

## ■ Research Paper

# A Systems View of the Evolution in Information Systems Development

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This paper proposes a three-stage information systems development (ISD) model based on the Ackoff systems view to analyze the ISD evolution from the 1950s to the 1990s. For organization as a machine, information systems (IS) are designed by information professionals. For organization as an organism, IS are developed according to the selected methodology of ISD. For organization as a social system, IS would be dualistic, one for itself and another for its components, and IS departments would also be dual: one would be inward and another outward. The study investigates the changing roles and missions of IS for the three stages and explores the evolution of ISD strategies. The model also suggests that in the social stage ISD acquiring and utilizing both the inward and the outward resources of ISD to create more value is the greatest challenge and most important task for contemporary IS managers. The implications of the model are also discussed. Copyright © 2001 John Wiley & Sons, Ltd.

**Keywords** social systems; systems view; information systems; information systems development; evolution

## INTRODUCTION

After decades of evolution, the roles and missions of information systems (IS) have dramatically changed. IS have traditionally been regarded as a product or a service, and now they have a new function as an innovative facilitator (Prahalad and Krishnan, 1999). Applications development has been the major mission of IS, but now it also focuses on information technology (IT) management. As an example, for implementing business process reengineering (BPR) in organizations, IT plays an important

role of enabler (Soliman and Youssef, 1998). Except for the development of IS for organization itself, developing interorganization systems and applications of electronic commerce should also be considered (Grover *et al.*, 1998). IS has become ubiquitous because of the current popularity of Internet technology. The web information system is rapidly growing to some extent, and is becoming a new-generation method of business data processing (Press, 1999). Information systems development (ISD) strategies are also becoming increasingly diverse and now include object-oriented methods, integrated enterprise systems and outsourcing in addition to traditional self-development and functional software packages.

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Systems scholars played a vital role in the early development of the IS field, especially in fundamental theory (Culnan, 1986; Xu, 2000; Eom, 2000). Ackoff (1967) highlighted five common erroneous assumptions made by most IS designers in the early years which were revised and then widely accepted in the field. Information requirement analysis (IRA) has been recognized as an important issue for ISD, and much of the methodology of IRA has been proposed (Davis, 1982). For example, prototyping methodology assumes that complete user information requirements cannot be obtained in the early stage, so IS designers should design a concrete system for users to derive information requirements from the interaction between users and designers. Churchman (1979) suggested that real IS designers should explore the model of the user, the reliability of the model and the meaning of the information for the user. Mason and Mitroff (1973) proposed a comprehensive definition and research framework for IS. Mason and Swanson (1979) indicated that measurement for management decisions is the foundation for the design of MIS.

Ackoff (1994; Ackoff and Gharajedaghi, 1996) provided three types of systems view to analyze the characteristics of an organization. This viewpoint is employed herein to improve our understanding of IS development. This investigation proposes a three-stage model based on Ackoff to analyze the evolution of IS development from the 1950s to the 1990s. The time period of the ISD stages is not compatible with the evolutionary stages of the modern organization as a result of the progress and limitations of information technology. However, ISD appears to evolve in a similar way to the organization when the technological limitations are discounted. The distinct stages are identified by the changing roles and missions of IS for the organization as a machine, an organism and a social system. The implications of the model are also discussed.

### THE THREE-STAGE ISD MODEL

Based on its changing roles and missions, IS development from the 1950s to the 1990s is

divided into three stages according to Ackoff's three types of systems. The model is shown in Table 1. In the mechanical stage, the IS role is to support organizations as a machine and IS missions are to support transaction processing systems and operational control. In the organismic stage, the IS role is to support organizations as an organism and IS missions are to support transaction processing systems and all levels of management. In the social stage, the IS role is to support organizations as a social system and IS missions should take account of organization, its components and other organizations of its larger systems.

#### Mechanical Stage

If we regard an organization as a machine, the mechanical system has no purpose in itself but has a function to help its owner to satisfy its purpose. The mainframe was the only choice for developing applications when information technology was being developed in the late 1950s and 1960s. Applications were designed as a machine and IS was regarded as a product as only IS professionals could design applications, ISD business-oriented programming languages being unavailable. IS primarily supported transaction processing, and well-structured systems such as general account, payroll and logistic systems (Aron, 1969) were the typical applications.

Although IS gradually developed from single-function applications, multiple-function applications, to multiple function, multi-level applications (Benjamin, 1972), IS were primarily employed to replace staff by machines, focus on cost savings, and to enhance the operational efficiency of transaction processing systems (TPS). IS was designed according to machine-like standard operating procedures because information technology could only be accessed by information specialists. Thus, the interaction between designers and users was minimized and the technology was not fully utilized.

Ackoff (1967) pointed out that managers often suffered from an overabundance of irrelevant information as a consequence of the erroneous assumptions made by most early IS

Table 1. Three-stage of information systems development

ISD stage	Mechanical stage	Organismic stage	Social stage
IS role	Support organization as a machine	Support organization as an organism	Support organization as a social system
Year(approx.)	late 1950s–1960s	1970s	1980s–
Organization purposes	For its owner	Defined by its head	Take into account its purposes as well as its components and its larger systems
Missions of IS	Support transaction processing systems (TPS) and operational control	Support TPS, operational control, management control and strategic planning	<ul style="list-style-type: none"> <li>• For organization Support TPS, operational control, management control and strategic planning; DSS/EIS/SIS Support organization to implement its strategies in the turbulent environment</li> <li>• For components Support components to achieve their purposes (by DDP) Enable individuals and groups to do better (by EUC)</li> <li>• From other organizations of larger systems Outward IS departments whose mission is also for organizations and their components</li> </ul>
ISD strategies	Designed by information technology (IT) professionals	ISD methods SDLC, BSP, CSF, prototyping (process-oriented methods)	<ul style="list-style-type: none"> <li>• To fit (high control) self-developing by process-oriented methods, object-oriented methods or CASE-aided methods</li> <li>• To adapt (partial control) Interorganization ISD Outsourcing</li> <li>• To follow (low control) Packaged systems, Enterprise systems</li> </ul>
Interaction pattern	Not much interaction (IS as a product)	User and designer	User, designer, and IS provider Organization and vendors or partners

designers. Dearden (1972) also highlighted some widespread fallacies and questioned whether management information was sufficiently homogeneous to analyze the information across all functional areas in the organization by 'super' information specialists to develop a total IS. Those comments show that the complexity of the functional knowledge and management decision

was not recognized, so management information was only generated as a by-product of TPS, and the phenomenon of information overload was widely criticized.

When IS moved from simple applications to multi-functional, multi-level systems, the importance and complexity of the systems were recognized, and the necessity for interaction

between the user and designer was also realized. Nolan's four-stage EDP growth theory (Gibson and Nolan, 1974) illustrates that after initiation and expansion stages a formalization stage corrects the rapid expansion tendency and a steering committee, usually including top management, evaluates and integrates the IS to ensure the ISD will achieve its goals. The IS enters the organismic stage when the roles and missions change from operation-oriented to management-oriented.

### Organismic Stage

The goals of an organismic system are defined by its head. Because an organismic system has to be an open system, the identification of a system goal has to consider the interactions between the system and its environment. Around the 1970s, the roles and missions of IS-supported management and decision had been widely accepted, and the advance of information technology enabled IS to become a new field. Many frameworks were proposed to integrate the distinctive IS missions for the organization as an organism. Zani (1970) provides an MIS blueprint to integrate IS to organizational strategies and structures as well as the organizational and information technological environment. Gorry and Scott Morton (1971) analyzed management information characteristics and proposed a framework with various types of decision systems. Mason and Mitroff (1973) proposed a new definition of IS and a five-dimensional research framework that included psychology type concerning information perception and evaluation, decision problem types, organizational context, evidence classifications and presentation modes.

The interaction between designers and users is a vital factor. The behavioral side of the IS has been given attention in the field (Dickson and Simmons, 1970), and the relationship of emotionality and rationality of the IS was also explored (Argyris, 1971). The relationship between IS and the power structure of an organization are also discussed herein (Keen, 1981; Markus, 1983). Numerous social factors are also considered in ISD.

The importance and difficulties of information requirement analysis (IRA) were recognized during this period. Davis (1982) proposed that there were three kinds of difficulties in obtaining accurate and complete information: the limitation of human beings as information processors, the complexity and dynamics of the requirements, and the interaction pattern between the user and designer. These factors complicated ISD and many ISD process-oriented methodologies including traditional systems development life cycle (SDLC), business systems planning (BSP), critical success factors (CSF) and prototyping were proposed to alleviate these problems (Davis, 1982).

Although many methods were available, application backlogs became commonplace, especially for the components of the organization. Meanwhile, low-cost minicomputers and microcomputers were beginning to enable components to develop their own systems. As a result, the possibility of supporting components to develop their IS was recognized. In addition, some of the functional application packages were available in the market, and ISD by buying strategy become a worthy choice (Lucas *et al.*, 1988). When the roles and missions of IS change from supporting the organization to achieve its purposes to supporting both itself and its components and the software vendors, which are components of larger systems, could play an important role in ISD in an organization, the development of IS would then enter the social stage. In the next section, we will investigate the social stage of IS from its missions to ISD strategies.

### SOCIAL STAGE IS

A social system should take account its purposes as well as the purposes of its components. Therefore, the missions of IS supported both the purposes of its organization and its components. Since the 1980s, the advance of IT enabled organizations to support their components and even individuals to do better by minicomputer, microcomputer and data communication technology.

In this stage, IS managers should also manage the interactions of their own and other organizations in their environments. Several other organizations could provide the same or a better service for ISD or IT management among organizations, components and individuals. User–designer interaction extended to more complex interactions between users, designers, partners and vendors. The internal market economy is becoming true for the internal IS component of an organization.

### Missions of IS

#### *Missions for Organization Level*

The traditional IS missions are to support transaction-processing systems and to provide management information for operational control, management control and strategic planning. IS missions become more complex and dynamic in the social stage. Decision support systems (DSS) were developed to support management decisions in certain areas (Angehrn and Jelassi, 1994). Executive information systems (EIS) were focused on supporting executives to do their jobs better, and strategic information systems (SIS) were specifically designed to support strategic planning (Grover *et al.*, 1998).

The IS social stage missions extend beyond developing application systems for organization since it also includes enabling organizations to implement its IT management strategies in a turbulent environment to create and sustain a competitive advantage. In fact, IT enables businesses to employ different strategies (Earl and Feeny, 2000). How to link IT to play these new roles needs more understanding about the model of the user, and it becomes a new challenge for IS personnel in the new stage.

#### *Missions for Component Level*

IS should empower components to achieve their own purposes. Each component can develop their application systems and then overcome some of the system backlog problems because minicomputers, microcomputers and data communication technology makes distributed data processing (DDP) possible. End-user computing

(EUC) enhances individual performance and learning to elevate individual and group productivity (Gerrity and Rockart, 1986). Indeed, end-user computing applications are increasing in light of the development of microcomputers, local area networks and client/server computing.

Although advanced IT is enabling organizations to support components and achieve more goals, it produces many conflicts when IS would like to appease both the components and the organization. Therefore, many organizations establish information centers to coordinate conflicts between the organization and end-users. The requirements of the new IT management functions should be satisfied since the skill requirements of an information center differ from those of the ISD (Rainer and Carr, 1992).

#### *Missions of Other Organizations*

The main challenge for the IS department may come from other organizations of the larger systems (the environment) during the social stage. No other cooperative and competitive mechanism previously existed in an organization until dedicated functional packages emerged in the late 1970s. Today, many specialized information service firms, which may be called IS providers, currently function in the same way as the previous IS department within an organization. Because these IS providers widely interact with customers, their employees possess more professional knowledge and initiative (Quinn, 1999). These IS providers offer the organization an additional choice to ISD or IT management. This makes the internal market economy possible. Therefore, missions to support both the purposes of organization and its components may come from inside as well as outside during the social stage. Outward IS departments come from other organizations within the larger systems, which may cooperate and compete with the inward IS department.

Although both inward and outward IS departments can develop IS for organizations or its components, the two departments have certain differences. Table 2 lists the four dimensions employed to distinguish the two departments: information requirements, social factors con-

Table 2. Difference between inward and outward IS departments

	Inward IS department	outward IS department
information requirements	Some unique and special information requirements should be considered	Tend to develop a rationale to collect and derive common requirements
Social factors concerned	Should be considered	Tend to be ignored
Knowledge and experience	Organization-oriented	Functional-oriented or industry-oriented
Information activity efforts	Should devote to the maintenance and improvement of legacy systems	More innovative to create new types of applications by new technology (division of labor in social level)

cerned, knowledge and experience, and information activity efforts.

For information requirements, because IS personnel of the outward IS department interact with users in many organizations, they have the opportunity to divide requirements into two sets for a given IS: one is composed of common, general requirements for most of the organizations, and the other is composed of unique, special requirements for some organizations. It is obvious that IS professionals tend to design systems according to general requirements because these rules may be developed into a set of assumptions or guidelines to become a rationale for an information requirements analysis of a given IS. However, some unique and special requirements should be considered by inward IS personnel.

Regarding the social factors concerned, outward IS professionals tend to develop systems from a rational, objective point of view. Thus, the traditional ISD order paradigm and objective viewpoint (Hirschheim and Klein, 1989) will be reinforced. Although the possibility of conflict and subjective dimension will be ignored, social factors such as emotionality (Argyris, 1971), power structure (Markus, 1983) and individual differences (Zmud, 1979) are considered by inward IS personnel.

For knowledge and experience needed for ISD, outward IS professionals tend to be functionally oriented or industrially oriented. To develop a comprehensive functional IS for organizations, much functional knowledge and related knowl-

edge may be required. For example, accounting IS requires accounting, cost accounting, managerial accounting and auditing. In addition, the requirements of governmental regulations should also be considered. Outward IS professionals have more opportunity to accumulate experience in employing standard and so-called best practice for the industry when developing special industrial IS. As an example, outward IS professionals who provide IS services to hospitals may have more experience of outpatient and inpatient information processing, bed management, general information requirements for hospital management, medical research, medical insurance companies and governmental regulations. Therefore, for these comprehensive functional IS or integrated IS of some industries, outward IS departments provide an excellent service for their customers. But for organizations that need to integrate their own IS to develop their core competence, inward IS departments would be required.

For information activity efforts, inward IS departments are fully responsible for mission-critical legacy information systems. The manpower needed for IS maintenance is about half that devoted to maintaining legacy systems to correct errors, enhance performance and revise systems to meet new requirements. Although certain outward IS departments devote their efforts to maintaining developed systems, many of them may devote the majority of their resources to creating new applications to meet or even create requirements for potential

Table 3. ISD approaches for social stage

ISD approach	degree of control	Strategy	Main interaction
Self-develop	High-control	Fit	User/designer
Interorganizational IS Outsourcing	Middle control Collaborative control by organization and partners	Adapt	User/designer/partner
Functional packages Enterprise systems	Low control (control by vendor) because the desired states of the system are defined by vendors	Follow	User/designer/vendor

customers. Thus, it is significantly easier for these outward IS departments to develop new systems than for the inward IS departments.

### Strategies of ISD

ISD strategies in the social stage can be divided into three strategies—fit, adapt, and follow—and five approaches—self-development, inter-organization system, outsourcing, package software, and enterprise system—as shown in Table 3. The fitting strategy is highly controlled because the IS are developed by inward IS departments and it can be designed to fit the organizational context. The following strategy is a low-control IS strategy developed by outward IS departments, and the desired state of the systems is defined by vendors. The adapting strategy is a middle-control IS strategy developed by both inward and outward IS departments.

#### *Self-Development*

IS are traditionally developed by inward IS departments. The quality of an IS depends on the development process because they are complex systems (Chroust, 1994). Although no ISD methods can completely support the development process, systems ideas can clarify perceptions of the processes (Xu, 1995), and contingency models can be used to assess certain methods (El Louadi *et al.*, 1998). In addition, some special IS management decisions such as DSS, EIS and SIS may be developed according to the required management information. IS for components tend to be single-function applica-

tions. DDP may be used to develop the systems and the end-user developers may play a significant role in the ISD. The degree of control over IS is high whether IS is developed from inward IS professionals or end-users.

In addition to traditional process-oriented methods, many new object-oriented and CASE-aided methods used for ISD have been developed for this stage. For example, software development has utilized object-oriented methods since 1988 (Wieringa, 1998) and now frequently use this method to develop business IS (Fedorowicz and Villeneuve, 1999). In addition, a CASE-aided method or template approach, proposed to make ISD faster, better and cheaper (Hofman and Rockart, 1994), emphasizes creation and maintenance in the design phase instead of the implementation phase.

Because new methods are proliferated rapidly in the social stage and many of the new methods are a required new way of thinking, the cost of learning a new method is getting higher. However, after learning and adjustment, these new methods can dramatically improve the productivity of ISD. This implies that qualified IS professionals will become a scarce resource and the manpower needed for ISD will be beyond the capacity that an organization can afford. This also implies that it may be necessary for an organization to get help from outward IS departments.

#### *Interorganizational IS*

Interorganizational systems (IOS) have been the most successful examples of competitive IS that link organizations to their suppliers, distributors

and end-users (Fredriksson and Vilgon, 1996). Network technology developments have enabled IOS to increase the variety of relationships between the organizations by developing 'symbiotic networks' to form horizontal alliances (Volkoff *et al.*, 1999). The systems are developed by some kinds of cooperation type (Kumar and Dissel, 1996), such as pooled interdependency, sequential interdependency and reciprocal interdependency. These different types of interdependency will affect the interorganization structure and may cause conflict between organizations (Kumar and Crook, 1999).

#### *Outsourcing*

Outsourcing has recently become one of the most popular ISD or IT management strategies (DiRomualdo and Gurbaxani, 1998). Traditional productions or purchasing decisions are insufficient for the ISD because self-development may produce application systems backlogs or purchasing package software may not satisfy the organizational requirements. Outsourcing decisions involve numerous concerns such as: Which part of the IS or IT function should be outsourced? What types of outsourcing can be considered? How to manage contracts to ensure quality?

A function should be outsourced if it can be regarded as a commodity, but it should be developed in-house if the function is a strategic service. Some authors (Lacity *et al.*, 1995) suggest that the underlying assumption of the viewpoint is too simple to operate, so the objective of how to maximize flexibility and control should be considered. Others (Quinn, 1999) argue that most organizations may outsource activities outside of its core competencies. A comprehensive outsourcing model (McCray and Clark, 1999) is proposed to demonstrate the complexity and dynamics of the outsourcing decision structure. The types of outsourcing proposed for further analysis include: total outsourcing, multiple-supplier sourcing, joint venture/strategic alliance sourcing and insourcing (Currie and Willcocks, 1998). Various contract models are also described to enhance the management of outsourcing contracts: fee-for-service contracts, strategic alliances/partnerships, and buying-

in of vendor resources (Lacity and Willcocks, 1998).

#### *Purchasing Package Software*

Perhaps the fastest and cheapest way to implement an IS is to purchase a software package. Small businesses generally implement an IS by purchasing packaged software to meet their needs because they lack both the IS professionals and financial resources (Chau, 1995). However, some risks have been proposed in the acquisition of dedicated functional packages, such as the ability of the package to meet user needs, the user may have to change their working procedures, and the user may become dependent on the vendors, etc. (Lucas *et al.*, 1988). Moreover, certain discrepancies often exist between the user's need and the package's functions because the package is the solution of the vendors (Sherer, 1993).

#### *Enterprise System*

After decades of ISD, many organizations are currently struggling to develop compatible IS and consistent operating practices, and integrated problems of IS become too difficult (Davenport, 1998). Therefore, highly integrated enterprise systems become an attractive solution for the organizations. However, users are discouraged from modifying systems because the systems are complex, cross-functional, integrated and designed according to the so-called best practice by vendors (Glass, 1998; Pereira, 1999). Therefore, an organization will be under the control of the systems if its development is not carefully planned. In addition, although an enterprise system is an integrated system, at least 20% of each customer's required functionality goes unfulfilled (Scott and Kaindl, 2000). As a result, putting the enterprise into enterprise system is also a complex decision that needs much effort to implement.

#### **Challenges for Social Stage ISD**

In the social stage ISD, the first challenge is to collect and filter information about the outward resources to derive evaluation proposals and



obtain valuable information to support ISD decisions. The principal advantage of social stage ISD is the very rich external resources available to organizations. However, organizations must make additional efforts to convert these resources into feasible solutions. The environment offers too many options with respect to enterprise systems, functional packages, inter-organization and outsourcing. Information regarding the acquisition and utilization of the supersystem resources is overloaded, so evaluation studies are needed before potential solutions can become workable.

The second challenge is about the difficulties of IS integration. Many organizations used to sacrifice control to survive, develop and accelerate growth. The social stage ISD shares the same approach. Some of the IS do not need to be developed through inward functions because the outward functions can support faster and effective development of IS to some extent. However, the diversified, outward-developed IS are not easily integrated. The MIS department will not be able to build an integrated IS through so-called federation subsystems in the previous stage. How to integrate IS from diversified, low-controlled subsystems to provide integrated information to support decision-making deserves further consideration.

The third challenge concerns the components' IS. For ISD in an organization, priority setting in the previous stage ISD would prioritize the organization level IS over its components; however, the social stage ISD order of priority requires further adjustment to ensure that the components' objectives can also be achieved.

The final challenge is on the thinking and learning of MIS professionals, since IS missions have become diversified and the ISD strategies more complicated. The principal IS mission was to establish critical, cross-functional applications for an organization, but the new stage MIS department should simultaneously consider the objectives of its components, supersystems and the system itself. IS professionals require new ways of thinking on how to develop IS to satisfy diversified missions using limited inward human resources and greater interactions between inward and outward functions. In

addition, the ISD method tends towards diversification and demands a more sophisticated learning process to improve the productivity of the IS professionals.

## DISCUSSION

Social stage ISD faces new challenges, especially as available MIS human resources become scarcer. Many new applications such as e-commerce are creating new requirements which the MIS department should be able to satisfy. However, many new outward resources are available from the environment on which social stage ISD more deeply depends. Proper integration of outward resources into the ISD would create great opportunities for ISD. The next section discusses how to meet the new stage of ISD challenges.

### Outward Functions in the MIS Department

The social stage ISD is characterized by the wealth of resources available outside organizations. The numerous options provided by the environment produce excessive information; hence filtering to produce meaningful information to support ISD decisions warrants further exploration. It means that the IS department would set up its outward functions to acquire and utilize outward resources for its ISD. The functions may be in the form of project teams responsible for collecting, analyzing and filtering the outward information, and proposing evaluation as a basis for ISD decisions. The functions may also include task forces to maintain continuous re-filtering and re-evaluation. Moreover, outward functions can serve as the interface between the organization and its outward functions and between inward IS professionals and the functional department personnel in an organization.

For instance, if an organization is considering enterprise systems as a potential solution to ISD, then the MIS department may establish a project team to conduct a study of filtering and evaluation. Enterprise systems seem to be far more

complex than functional packages, with lower flexibility and higher cost. Therefore, prior studies must be included to collect, filter and evaluate information about the outward resources. The principal tasks of this period include understanding and evaluation of systems' products and vendors, including their strengths and limitations. Following preliminary evaluation, the impacts of the translation from the existing operating procedures to the so-called 'best practice' procedures should also be evaluated. A comprehensive study may include the study of conventional technical, cost/benefit, operating procedures, as well as organizational and behavioral analyses. The study may also address the problem of integration for future ISD. Naturally, project team members could include functional and MIS department personnel, consultants familiar with the systems, and representatives of the vendors. Once the systems have been installed and implemented, the main tasks may be shifted to a task force. Continuous re-filtering and re-evaluating the systems is required because new versions or new functions may be available in the future.

In the case of outsourcing, establishing a task force to search continuously for possible outsourcing partners may be appropriate. The primary mission of the force is to set up a scanning, filtering and evaluation mechanism for outsourcing partners. The team's tasks also include suggesting the type of contracts and playing roles of interface between MIS department and the outsourcing partners. Scanning information about outward outsourcing partners is onerous and involves collecting information about outsourcing partners in the larger systems, past performance and customers' evaluation of the potential partners, the new IT they employ and contract features. In sum, the task force is responsible for setting up and maintaining a mechanism for scanning, filtering and evaluating potential outsourcing partners, and estimating the transaction cost for the outsourcing decisions.

When teams perform collection and evaluation of outward resources, the members of the teams should also understand the internal requirements and operating mechanisms of the organi-

zation. This means that outward and inward functions are complementary. Information collected, filtered and evaluated by outward functions is valuable for inward functions such as introducing industry standards and best practice, and innovative techniques that could accelerate inward IS learning. Information about the ISD status of the environment may also stimulate the IS department into instituting necessary reforms or accelerating learning.

### Needs to Resolve Integration Problems

One of the most important missions of the MIS department is ISD. However, a professional manpower shortage in social stage ISD would force the MIS department to develop fewer application systems. Other applications would be relegated to different ISD strategies, such as outsourcing and enterprise systems. Unfortunately the results of the diversified development of application systems create integration difficulties. The integration of IS in the previous stage is based on self-developed systems, giving the MIS department a high degree of control. As ISD becomes more diverse, future integration should be built on low-controlled IS. IS integration approaches evolved from total systems, federations of subsystems, to selected integrated systems. Integrated systems cannot be assumed out there and should be carefully identified since the systems may be limited by the outward-developed systems. Therefore, an in-depth analysis of integration objectives and a comprehensive understanding of existing IS characteristics and limitations should be conducted. The feasibility of the desired integrated systems can then be confirmed.

Therefore, the MIS department should establish integration projects or task forces to identify, analyze and implement possible integrated systems to provide integrated information for decision making. The scope of the analysis of the integration team may also include computing infrastructure, information requirements and databases. In fact, MIS key issue surveys revealed that information architecture and data resources were the most important issues in the

early 1990s (Niederman *et al.*, 1991), and establishing a responsive IT infrastructure was the top issue in the mid-1990s (Brancheau *et al.*, 1996).

The integration teams should also learn new tools and methods to increase productivity such as integrating the information from heterogeneous databases using open database connectivity (ODBC) or middleware. Data warehouse methods integrate databases by collecting, restructuring and developing subject-oriented databases to provide cleaned and integrated information (Gray and Watson, 1998). Data-mining methods support the knowledge discovery in databases (KDD) process by investigating the data pattern in larger databases (Fayyad *et al.*, 1996). With object-oriented methods, each system can build various types of independent functioning components. The integration team can benefit greatly from the construction of loose-coupling integrated systems by using the black box approach to collect and analyze components from various diversified systems for building object bases and conducting a detailed analysis of the input and output of various objects.

### More Autonomy for Functional ISD

An organization should serve the purposes of their components in the social stage, and functional ISD ought to have more autonomy. There existed too many applications backlogs and the components requirements could not be satisfied since IS professionals were busy to develop critical, cross-functional IS. The components can now develop their own systems via the DDP or EUC. Moreover, dedicated functional packages have become a popular IS implementation solution for components. The success of the functional packages suggests that the package systems have the ability to provide functional information more efficiently to some extent.

Components often have at least dual supersystems: one is the organization of which it is a part, and the other is their professional supersystem. Therefore, a component IS must not only satisfy the information requirements of their organization but also those of their professional

supersystems. As an instance, the accounting department must provide management accounting information to the managers of the organization but also provide information to the government, investors and auditors. An international company may also have to provide accounting information to their headquarters and the local government. Because many of those information requirements from the environment belong to some functional requirements in an organization, the IS of functional components should satisfy all of the functional, outward requirements from the environment. Usually those outward requirements may increase due to more and more interaction of the organization and its environment.

A component IS may have to provide both the inward and outward information requirements of their dual supersystems. Functional packages are popular because the systems are developed by the functional professionals from outward IS departments whereas the ability to provide outward requirements will be limited if an IS is developed inward. Outward IT professionals have more knowledge and experience to develop packages that satisfy the functional information requirements of both functional components and their outward functional information requirements.

### Systems Thinking and Learning

Perhaps the greatest challenge for the MIS department is to develop IS to add more value. In the social stage ISD, identifying the mission-critical applications and providing integrated information to support decision making with scarce IS professionals are more complicated. Churchman (1979) pointed out that MIS professionals with systems thinking should focus on the world of the user, be able to analyze the meaning of information for the user, and then realize the true benefit of IS. MIS professionals should continually explore and understand the users' world and then relate the meaning of information to the users' model to create added value by IS. MIS professionals thus require systems thinking to examine the real objectives

and missions of the MIS department and to focus the limited IS resources on the most effective tasks. In an increasing complex and dynamic environment, MIS professionals need systems thinking to help them to see the whole picture, thereby consolidating IT to add more value so as to increase the competitive power of an organization.

An MIS professional with systems thinking focuses on defining and analyzing the problems before applying IT to establish feasible solutions. Since defining problems has recently become more complicated, a conscious learning process is needed (Churchman *et al.*, 1957). An MIS professional with conscious learning could continually sense, detect and identify ISD problems, and reflectively change goals if necessary to ensure that the resources were available for more value-added tasks. In short, the professional should be able by in-depth learning to find the fundamentals underlying the problems and not just analyze the symptoms. We believe that comprehensive analysis of ISD problems with systems thinking and conscious learning can better enable MIS professionals to identify ISD problems and to improve their productivity.

Importing internal competition mechanism for the MIS department can also accelerate learning, allowing MIS inward and outward functions to be cooperative but competitive. In the past, only the MIS department could solve ISD problems such that the main ISD problem was selecting the ISD methodology. Many solutions involving outward resources can be employed in social stage ISD, and the MIS department faces competition from these new available strategies. The outward functions may propose another solution to the same ISD projects. This competition mechanism will speed up the learning of the inward functions through more competition pressures and innovative proposals from outward functions. The mechanism would also increase the democratic process for ISD, from which many new views, methods and tools are disclosed.

### Managing the interactions

The rate of IT development is accelerating in the social stage. More platforms, applications, IS

methods and ISD solutions are now available. In this turbulent environment, IS missions should be continuously identified to support the organization as a social system. By the viewpoints of living systems, the higher the level of systems, the more complex they are required to be to survive (Miller, 1978). Therefore, how to increase the variety to create more value becomes the greatest challenge and most important task for the contemporary IS manager. All available resources, ISD strategies and interaction patterns of user, designers, partners and vendors should be considered. Therefore, it is necessary to increase the variety of the MIS department by acquiring and accumulating new IT knowledge and experience, as well as ISD methods and tools.

How to manage interactions to increase variety is more important. IS manager should manage: (1) the interactions between the IS department and their organization; (2) interactions between the IS department and other components in the organization; and (3) interactions between the IS department and other organization, and outward IS departments of the larger systems.

For interactions between the IS department and their organization, IS departments may develop critical IS for an organization, design special IS to support management and decisions according to the requirements of the managers and decision-makers in the organization. The more IS professionals understand the model of the user and the meaning of the information for the user, the more the quality of the IS will be improved. In addition, the IS department may play an important role in supporting the organization in implementing its strategies.

For interactions between the IS department and other components in organization, IS departments may develop IS for other components, support them to design their own IS, or help them locate and evaluate functional packages to increase the variety of the components. IS departments may also establish information centers to enhance the productivity of the end-user or train end-users to develop their own IS. In addition, IS departments may provide a standard to coordinate the activity of the end-user computing in the organization.

The most complex and significant interactions are those between the inward and outward functions of the IS department in the social stage. Outward IS departments may possess more qualified IS professionals with better development methods and new skills. Therefore, instead of focusing on ISD or IT management within the organization, the IS manager must discover and evaluate potential partners and competitors to increase the IS department variety.

## CONCLUSION

This study proposes a three-stage ISD model based on Ackoff's systems view to analyze the evolution of ISD from the 1950s to the 1950s. IS development was divided into three stages according to the changing roles and missions of the IS. For organization as a machine, IS are designed by information professionals. For organization as an organism, IS are developed under the selected methodology of ISD. And for organization as a social system, IS would be dualistic, one for itself and another for its components, and IS departments also be dual: one is inward and another is outward. More ISD strategies are available in the social stage. The proposed model divides the strategies into three kinds by level of control. The fitting strategy is a highly controlled strategy because IS is developed by an inward IS department and the IS can be designed to fit the organizational context. The following strategy is a low-control strategy developed by an outward IS department and the desired state of the systems are defined by vendors. The adapting strategy is a middle control strategy where IS is developed by both inward and outward IS departments.

In the social stage ISD, inward IS professionals are scarce and the outward resources are abundant. Many challenges should be met and new problems resolved. Acquiring and utilizing both inward and outward resources for ISD to create more value is most the challenging and important task for contemporary IS managers. The MIS department may set up outward functions to collect, filter and analyze information about outward resources to provide evalua-

tion proposals and valuable information to support ISD decisions. MIS professionals need system thinking to help them to view the whole picture, consolidating IT to add more values to increase the competitive power of an organization. IS managers can also introduce an internal market economy mechanism for ISD to accelerate the learning process of the inward functions through more competition and innovative proposals from outward functions during the social stage.

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