

An Action-Oriented Perspective of Information Systems in Organizations

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Abstract

Despite the best efforts of researchers and practitioners, information system (IS) failures continue to occur. IS projects are not carried out in isolation, and organizational factors can affect the project outcome. Using a case study conducted at a large, multinational organization, this research investigates the roles users perceive an information system to play. The purpose is not to animate the information system and give it life of its own, but rather, to make explicit the socially constructed roles conferred on the information system by the users. The role which an individual perceives an information system to be playing is determined by three factors: the combination of business knowledge and information systems knowledge of the individual, the socially constructed image of the information system, and the functionality provided by the information system.

Keywords: ERP systems, information technology, organizational structure, technology-organization fit

Introduction

Despite the best efforts of researchers and practitioners, information system (IS) failures continue to occur (Lyytinen & Robey, 1999). IS projects are not carried out in isolation, and organizational factors can affect the project outcome. There exists a significant body of research concerning the impact of information technology (IT) on organizations (Lucas & Baroudi, 1994; Robey & Boudreau, 1999).

Previous research has investigated the causal relations between prerequisites for system use and system use, user satisfaction, and impact (DeLone and McLean, 1992). Researchers have examined the relationship between user participation in systems development and system use (DeLone, 1988; Hartwick and Barki, 1994; McKeen et al., 1994; Tait and Vessey, 1988; Hirschheim, 1985). In all of these studies, the information system is viewed as an object that is used by people.

This paper takes a social constructionist stance (Berger and Luckmann, 1967). It explores the roles the informa-

tion system is perceived to play by its users. In actor network theory, the information system is viewed as an actor interacting with other technological and social elements of the network. Actor network theory describes how the information system acts as a change agent or an enemy of those who want change in the organization (Hanseth and Braa, 1998).

This paper discusses the influence that information systems have had on the organizing process and organizational structure in a large, multinational company. Even though the actual case study focuses on the roles played by an Enterprise Resource Planning (ERP) system in the company, the concepts discussed in this paper apply equally well to other types of information systems such as knowledge management systems, active data warehouses, and operational data stores.

Alignment of Organizational Infrastructure and Technological Infrastructure

It is widely posited that to fully leverage IT functionality, business operations and IT investments should be strategically coordinated and closely aligned (Henderson & Venkatraman, 1993; Star & Ruhleder, 1996; Agarwal, Krudys, and Tanniru, 1997). The infrastructure alignment is the functional linkage between the organizational and the technical infrastructures that reflects the need to ensure internal coherence between the organizational requirements on the one hand, and the delivery capability of the information systems function on the other. Infrastructure

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alignment is the fit of the organization and IT through simultaneous development of infrastructures, where respective design issues are jointly addressed.

Organizational structure is enacted or modified continuously (Giddens, 1984). This implies that we must continuously review and upgrade the functionality of the information system in order to ensure that the functionality provided by the information system is capable of satisfying the information requirements of the changing organizational structure.

Five Roles of an Information System

Five roles were identified, which an information system is perceived to play by the users in an organization: *Bureaucrat*, *Manipulator*, *Administrator*, *Consultant* and *Dismissed*. *Dismissed* signifies an information system that is not used at all by the intended users. A large variety of roles that an information system could be perceived to play in an organization were considered. The five roles described in Table 1 were the most meaningful in the context of the current research.

Different individuals in the organization may view the information system as playing different roles. Therefore, these roles may coexist simultaneously. When we attempt to achieve an alignment of organizational structure and IS functionality we must consider the multiple roles which an information system may be perceived to be playing.

Dimensions Affecting User Perceptions of Information Systems

The way an information system is used is influenced by the perceived fit between the organizational structure in the company and the IS functionality. The information system may be used in ways that either match or do not match the organizational structure and business processes. Due to communication gaps between the system designers and the end users, the information system may be used in ways not originally intended or may not be used at all. This dimension is labeled “IS fit with organizational structure.” “IS fit with organizational structure” may vary from “good fit” to “poor fit.” The dimension “IS fit with organizational structure” is, to some extent, a mentally constructed one. The user who has a better understanding of a

<i>Bureaucrat</i>	A <i>Bureaucrat</i> is an official who adheres strictly to the rules and principles laid down for him, rather than making decisions on a case-by-case basis. An information system perceived to play the role of a <i>Bureaucrat</i> maintains the structure in the organization. It makes certain that the enactment of structure conforms to the existing rules. This may at times seem inflexible. However, the structure it enforces is one accepted by its users.
<i>Manipulator</i>	A <i>Manipulator</i> is someone who controls, directs, or influences others in a way that is not entirely of their choosing. The information system may be perceived to play the role of a <i>Manipulator</i> if it is allowed to change or conserve work processes in ways not intended or desired by its users. If users, with or without external pressure, feel bound by the use of the information system, it may take on the <i>Manipulator</i> role.
<i>Consultant</i>	A <i>Consultant</i> is someone contracted to perform specific, nontrivial tasks, and to provide advice. The <i>Consultant</i> is neither responsible for, nor in control of, the work the organization performs. An information system perceived to play the role of a <i>Consultant</i> provides the user with a variety of solutions. The use of the system follows the user’s wishes and leaves the user in control. For this to happen, the user has to understand the advice provided and be in a position to exercise the freedom of choice.
<i>Administrator</i>	An <i>Administrator</i> is someone who takes care of less complicated tasks in an orderly way. An information system perceived to play the role of an <i>Administrator</i> is not used to the same extent as the information system acting as a <i>Manipulator</i> or a <i>Bureaucrat</i> . The information system administers and simplifies record keeping and dissemination of data, but does not affect the processes and the structure of the organization in any fundamental way. The user takes a more active role and the information system is put to limited use.
<i>Dismissed</i>	The <i>Dismissed</i> is someone who has been temporarily dismissed from work, but may be reinstated at some later point in time. The <i>Dismissed</i> system is not used at all by its intended users. The information system that is <i>Dismissed</i> becomes redundant. To keep dismissing the system, the user will need good reasons and have a strong bargaining position within the organization. Purchasing and installing an information system is costly, and the <i>Dismissed</i> system provides no return on investment.

Table 1. Five Roles of an Information System

system may find and use functionality that supports the existing way of working, whereas a user who has a poorer understanding of the system and/or the business may fail to detect how the system can be used to support the existing way of working.

The way an information system is used is also influenced by the user's perception of how the system is trying to influence the user's work. Individuals may be constrained in their actions by the information system. Alternatively users may use the information system in ways that support, but do not control, the way the work is performed. This dimension is referred to as "direction of control." "Direction of control" may vary from "IS controls actions" to "individuals control actions." Who is viewed as being in control: the user or the information system? This is, to a large extent, a matter of perception. The more knowledgeable the user is regarding the information system and the business processes and tasks, the easier it is to gain a sense of control.

Thus four different roles that users may perceive the information system to be playing can be identified (see Figure 1). In the upper half of the figure, when the IS controls actions, the *Bureaucrat* represents good fit between IS and organizational structure, and the *Manipulator* represents poor fit between IS and organizational structure. In the bottom half of the figure where the user controls the actions, the *Consultant* represents good fit between IS and organizational structure and the *Administrator* represents

poor fit between IS and organizational structure. The fifth role, the *Dismissed*, is the role the information system is perceived to play if it is discarded or ignored by its intended users.

The discussion of the roles an information system is perceived to be playing by its users is based on a case study of the implementation and use of an ERP system in Asea Brown Boveri (ABB). The history of the system goes back several decades, but the focus of the study is on the last decade.

The Use of ERP Systems in Organizations

During the past few decades, organizations have focused on IT and have implemented various applications to automate their business processes. These applications were not developed in a coordinated way but have evolved as a result of the latest technological innovation (Themistocleous & Irani, 2000). The IT infrastructure in several organizations consists of autonomous and in many cases heterogeneous solutions (Klasell & Dudgeon, 1998). This situation has caused various integration problems as applications could not cooperate and disparate IT solutions could not work together.

During the 1990's, Enterprise Resource Planning (ERP) systems were introduced as integrated suites of software that automate core corporate activities such as finance, human resources, manufacturing, supply and distribution (Gibson et. al., 1999). ERP systems let a company share

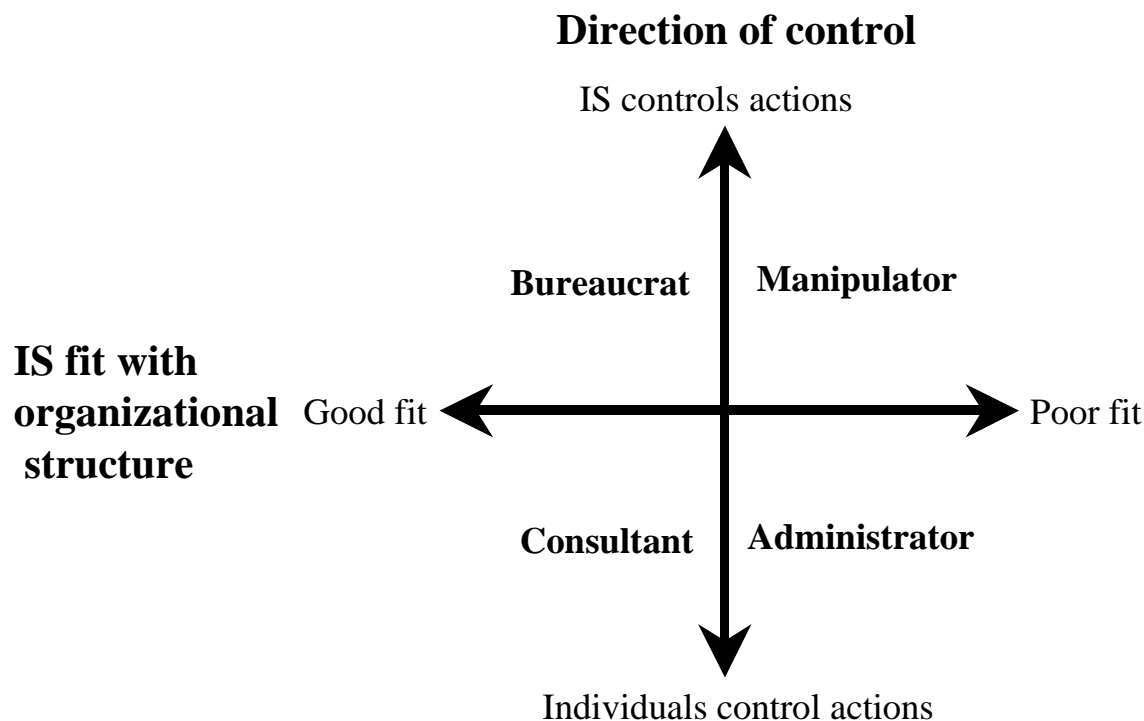


Figure 1. Dimensions Affecting User Perceptions of Information Systems

common data throughout the enterprise and allow the access of information in a real-time environment. According to Davenport (1998), ERP solutions are designed to solve the problem of fragmentation of information in large business organizations and integrate all the information flowing within a company (Spratt, 2000). The literature (Loos, 2000; Meier et al., 2000; Schonefeld & Vering, 2000) indicates that there is a need to integrate the ERP systems with the rest of the IT applications within the organization. AI technology may address this integration need (Linthicum, 1999; Hasselbring, 2000; Zahavi, 1999).

An ERP system is a business tool. Since it is used by many individuals in the organization, it becomes a tool with far-reaching influence of its own (Huges, 1987; Kling and Scacchi, 1982; Orlikowski and Gash, 1994; Robey and Azevedo, 1994; Sahay et al., 1994).

The Five Roles and Structuration

Following Giddens (1984), the term structuration is used to refer to the process of reproduction or transmutation of a social system.

- An information system perceived to be playing the role of *Dismissed* plays no part in either reproduction or transmutation of the organizational structure; it does not affect the structuration process of the organization at all.
- The *Administrator* system does not provide its users with much support and does not play a significant role in the enactment of organizational structure. The system perceived to be playing the *Administrator* role provides some support to the user without interfering too much with the way the user wants to work.
- The *Bureaucrat* system reinforces the existing organizational structure by directing enactment of structure to be consistent with the existing recommended procedures.
- The *Manipulator* system steers enactment of structure away from the way the user wants to act, and toward ways that the system endorses. This manipulation could be perceived as being both negative and positive, depending on the individual's perspective and on the change the *Manipulator* system is bringing about. In Hanseth and Braa (1998), the ERP system SAP is viewed first as a powerful change agent helping top management bring about organizational changes. Later on, SAP is viewed as everybody's enemy, resisting all organizational change. The users perceived SAP to be a *Manipulator* system in both situations. At

first, it slowly forced people to modify their enactment of structure in directions they felt uncomfortable with, and then forced a consistent re-enactment of the existing structure even when people felt that change was called for.

- The *Consultant* system influences structuration by increasing the choices available to the user and by supporting different courses of action.

The Five Roles and Individuals

The information system is not an independent, invariant, externally designed actor. It receives its character in interaction with the structure of the organization, the other information systems, and its users. The user, being influenced by the information system, thereby also confers agency on the information system — it is allowed to influence actions, and thus, also the organizational structure (Giddens, 1984).

- An information system, which has been actively rejected by its intended users is referred to as *Dismissed*.
- To enable a system to play the *Manipulator* role, the users have to obey and follow the instructions in the system. This may be done consciously and reluctantly or unknowingly and without questioning the manipulation.
- A system perceived to be playing the *Bureaucrat* role also requires its users to follow its instructions, but in this case the users agree with the instructions.
- In the *Administrator* role, the system does not have power over the users. Instead the users use the system as they like, and only selectively. It is used to supply data and record results of decisions, rather than to play an active part in the decision-making activities the user performs.
- The system perceived to be playing the *Consultant* role suggests alternative actions to the users and lets the users choose between the alternatives suggested. The support offered by the system is substantial and plays an important role in the users' work.

Research Methodology

Since the focus of the research is on investigating the roles an information system is perceived to play in an organization, a qualitative research method is appropriate (Bryman, 1989). The researcher chose an interpretive approach since

various subjective perspectives need to be taken into account and because of the complexities of the context. During the case study extensive opportunity existed for informal contact with members of the organization. The researcher was also conscious of the historical context of the situation.

In case study research, good access to the organization is crucial: access that allows the researcher to follow the course of events in history and develop an understanding of the processes and the people (Gummesson, 1991). The company Asea Brown Boveri (ABB) was selected because it had changed information systems a few years previously and had reorganized its organizational structure to accommodate the new information system.

The empirical work was done in the spring of 2001. Fifteen face-to-face interviews, each lasting between two and five hours, were conducted with a wide range of people in the organization, including the Company Division Manager, Purchasing Manager, IT Manager, Project Manager, Head Planner, Operations Planner, salespeople, IT staff, Production Leader, Constructor, Controller, Accounting Manager, and Order Planner. Some of the interviewees had been members of the ERP project team. The interviews were semi-structured. The interviewees were first asked to briefly narrate their story about how the ERP system had evolved during the last decade. Then the interviewees answered more specific questions from the researcher. The resulting case description was presented to the interviewees, who verified it.

The case study was built using a grounded approach (Glaser and Strauss, 1967). The analysis was based on the exploration of metaphors as well as on social constructionist interpretation. The research was inspired by the model of Tsoukas (1991), and the basic metaphor explored was that of the information system as an actor in the organizing process.

The Case Study

In the early 1990s, ABB was experiencing a difficult period. Even though the company was receiving more customer orders than ever, it was making losses. According to the Company Division Manager:

Why did the company have such difficulty earning money, although we had production volume? We had a lot of technical problems and other trouble. It was so expensive to resolve problems and delays. We were known for always being late, and internally we were criticized a lot.

The Logistics Manager in the division wanted to control production with the materials requirements planning

(MRP) technique. Specifically, he wanted to use the MRP II technique, which combines the MRP technique with the functionality provided by ERP systems. He received support for his ideas from the company CEO. They agreed that investing in a new ERP system was necessary to implement the ideas.

At that time the company was using an enterprise-wide system, AROS, which had first been developed in 1960. When the AROS system was initially developed, it was a good fit with the organizational structure of the company. By 1990, however, although the AROS system had been adapted over time, it no longer worked well in the organization. Initially, the AROS system was a homogeneous, well-integrated system. Over time, a variety of components had been added to the AROS system and different departments undertook further development of the system. As the AROS system evolved over time, it became a complex system that was difficult to understand by the people who were maintaining the system. Hence, it was difficult to make modifications in the system to support the organizational work. This resulted in increasing frustration and dissatisfaction with the AROS system by its users. According to the Purchasing Manager:

It seems ridiculous to those who haven't been involved, but at that time you did what the computer told you to do. The purchasers had no knowledge in material control principles. They were locked into what AROS supported them with and had no idea what happened in the program.

According to the Company Division Manager:

In the management team, we were very frustrated over not having sufficient information to manage the company. We asked for rather elementary information. They said: "Sorry you can't have it." The situation was impossible.

The AROS system had, in some sense, power over the organization. It refused to give the employees the information they needed and became a hindrance to organizational change. The Company Division Manager called the AROS system "Jack in the box" because a change in one part in the system often resulted in failure in another part of the system. Experiencing difficulties with the AROS system, the employees had developed a "quick fix" culture to work around the system. For example, they would borrow material between production orders, without registering this in the AROS system, to speed up an important order.

In 1992, a project called BLICK was started with the aim of introducing software that supported materials requirement planning. Process analysis was undertaken, but the decision on which ERP system to purchase was made

quickly and not methodically. Since a comparable organization was buying the TRITON system from BAAN, the BLICK project managers decided to purchase the TRITON system too. However, BAAN could not deliver the required system functionality. Hence, the implementation, planned for 1994, was postponed to 1996. By 1996, the organization had changed significantly. Furthermore, the training the employees had undergone in 1993 on the TRITON system and MRP principles was forgotten. According to the IT Manager:

We should have started the training all over again, but there was no backing for such measures by management... They wanted to get this delayed project finished as soon as possible.

The TRITON system that was implemented in 1996 was set up according to the configuration decided by the project members in 1993. It was a system that didn't support the organization effectively. Hence, the project group sought to change the organizational structure to fit the capabilities of the TRITON system. The installation of the TRITON system was forced on most of the employees and compelled them to operate in new ways. This led to a high level of frustration and dissatisfaction among the employees. According to the Production Leader:

At the outset, TRITON almost became a dirty word.

For every quotation, the salespeople were forced to configure a specification in the TRITON system. This took time and they could not spend as much time selling as they wanted. Shortly after the implementation of the TRITON system, they refused to use the TRITON system. Other employee groups accepted the TRITON system only after it was modified extensively. The TRITON system prevented the employees from returning to the "quick fix" culture. The operators had to finish one order before they could start another order. The accountants were able to monitor and manage the planners' and operators' actions. This allowed much more efficient tracking of data. According to the Accounting Manager:

If we just correct data and guess what it should be, then incorrect data will just continue cropping up... That's why we always try to locate who the incorrect transaction came from.

The purchasers made use of the option offered by the TRITON system of employing different replenishment models for different materials based on the attributes of each material. According to the Purchasing Manager:

In one way, the system change was a psychological revolution. You started to understand what you were doing. Today when you ask them, they actually tell

what they are up to... They even start to question our initial decision to use the MRP technique for all materials.

The Operations Planner, though, only used the TRITON system selectively. He was supposed to use the TRITON system, but instead he extracted data from the TRITON system to an Excel program and planned the production on his own. Then he entered the production data he had planned into the TRITON system. According to the Operations Planner:

We prepare the operations plan using Excel. We don't think that TRITON supports the operations planning well enough. It's intended that TRITON should calculate the timing of the start of an order but there are so many strange things. The system can't take everything into consideration and the real world is much more flexible.

By the late 1990s, the company had managed to reach the ambitious profit goals set by the ABB Corporation. It had more than doubled the amount of orders processed without increasing the number of employees. At present, it seems like a success story, but as the Accounting Manager put it, it is a journey on which you can never relax. According to the Accounting Manager:

I think that if you don't care enough, you soon end up again with a system that no one understands... It's important that you systematically train and refresh the knowledge of the employees. We have a rather high employee turnover rate, and you easily forget that.

The Five Roles of the Information System

The roles presented below result from viewing the ERP system as an actor in the process of organizational transformation. By analyzing the users' recollections of the process of information system implementation and use over more than one decade, it is possible to demonstrate how the information system changed in character over time.

Manipulator

The first system, AROS, was perceived as a *Manipulator* in the early 1990s. When it was first developed in 1960, the AROS system had been tailored to suit the business processes of the organization. However, as the business changed over time, the AROS system had been modified to such an extent that the systems analysts could no longer understand and control the complexity of the system. Further changes to the AROS system led to unexpected errors and problems. Suggestions for improvements in the com-

pany were rejected because the IS staff could not make the necessary changes in the AROS system.

When the AROS system was terminated, the BLICK project team members set up the new TRITON system in a way that they thought would help increase efficiency in the company. The TRITON system forced its users to work in a new way, which they resented. Thus, the TRITON system was also perceived as a *Manipulator* during the initial deployment and use phases of the system.

Bureaucrat

As time passed, people adapted to the way of working required by the TRITON system. Furthermore, the way the TRITON system was set up was modified to some extent to adjust to the requirements of the users. The TRITON system forced processes to operate in a systematic manner and rooted out the “quick fix mentality.” When using the AROS system, it was often the case that material was “borrowed” between orders without the changes being entered into the AROS system. The TRITON system restricted such behavior. In the TRITON system, the whole production process broke down immediately if an order was assembled using material from another order. The go ahead to start assembling an order would not be issued until all required material was present and correctly entered into the system. Irregularities showed clearly, and it was easy to demonstrate the negative effects of unofficial improvisations. The workers began to see the interconnections in the business processes more clearly. The TRITON system was perceived to be playing the role of a *Bureaucrat*.

Administrator

The TRITON system was not always given the opportunity to act as a *Bureaucrat*. The Operations Planner felt that the TRITON system was trying to take over the detailed production planning. However, the TRITON system was not very good at planning. The lead times became too long and it was not possible to adjust the capacity of different stations. The Operations Planner then extracted all the job order data from the TRITON system, planned the production schedule manually using Excel spreadsheets, and entered the resulting production plan into the TRITON system. He used the TRITON system to gather the data, but not for the more complex, decision-making parts of his work. The TRITON system relayed data to him from the Head Planner, the Order Planner, and the Configurer. The finished production plans that he subsequently entered into the TRITON system were relayed by the TRITON system to the Material Planners and the assembly workers. Thus, the TRITON system was not allowed to control the actual production planning. The TRITON system only supported record keeping and made possible the electronic commu-

nication between the order planner and the other functions — a purely administrative role.

Consultant

During the spring of 2001, the procurement practice, which was facilitated by the TRITON system, was beginning to be questioned. People started investigating other ways of carrying out the procurement activities. With the AROS system, they had been confined to the AROS way of working, and did not understand enough of the logic behind the activities to question the way things were done. Prior to the installation of the TRITON system, they had been trained in different material requirement planning techniques and how to operate the TRITON system using the different techniques. This training made them question the way the system was set up, and they learned how to adjust the TRITON system to support different planning techniques for different materials. The TRITON system was perceived as a *Consultant*. The users could decide whether to employ the competence and logic built into the TRITON system or to only receive support for the kind of material planning which they felt was appropriate.

Dismissed

The salespeople refused to use the TRITON system. The TRITON system required the salespeople to enter detailed information on prospective customers and potential orders before allowing them to make proposals to the customers and close deals with the customers. Before the salespeople could confirm the orders, the ability to manufacture the orders had to be confirmed by the planners and scheduled delivery dates had to be calculated. In principle, this would have been beneficial for the company. However, the salespeople *Dismissed* the TRITON system almost from the start, claiming that the workload for entering the data into the system was excessive. Thus, the TRITON system was *Dismissed* by the salespeople.

Discussion and Conclusions

The five roles identified in this paper stimulate discussion regarding the interplay between the use of information systems and organizational change. The purpose is not to animate the information system and give it a life of their own, but rather to make explicit the socially constructed roles conferred on the information system by the users.

The role which an individual perceives an information system to be playing is determined by three factors: the combination of business knowledge and information systems knowledge of the individual, the socially constructed image of the information system, and the functionality provided by the information system. This observation leads us to alternative solutions to the objective of achieving a good fit between the organizational structure and the

functionality provided by the information system. The revolutionary approach of replacing the information system may seem like an obvious and effective solution. However, an incremental approach consisting of training, dialogue, and reflection about the business processes, the information system, and the interplay between the two, could often be a better choice.

Strengths of the Research

The research presented in this paper is based on qualitative data. The unique strength of the qualitative research methodology is that it takes into account the research context, setting, and the participant's frame of reference. There are several advantages to using the interview method to collect data. The questions were targeted and focused directly on the phenomenon being studied. The interview data is also insightful since the interviewees were given the opportunity to provide perceived inferences regarding the phenomenon being studied.

Limitations of the Research

This research has several limitations. Since the data collection method was based on interviews conducted in a single organization, there are questions regarding whether the results observed are generalizable to other organizations. There is a need for further research that tests the generalizability of the findings via more case studies.

The use of interviews to collect data has several drawbacks. There may be inaccuracies in the data due to poor recall on the part of the interviewees since they were recalling events that had occurred during the previous decade. Interviews also suffer from the problem of reflexivity – the interviewees may provide the interviewer with information they perceive the interviewer wants to hear.

Directions for Future Research

The perceived roles of an information system, which were evoked by the users in this study are specific to the information systems in a mature, large, multinational organization. While the choice of this context revealed five different perceived roles of the information system, the study of only one context is a limitation of this research. Studies conducted in different contexts might yield additional dimensions associated with users' perceptions of information systems. As information technology evolves, the roles the information systems are perceived to play will also evolve, and will require further investigation.

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