué en esta etapa más elevada del desarrollo humano la política convencional científica se enfrenta con el concepto de la ingeniería del desarrollo tecnológico? Y ¿por qué, a pesar de eso, la política científica y la tecnológica siguen con una misma intención?

Se propone urgentemente la nueva vinculación entre la ciencia, la tecnología y la sociedad, su concepto nuevo, sobre la base de que el modelo de desarrollo que empleamos en Europa sigue considerando a la ciencia y a la tecnología como factores endógenos de la economía, a pesar de que no lo sean. Se pregunta si en la etapa más alta de la evolución socio-técnica los avances científicos y tecnológicos pueden realmente tomarse como recursos interiores del desarrollo económico produciendo el conocimiento como una función de la acumulación de capitales.

Se argumenta que o bien a nivel corporativo o bien a nivel gubernamental el asunto del enfoque de la ingeniería hacia la creación y hacia la implementación de la ventaja tecnológica y la cuestión de la cognición

científica deben ser concebidos como un solo concepto en cuanto a su intención pero separados en su logro, debido a sus distintas direcciones. Se debe reevaluar los conceptos de la política científica y de la política tecnológica y crear la debida separación. Copyright © 1996 Elsevier Science Ltd

### Action research for international information technology transfer: a methodology and a network model

Ann C. Séror

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### Action de recherche et transfert international de la technologie: Une méthodologie et un modèle de réseau

#### Résumé

L'objectif de cet article est de présenter une méthodologie pour l'action de recherche pour soutenir le transfert de la technologie d'information dans un contexte de développement national. L'une des approches à ce problème est de considérer l'implantation de technologies nouvelles et une nouvelle conception de l'organisation comme étant des processus parallèles et de développer des rôles directifs pour l'action de recherche dans le contexte d'un réseau interactif. La méthodologie de l'action de recherche proposée ici est conçue pour compléter le développement du système technique, tout en identifiant les demandes et les contraintes comportementales et culturelles de l'organisation. Les principes fondamentaux de cette méthodologie servent comme base pour formuler des recommandations pour de futures recherches et pratiques. Copyright © 1996 Elsevier Science Ltd

### Aktionsforschung für internationalen Transfer von Informationstechnologie: eine Methodologie und ein Netzwerkmodell

#### Abriss

Das Ziel dieser Arbeit besteht darin, eine Methodologie für Aktionsforschung zu präsentieren, um den Transfer von Informationstechnologie im Kontext von nationaler Entwicklung zu unterstützen. Ein Ansatz zu diesem Problem besteht darin, die Realisierung von neuen Technologien und die Umgestaltung von Organisationen als parallele Prozesse zu betrachten und leitende Rollen für Aktionsforschung im Kontext

eines aktiven Netzwerkmodells zu entwickeln. Die hier vorgeschlagene Aktionsforschungsmethodologie wurde erstellt, um technische Systementwicklung mit der Identifikation von Anforderungen und Beschränkungen von Organisationskultur und -verhalten zu ergänzen. Die grundlegenden Prinzipien dieser Methodologie dienen als Grundlage für die Formulierung von zukünftiger Forschung und Verfahrensweisen. Copyright © 1996 Elsevier Science Ltd

### **La investigación de acciones para la transferencia internacional de la tecnología de la información: una metodología y un modelo estructural**

#### **Resumen**

Se presenta una metodología para investigar la acción en apoyo de la transferencia de la tecnología de la información en un contexto de desarrollo nacional. Uno de los enfoques es considerar a la implementación de la tecnología y a la reestructuración de la organización como dos procesos paralelos y por tanto desarrollar puestos administrativos para la investigación de la acción en el contexto de un modelo interactivo de red. La metodología para la investigación de la acción que se propone en este documento fue concebida para complimentar al desarrollo del sistema técnico, identificando las necesidades y las limitaciones de la cultura y el comportamiento de la organización. Los principios básicos de esta metodología sirven de base para formular unas recomendaciones para la investigación y la práctica en el futuro. Copyright © 1996 Elsevier Science Ltd

### **The role of predevelopment activities and firm attributes in new product success**

Stephen A. Murphy and Vinod Kumar

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### **Rôle des activités de pré-développement et attributs des entreprises dans le succès de leurs nouveaux produits**

#### **Résumé**

La mise au point de brochures de produits se focalise surtout sur l'amélioration de l'efficacité et le taux de réussite dans le processus de développement tout en négligeant les activités qui comprennent les différentes étapes de mise au point du produit. Il en

résulte que l'on connaît mal la façon dont les pratiques de pré-développement diffèrent d'une entreprise à l'autre et on ne sait pas pourquoi. Nous avons fait une étude sur une quinzaine d'entreprises appartenant à l'industrie des circuits intégrés de l'Ontario, qui a révélé des différences intéressantes dans les pratiques de pré-développement qui affectent directement le potentiel de succès d'un nouveau produit. Nous avons pu remarquer que la taille de l'entreprise, son âge, l'intensité des activités de R&D constituaient des points de repère significatifs sur le devenir des pratiques de pré-développement. De plus, nous avons identifié quelles étaient les activités qui peuvent servir de guides dans la mise au point réussie et dans le lancement sur le marché de nouveaux produits. Copyright © 1996 Elsevier Science Ltd

### **Die Rolle von Vorentwicklungsaktivitäten und Firmenattributen beim Erfolg von neuen Produkten**

#### **Abriss**

Die Literatur über Produktentwicklung konzentriert sich hauptsächlich auf die Verbesserung von Wirksamkeit und Erfolgsraten des Entwicklungsprozesses und vernachlässigt dabei fast vollständig die Aktivitäten, die die Vorentwicklungsstufen ausmachen. Als Resultat davon wissen wir nur wenig darüber, wie oder warum sich Vorentwicklungspraktiken zwischen Firmen unterscheiden. Unsere Studie von 15 Firmen in Ontarios integrierter Leiterplattenindustrie enthüllte interessante Unterschiede zwischen Vorentwicklungspraktiken, die die Wahrscheinlichkeit des Erfolgs eines neuen Produkts direkt beeinflussen. Es wurde enthüllt, daß Firmengröße, Alter und die Intensität der F&E bedeutende Indikatoren der Vorentwicklungspraktiken waren. Außerdem wurden Aktivitäten identifiziert, die als präskriptive Richtlinie für die erfolgreiche Entwicklung und Markteinführung eines neuen Produktes dienen. Copyright © 1996 Elsevier Science Ltd

### **La importancia de las actividades de predesarrollo y las características de la empresa para el éxito de un producto nuevo**

#### **Resumen**

La información publicada acerca del desarrollo de productos se enfoca principalmente en mejorar las tasas de eficiencia y de éxito del proceso de desarrollo mientras que en gran medida no se mencionan las actividades relacionadas con las etapas de predesarrollo. Por consiguiente se sabe poco realmente acerca de las diferencias entre las prácticas de predesarrollo de distintas empresas y sus razones de ser.