

Issues of Human Computer Interaction

Anabela Sarmento

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Dedication

To Ivo, Pedro Ivo and Nuno Miguel,
for all the time
that I was not able to be with them.

Issues of Human Computer Interaction

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Preface

Human Computer Interaction (HCI) has its roots in the main areas of industrial engineering, human factors and cognitive psychology with the focus on the development of user-friendly IT. Traditionally, the research in this area has emphasised the technological aspect of this relationship (the *Computer*). More recently, other aspects concerning the organizational, social and human context also began to be considered (the *Human*). Today, one can say that any attempt to facilitate the relationship between the machine and the user must consider not only the technological perspective (e.g., promote the usability) but also, for instance, the way the user is going to use the technology and his or her purpose as well as the social and cultural context of this use (the *Human* and the *Computer*).

Another issue that should be considered in this interaction is the impact that information systems/technology may have on humans and organizations. There is general consensus that the adoption of any IT/IS brings change. Furthermore, IT/IS and organizations have a mutual influence on each other, meaning that this technology affects organizations and that organizations necessarily affect, for instance, the design, the choice and the management of those systems. The adoption of an IT/IS is, thus, mediated by factors that will influence the interaction between the sectors involved. It is also generally agreed that the adoption of a certain IS by different organizations does not give rise to the same changes; that is, the same technology might engender different impacts and these differences are due not to the characteristics of the technology itself, but to the characteristics of the context and the relationships that are established among all the factors involved.

It is already possible to find in the literature some models to help to assess the impact of the adoption of the technology. One could summarize all the contributions of these models by saying that the factors that should be considered in this process are (Sarmiento, 2002, 2003): (1) Technological factors, including

the characteristics of the technology that is going to be adopted and the technology already existing in the organization; (2) Structural factors, including the organizational design, the complexity, the number of hierarchical levels, the number of departments, the centralization or decentralization of power and decision making, the coordination of tasks, the formalization of procedures, the design of tasks and jobs and the degree of specialization; (3) Social and individual factors, including the multidisciplinary work teams, their distribution in time and space, their education, training, work satisfaction, skills and individual characteristics; (4) Political factors, including who decides on the kind of technology to adopt, its design and implementation, who is going to use it, its purposes and objectives; and (5) Cultural factors, norms, rules, reaction to change and organizational learning capacity.

These factors cannot be analysed in isolation as they interact with each other, influencing the effects of the adoption and use of the new IT. Moreover, it is not possible to say that one factor is more important than the other because the result of an interaction depends on the relation that is established among all the factors involved, over a period of time.

Another issue that should be considered is the understanding of the technology that is going to be implemented. This means that sometimes it is not enough to just consider the arguments advanced by the seller or reported on the leaflets to acknowledge the advantages and benefits of the technology. It is necessary to know the impacts on several organizational domains, for instance, in the coordination of the processes, in the internal communication or in the management of organizational knowledge. Furthermore, organizations must also be aware that changes might not happen in the way they expect. Some changes may not happen at all while others may occur unexpectedly.

Taking the roots of HCI, and the way it has evolved in the last few years, we wanted this book to cover the different perspectives and point towards some directions for further research. This book is divided in five sections. The first section, “Tools to Improve Usability and Web Design” deals, precisely, with the more technological aspect concerning the interaction between human and machines. Subjects such as the usability and the Web design are discussed in those chapters. Section II, “Internet and End Users’ Concerns,” includes three chapters reporting on the importance of users and their characteristics. Section III, “IT and Issues Regarding Human Resources Management,” comprises chapters debating the needs of management of human resources engendered by the adoption of new IT. Section IV, “Human and Organizational Issues Regarding IT Adoption and Use,” discusses the importance of the consideration of human aspects when choosing and adopting technology and how

neglecting these might lead to the failure of IT adoption. Finally, in Section V, “Case Studies of Human and Organizational Issues Regarding IT Adoption and Use,” we present some empirical projects that were carried out to study the impact of IT adoption and the reasons beneath some examples of IT failure.

The following is a brief description of each section and the chapters included in them.

Section I presents and discusses some tools that can be used to improve usability and Web site design.

In the first chapter, “Service-Oriented Human Computer Interaction and Scripting,” Neil McBride and Ibrahim Elbeltagi propose the concept of service-oriented human computer interaction (HCI), in which HCI derives from service design, dialog is driven by customer needs and perceptions, activities are considered and the service interaction dialog is aligned with the computer dialog. Furthermore, the authors suggest that the use of scripts can be a valuable tool to enable the development of human-computer dialogs, because it aligns more with the expectations and needs of the customers, enabling the service to meet some of the criteria of service-oriented HCI.

In Chapter II, “User Acceptance of Online Computer Games: Comparing Two Models in a Field Study,” Yuan Gao examines two models for predicting user acceptance of online computer games. These models are the technology acceptance model and the consumer behaviour model, based on marketing and advertising research. The chapter describes an empirical research method to test these models. Findings suggest that product presentation has influence on the acceptance of the technology, including online computer games.

In Chapter III, “Web-STAR: Development of Survey Tools for Use with Requirements Gathering in Web Site Development,” Jonathan Lazar, Adam Jones and Kisha-Dawn Greenidge introduce the Web-STAR (Survey Tool for Analyzing Requirements) project; this offers a standardized survey tool, which developers can use to determine the user requirements for existing or new Web sites. Chapter III also provides a background for requirements gathering and its challenges, followed by a discussion on the relevance of Web usability and the need for surveys and toolkits that aid the development process. Finally, the progress of this project is discussed.

Section II addresses issues related to end users’ concerns in an Internet context.

Chapter IV in this section, “The Use of Query Operators and Their Effect on the Results from Web Search Engines,” by Bernard J. Jansen, discusses the use of query operators such as Boolean and phrase searching to improve searching performance. The author reviews the existing literature on this subject and tests his assumptions by examining the effects of query structure on the documents retrieved by Web search services. Findings show that approximately 66% of the results were identical regardless of how the searcher entered the query, suggesting that the use of complex queries is generally not worth the effort for the typical Web searcher.

Chapter V, “Interactive Proxy for URL Correction,” by Kai-Hsiang Yang, addresses the issues of Uniform Resource Locator correction techniques in proxy servers, based on personal browsing access logs, to meet the different users’ needs. According to the research undertaken, users will no longer be too concerned with the URL (whether it is correct or not) because even when the URL entered is incorrect, they will be taken to the desired Web page.

In Chapter VI, “Emerging Practices and Standards for Designing Business Web Sites: Recommendations for Developers,” Carmine Sellitto and Andrew Wenn report some of the emerging technical design aspects of information delivery that a developer should consider in the implementation of business Web sites. These authors recommend a Web site design framework that encompasses some of the more technically based features associated with accessibility, proper html encoding and metadata elements. Some aspects concerning information quality are also discussed.

Section III deals with IT and human resources management issues.

Chapter VII of this section, “A Framework for Defining E-Business IT Skills Portfolio,” by Susy Chan and Abdulrahman A. Mirza, discusses some of the consequences of organizational change arising from the adoption of an e-commerce or e-business model. For instance, there is the need for a new IT skills portfolio. Based on a literature review, authors propose a framework that will help to guide the development of a desired skills portfolio for e-business transformation. The chapter concludes with a research agenda.

In Chapter VIII, “Issues in End-User Behavior,” Murray E. Jennex describes some action research undertaken to solve a problem concerning the high level of engineering time that was spent performing IS functions. This research contributes to the identification of issues that affect system development, use of programming standards, documentation, infrastructure integration and system support.

In Chapter IX, “Employee Perceptions of Outsourcing of Information Technology Operations: An Empirical Investigation,” Lynda Roberson Louis describes a study carried out to investigate the perceptions of employees directly involved in IT outsourcing and correlates these perceptions with factors identified in previous studies. The human factors evaluated are job security, benefits and compensation, morale, productivity, training and skills, and career opportunities. The author proposes a *modified management outsourcing adoption model* as a tool for use in management action plans to incorporate employee perspectives into the outsourcing phases, potentially leading to better agreements that benefit all parties involved.

The human and organizational issues regarding IT adoption and use are addressed in **Section IV**.

Chapter X in this section, “Surfacing Occupational Threats to IT-Enabled Change: A Neglected Role for Organization Development?” by Joe McDonagh, discusses some of the challenges that have emerged as a result of IT implementation. Although recognizing that it is the technical and economic considerations that are uppermost, during IT implementation, the author concludes that it is the human and organizational factors that should be considered to be responsible for IT failure. Results show that there is a need for a more integrated approach to the introduction of IT in organizations.

In Chapter XI, “Human Factors in the ‘System Selection’ Stage of Library Automation,” Nasrine Olson discusses issues that are relevant in the field of library and information science. The author then describes qualitative research to study how and why library workers make their choices of automated library systems. Results show that more emphasis on human issues regarding IT adoption should be considered.

In Chapter XII, “Stressing Office Technology’s Non-Technical Side: Applying Concepts from Adaptive Structuration Theory,” Huub J. M. Ruël introduces the concepts of *spirit* and *appropriation* from Adaptive Structuration Theory. A framework is developed and applied. Results show that if users have a clear image of the spirit of the IT, it will be better incorporated in their daily tasks. Based on the results, the author draws some recommendations for IT implementation and use.

Chapter XIII, “Expanding the Information Carrying Capacity of the New Media in the Context of Virtual Teams” by John D’Ambra and Zixiu Guo, considers the role of computer-mediated communication (CMC) in supporting the work of virtual teams. After a discussion concerning the characteristics of CMC,

the author presents a framework to help to study the effective use of CMC within organizations.

In Chapter XIV, “Change and Challenge: Managing the E-Business Organization,” John Mendonca describes the characteristics of e-business with its impact in organizational management, focusing on four dimensions: how organizations manage and control processes and projects, organizational design, technology transfer management and changes to the nature of work. The author considers that understanding the challenges and adopting new management styles and techniques are critical success factors for the organization.

Section V, the last section, presents some case studies dealing with the human and organizational issues regarding IT adoption and use.

Chapter XV in this section, “Data Quality and Work Alignment: Do IT Professionals Think Differently?” by Latif Al-Hakim and Hongjiang Xu, provides some theoretical background for data quality and its relation to work alignment. A theory of data quality alignment is developed and applied in four case studies. Results show that the quality of data is the most common source of business failure, as this aspect is mostly neglected by the organizational actors involved.

In Chapter XVI, “Human Issues and Computer Interaction: A Study of a U.K. Police Call Centre,” Steve Clarke, Brian Lehaney and Huw Evans describe a project developed with an action-research approach to solve some of the problems that arose after the implementation of a call centre. Authors conclude that the difficulties that were being experienced by these police officers were due to human issues that were not taken into consideration during the call centre implementation.

In the last chapter, Chapter XVII, “The Role of Group Learning in Implementation of a Personnel Management System in a Hospital,” Tatyana Bondarouk and Klaas Sikkell propose an implementation model of collaborative technologies, which is regarded as a learning process, with the following activities—collective acting, collective reflecting, knowledge dissemination, sharing understanding and mutual adjustment. This model is then applied in a longitudinal case study. Conclusions show that group-learning processes do play an important role during adoption of a new collaborative technology such as groupware systems. This group-learning process emerges immediately after the introduction of the new system and will influence the success or failure of its use.

The chapters in this book are a selection of some of the articles presented at the 2003 IRMA International Conference held in Philadelphia. They were all blind reviewed for acceptance in the conference and in this volume. I really hope that they will be enriching and inspiring and that the reader will enjoy reading them as much as I enjoyed preparing them.

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Finally, I would like to thank Mehdi Khosrow-Pour for his original editorial challenge.

Thank you all.

Anabela Sarmento

Section I

Tools to Improve Usability and Web Design

Chapter I

Service-Oriented Human Computer Interaction and Scripting

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Abstract

The emphasis of human-computer interaction (HCI) design on the technology and computer action tends to obscure consideration of the contribution of the computer interface to the service interaction. This chapter suggests that since a majority of commercial information systems support or provide services, the nature and progression of the service encounter should be a key concern of human computer interface designers. The chapter proposes the concept of service-oriented HCI in which HCI design is derived from service design, dialog is driven by customer needs and perceptions, activities that have led up to the service encounter are considered, and the service interaction dialog is aligned with the computer

dialog. As part of service-oriented HCI, the chapter illustrates the use of scripting to examine ex-post the role of a computer interaction in a service encounter. It demonstrates that the computer dialog can drive the service interaction in such a way that the quality of the interaction is reduced and customer satisfaction affected. It concludes that the role of the computer system in a service interaction is an area for further research. Furthermore, script analysis may enable the development of human-computer dialogs that meet some of the criteria of service-oriented HCI.

Introduction

Computer systems play a prime role in the support and delivery of services. For many systems their main role is in enabling service encounters between customers and providers. In health care, the role of the information system is service-oriented, supporting a range of service encounters between clinicians and patients. In many financial services, information systems support the call centre, providing the framework within which the operator and customer interact. In retailing, information systems underpin every aspect of the industry, whether taking orders, dealing with transactions or organising the warehouse. Additionally, the information system may replace the human service provider, rather than just supporting the service encounter. ATMs, self-service airline ticket dispensers and Internet shopping sites represent services entirely delivered by the computer. Here the service encounter is purely between the computer and the customer.

Since many, if not most, information systems are delivering or supporting a service, the study of the service encounter is key to the development of the human-computer interface. If the computer system is supporting a service encounter, it must be in tune with that service encounter. It must deliver the required information at the correct point in the encounter and should not dictate the progression or outcome of the encounter. Design of the HCI should be derived from an understanding of the service interaction. In many cases design of the service, using, for example, a service blueprint (Zeithaml & Bitner, 2003), should precede the design of the computer system and its human interface. Rather than a focus on data and data presentation, the focus should be on the progression of the service encounter and the progression of the dialog. Since information systems are often primarily service-oriented, HCI

design should be driven by an understanding of the service encounter. HCI concerns should move beyond screen layout, screen colours and ergonomics, to an understanding of the structure and dialogs of the service encounter.

It is often the case that the design of the computer dialog follows more the data needs of the service provider rather than the expectations and needs of the customer in the service encounter. The HCI and dialog is oriented to the data model and data requirements of the system and pays scant attention to the natural or preferred way in which a dialog progresses within the service encounter. HCI concerns focus on the capture of data, the presentation of data fields and the completeness and validity of the data. Attention may be paid to screen colours and data layout, but the HCI is essentially driven by the internal business processes of the service provider. Customers are forced into a frustrating and unnatural dialog, which supports the data needs of the computer system rather than the service concerns of the customer. One consequence of such a service dialogue, forced into a particular pattern by the computer system, is that there is a built-in failure in service quality.

Where the focus moves away from the data requirements of the computer towards the user, there is still a tendency to treat the user as the passive recipient of computer information rather than an active participant in a service encounter. Approaches that apply cinematographic techniques such as film cutting (May et al., 2003) to user interface design only serve to strengthen the design philosophy that users are passive viewers of computer screens. In contrast, affective computing, in which computers recognise human emotion and adapt accordingly (Hudlicka, 2003), models one important aspect of the service encounter.

Service industry researchers have identified the pivotal nature of the service encounter between the customer and the human or computer service provider in determining the customer's perception of service quality. The quality of the so-called "moment of truth" may be significantly undermined by HCI that is insensitive to the service encounter and driven only by technical and business processing needs. However well designed the presentation of the data is, if the computer dialog is not in tune with the service dialog, problems will occur resulting in frustration and anger in the service customer, whether the service interaction is with a shopping site or a call centre operative.

The provision of service-oriented HCI requires significant study of the service and its design using a range of tools and techniques. Where a service exists, observation of the service encounter may provide information as to what functions a computer system should carry out to support that service, or what

needs to be done to improve the computer system so that it is in tune with the service. Where a service is being developed (Edvardsson et al., 2000), or an existing service being reviewed, examining both the customer's and provider's expectations of the service may give helpful insights into how the computer support for the service should be improved or developed.

Once such tool that may enable the expectations of customers and providers to be investigated is scripting. The value of scripting in HCI has previously been identified (Preece, 1994), but little has been done to flesh out its use and identify some of the outcomes it may provide in HCI design. In order to further develop the concept of service-oriented HCI, we discuss scripting and present a small study from an internal service area, the IT help desk, which raises some significant issues in the development of human-computer interfaces that adequately support the service encounter.

Script Theory

In order to make sense of the world, people develop cognitive structures to describe what they expect to happen in a particular situation. For example, on entering a McDonalds restaurant, the customer uses a script to act appropriately in the situation. This involves queuing at the counter, ordering, and receiving the meal on a tray. If the customer was approached by a smartly dressed waiter and ushered to a table, the customer would be confused because such service provider's behaviour did not agree with the customer's script. Similarly, if the customer entered a McDonalds restaurant and asked for a shoe fitting, the customer's script would clearly be wrong. Scripts are knowledge structures that are organised around routinized goal-oriented activities.

Script theory was developed by Schank and Abelson (1977) as a means of encoding knowledge structures in computer programs. It has been applied in management studies as a way of mapping knowledge of processes. Leigh and McGraw (1989) applied script theory to industrial sales personnel's activities. More recently, Greenwood (2000) has applied scripting in nursing, Hubbert et al. (1995) applied script theory to hairdressing as an example of a service industry, and Erasmus et al. (2002) propose the use of script theory in consumer behaviour research.

A script involves a location where the activity takes place, defined roles and props, entry conditions, expected outcomes and a number of scenes (Schank & Abelson, 1977). Activity is targeted at achieving a goal. That goal may be divided into subgoals. Similarly, a computer interaction involves goals and subgoals.

The script will usually require exchanges between several actors taking on roles. The typical analysis occurs at the level of the dyadic interaction between the customer and the service provider (Solomon et al., 1985). The exchange that takes place between customer and provider will depend on the scripts of the participants.

Scripts are triggered by instantiating events and depend on entry conditions. For example, if one was hungry, hunger would be the instantiating event and one's goal would be to satisfy one's hunger. However, entry conditions for a restaurant will require hunger and the possession of a means to pay by the customer. If entry conditions are satisfied, a script may be invoked from the customer's memory. Similarly, a script may be invoked by the provider in response to the customer's request. In a restaurant, roles may include customer, waiter, cook, cashier, and owner — all acting according to their own scripts. The customer selects a script according to the type of restaurant.

The use of scripting in HCI will involve the comparison of customer and provider scripts, the analysis of the differences, the analysis of the role and appearance of computer interactions within the service interaction, and the comparison of the provider and customer scripts with the existing or proposed computer dialog. Understanding the customer's script and point of view may have significant effects on the design of the human-computer interface. Scripts may differ in content and elaborateness. Frequently, provider scripts are more elaborate and detailed than customer scripts. If some actions appear in more detail in the customer script than in the provider script this may point to a potential reduction in the quality of the service interaction. Such a reduction in the quality may be perpetuated by the fixed information requirements of the computer system.

Scripts may start and end at different points, again creating service quality gaps. Hubbert et al. (1995) found that the customer's script started before the provider's script. While the hairdresser considered that the service interaction started when the customer entered the salon, customers considered the script to begin when an appointment was booked. Similarly, the computer system may not support the entire service encounter. Often, the computer dialog takes the point of view of the service provider and hence starts where the provider

thinks the service encounter starts. This may be very different from the customer's perception of the start of a service encounter.

Scripts may be strong or weak. Strong scripts include expectations of sequence as well as occurrence of events. Weak scripts do not include sequence expectations. Schank and Abelson (1977) defined a situational script as one where, in a particular context, participants have interlocking roles and share an understanding of what is supposed to happen. The focus of service industry scripting studies is on strong, situational scripts, which are examined for mismatches.

Scripting enables the HCI designer to draw out the expectations of the user or potential user of the computer system. They identify the customer's knowledge structures concerning the service and the service dialog that the HCI designer is aiming to support and represent in the computer system. Furthermore, investigating a potential user's service script away from the computer interface may avoid bias and undue influence by the human computer interface that already exists.

Scripting may be used to:

- Analyse the service interaction in order to determine the required dialog for the computer system;
- Compare the service interaction from the point of view of the provider and the customer with the computer dialog in order to identify gaps in the computer dialog and shortcoming in the HCI design;
- Analyse the role of the computer system and its human interface within the service encounter in order to determine whether it inhibits or promotes the flow of the conversation and to see whether it is unduly determining the direction of the service interaction. Gaps between the service provider's script and the customer's script discovered through the application of scripting may be found to be gaps in the computer dialog;
- Provide an alternative approach to HCI design. Generally HCI design, and particularly dialog design is based on the service provider's business processes. The emphasis is on what the provider organisation does and its business and data needs. Designing a service involves an understanding of what the customer does to help deliver the service. It is characteristic of a service in which the customer is involved in the delivery.

Scripting may be used ex-ante to examine participant expectations in the service encounter as a first step toward designing the human computer interface for the service encounter and ex-post to analyse the role of a computer system in a service encounter post-implementation. It is likely that, in both cases, one outcome of a scripting study would be changes in the HCI design.

IT Help Desks

IT help desks provide a prime example of a service, whether internal or external, in which a service interaction is supported by a computer system.

In IT service delivery, the internal help desk has a pivotal role in delivering IT services within the organisations and determining service quality. The traditional role of the IT help desk is in providing technical IT solutions for non-technical users. It provides the key interface between users and IT professionals and is the hub of IT services activity. The support of existing information systems and the introduction of new information systems may be managed and monitored from the help desk. Indeed, IT help desks may have a strategic role in the take-up and management of information systems (Marcella & Middleton, 1996). Critically, internal help desks will be the link to external maintenance providers. The speed and accuracy of diagnosis, together with the identification of the supplier and the time-to-contact, will all be integral parts of any mission-critical system (Bruton, 2002; Czegel, 1998). However, despite its key role at the heart of the IT department, the help desk tends to have a poor image.

User interaction may start with the help desk when hardware and software are installed at the user's desk. The help desk will support and manage the installation process, help the user get started on the company's network and support application training. The help desk has also traditionally focussed on reactive support, receiving requests for help, filtering requests and allocating technical resources to resolve problems arising out of the requests. However, IT help desks may be moving towards a more proactive role, becoming the "human face" of IT, servicing requests for new systems, arranging user training, monitoring business benefits of delivered information systems and negotiating and evaluating service level agreements (Bruton, 2002).

The help desk system supports the IT help desk service function by recording the customer's problem and tracking the service request's progression toward

completion and closure. The call is allocated a priority that is used by the service engineers to determine the order in which calls are answered at peak times. The computer system may be used not only to drive the service interaction, but also to drive the workflow in a manner that may not be completely to the customer's advantage.

The perception of IT help desk service quality will be significantly influenced by the quality of the service encounter between the internal customer and the help desk technicians. Differences in scripts between the help desk customer and the service provider may have a significance influence on the perception of the service.

Method

Help desk staff and end users in a city council were interviewed. The IT services department of the council comprised some 104 staff. As part of the Town Clerk's Department, it provided a variety of IT support services. It operated a help desk for internal customers that looked after the front office activities and directed requests to technical services. The help desk was managed using a Quetzal system. Calls were classified according to three levels of priority and the help desk was run on the basis of service level agreements developed by the customer service manager. Four staff ran the help desk, supported by a manager.

All help desk staff and three end users were interviewed. Scripts were obtained from both the help desk operatives and the internal customers. Firstly, the participants were interviewed to get some information on their use of the help desk, and their attitude to it. This helped in the interpretation of the resulting scripts. Next each participant was asked to write down a sequential list of the activities that they would carry out in a service encounter with the help desk in order to resolve a problem. In our research we provided the participant with examples of unrelated scripts, such as, for example, hairdressing:

MAKE APPOINTMENT
ENTER
WAIT
WASH HAIR

CUT HAIR
PAY.

Showing the participants examples of unrelated scripts ensured that the participant's help desk script was not influenced by help desk examples. Other unrelated scripts such as a visit to the GP, or a restaurant visit may serve this purpose equally well.

Once the participant was shown a script, the participant was given some time to write out his or her own script, which was then collected for analysis.

The small size of the sample precluded any quantitative analysis. Scripts were compared using a small database to identify similarities and differences.

Analysing the Scripts

Schank and Abelson (1977) focused on how a script is developed and used approaches derived from artificial intelligence to enable the encoding of scripts in a form that could be represented in a computer program. Hubbert et al. (1995) analysed scripts in terms of subgoals and derived a master list of subgoals. Their analysis was very much statistically focussed, examining frequencies of subgoals and quantifying elaborateness using chi-square analysis. We take a more qualitative view, drawing out interpretations from individual scripts, highlighting qualitatively significant differences and drawing some conclusions. Scripts may be treated as texts that can be analysed as a form of literature. The following sections analyse four scripts from help desk operators and three from end users individually. Some initial comments are made, leading to a discussion of the implications for the design of human-computer interfaces.

Help Desk Operator Script 1

SCRIPT TYPE: HELP DESK

MAIN GOAL: RESOLVE QUERY

SUBGOALS:

CUSTOMER CALLS
ANSWER PHONE
ASK QUESTIONS
OPEN CALL
ADD DETAILS
GIVE CUSTOMER RESPONSE TIME
ALLOCATE CALL
TECHNICIAN CALLS CUSTOMER
FIND RELEVANT SERVER
RESET PASSWORD
ADVISE CUSTOMER PASSWORD RESET
CHECK CUSTOMER OK
END CALL

The help desk operator imagines a specific call to reset a password, in itself a very common activity. The script splits into three scenes: receiving the call, technicians calling the user, and the help desk operator checking with the customer before closing the call. Receiving the call splits into interactions with the customer and with the computerised help desk system. The script indicates that interaction with the help desk computer system is important, but not necessarily a driver of the call.

Help Desk Operator Script 2

SCRIPT TYPE: HELP DESK

MAIN GOAL: RESOLVE QUERY

SUBGOALS:

SWITCH PC ON
LOG INTO PC
OPEN UP CALL SYSTEM
LOG INTO PHONE SYSTEM
PICK UP UNFINISHED WORK
ANSWER PHONE
GREET CUSTOMER
TAKE CUSTOMER DETAILS

OPEN CALL
 CUSTOMER DETAILS APPEAR
 ASK QUESTIONS
 ADD CUSTOMER DETAILS
 ADD MACHINE DETAILS
 CONFIRM CUSTOMER DETAILS
 CONFIRM MACHINE DETAILS
 AGREE PRIORITY
 CALL REF
 RESPONSE TIME
 ALLOCATE CALL

In this case the help desk operator's script starts with logging on to the help desk system. There is a great deal more elaboration on the use of the help desk system. Indeed it may be suggested that the script is being driven by the computer system's requirements. The structure of the service interaction may be driven by the computer dialog, forcing the customer into an exchange that may not be seen as relevant to the customer's problem and need for a solution. The script ends once the call is allocated. This script includes agreeing priority, which script 1 does not mention.

Help Desk Operator Script 3

SCRIPT TYPE: HELP DESK

MAIN GOAL: RESOLVE QUERY

SUBGOALS:

ANSWER PHONE
 GREET CUSTOMER
 ADD CUSTOMER DETAILS
 ADD MACHINE DETAILS
 ADD DEPT DETAILS
 ADD LOCATION DETAILS
 ASK QUESTIONS
 ADD CUSTOMER COMMENTS TO CALL
 AGREE PRIORITY

THANK CUSTOMER
ALLOCATE CALL
END CALL

This third example script also elaborates on the computer system dialog and suggests that the help desk system dialog is an important driver. The level of detail concerning data input suggests that the computer input requirements, not the customer, are the prime focus of the help desk operator in the service interaction. Both agreeing on priority and communicating a response time are mentioned, but again the script ends once the call is allocated.

Help Desk Operator Script 4

TYPE OF SCRIPT: HELP DESK

MAIN GOAL: RESOLVE QUERY

SUBGOALS:

ANSWER PHONE
GREET CUSTOMER
LISTEN TO PROBLEM
ASK QUESTIONS
LISTEN TO ANSWERS
PROBE CUST FOR MORE INFO
OPEN CALL
ADD CUSTOMER DETAILS
ADD MACHINE DETAILS
AGREE PRIORITY
CALL REF
RESPONSE TIME
END CALL

This final example of a help desk operator's script is less elaborate in terms of computer interaction and somewhat more customer-focused. It is the script only that includes listening to the customer. Again, the call ends once the

response time has been communicated. It makes no reference to closing the call.

End User Script 1

SCRIPT TYPE: END USER

MAIN GOAL: RESOLVE QUERY

SUBGOALS:

CALL HELP DESK

WAIT FOR REPLY

GIVE NAME

GIVE LOCATION

EXPLAIN PROBLEM

REPLY TO SECONDARY QUESTIONS

AGREE PRIORITY

CALL REF

WAIT

ENGINEER ARRIVES

DESCRIBE PROBLEM IN DEPTH

LEAVE ENGINEER TO RESOLVE PROBLEM

RESPOND TO SECONDARY ENQUIRY BY ENGINEER

NOTE WHEN PROBLEM FIXED

WAIT(LATER)

RECEIVE CALL FROM HELP DESK

GIVE SATISFACTION RATING

END

The end user script contains three scenes. Firstly, the call is made, next the engineer visit is received, and finally the call is closed. Furthermore, three wait events occur. The script may indicate that waiting is considered a significant issue. The end user specifically notes when the problem is fixed. In examining the human-computer interaction, this script suggests that significantly increased coverage of the service interaction may be needed in the help desk support system dialog.

End User Script 2

TYPE OF SCRIPT: END USER

MAIN GOAL: RESOLVE QUERY

SUBGOALS:

LOG CALL IN CENTRAL REGISTER

CALL HELP DESK

GREET OPERATOR

EXPLAIN PROBLEM

AGREE PRIORITY

CALL REF

CHECK DETAILS OF CALL WITH HELP DESK

END CALL

ASSIGN CALL REF IN CENTRAL REGISTER

Significantly, this end user script involves a user-maintained log, the Central Register, maintained by the Central Payroll. The script begins and ends with the Central Register. The script does not refer to problem resolution or call closure. The interview suggested that the respondent was not particularly concerned with call resolution since she would just do other work while waiting for the call to be dealt with. Furthermore, it may be that interaction with the Central Register is seen as the point at which ownership of the problem ceases for this user and becomes someone else's responsibility.

End User Script 3

TYPE OF SCRIPT: END USER

MAIN GOAL: RESOLVE QUERY

SUBGOALS:

PICK UP PHONE

CALL HELP DESK

EXPLAIN PROBLEM
 AGREE PRIORITY
 CALL REF
 RESPONSE TIME
 ENGINEER ARRIVES
 DESCRIBE PROBLEM IN DEPTH
 LEAVE ENGINEER TO RESOLVE PROBLEM
 GIVE SATISFACTION RATING

The third end user script includes interaction with the engineer and a return call either to or from the help desk to give a satisfaction rating. Both these elements may need to be made explicit in the computer dialog.

Discussion

This small study has looked at customer and service provider scripts for an interaction that is strongly supported by the IT help desk computer system. The aim of the service is to provide fixes for computer problems experienced by staff within a public sector organisation. The scripts provide interesting insights as to the expectations of participants in a service encounter that are relevant to the development of human-computer interfaces.

Three out of four help desk operator scripts end when the call is allocated. For end-users the service interaction does not end until the problem is resolved and the call is closed. End user scripts, with the exception of end user 2, who relinquishes responsibility once the call is recorded on a register, involve the interaction with the technician and the closure of the call. For example, GIVE SATISFACTION RATING is part of two end user scripts but only one help desk operator script. Scripting may reveal mismatches between providers and customers concerning where service interactions begin and end. If the computer dialog only supports the provider's view of the service, then elements that are important to the customer may remain unsupported. Scripting may enable the scoping of the service interaction and the matching of the computer dialog to the service dialog.

The extension of the end-users' scripts beyond the operators' scripts to include waiting and the visit of the support engineer suggests that computer dialogs

should seek to integrate a variety of provider participants in the service. Here the dialog should connect the help desk operative and the engineer. Furthermore, the computer dialog should be sensitive to pauses in its progression. The dialogs in the help desk system should be aware that a wait has occurred and reflect this when interaction with the system is resumed.

Three of the scripts contained a significant number of subgoals concerning data input into the help desk computer system. In one script the extent of elaboration of the computer system dialog suggests that the system is the focus of the script and the script may be driven by the computer system. Such subgoals are not of interest to end users. Information elicited by the help desk operators may be seen as a REPLY TO SECONDARY QUESTIONS subgoal by the end user or part of EXPLAIN THE PROBLEM. Service encounters that are effectively driven by the supporting computer systems carry a number of risks. The information required by the computer system may not be central to the service encounter and may not be in tune with the customer's concerns. Gathering information seen as irrelevant to the customer may slow down the service interaction and be perceived as time wasting by the customer. It will be necessary in the service encounter to ensure that dialog is effectively conducted with the computer system and is not inhibiting the flow of the service encounter. These scripts suggest that the information requirements of the computer system can have a significant effect on the service encounter. Inadequate human-computer interfaces that are not sensitive to the nature of the service encounter can damage service quality and even alienate the customer at significant cost to the business. Therefore it is important that information systems designers elicit customer and provider scripts before defining the computer dialog.

The extent of elaboration of subgoals within a script indicates the importance attached to those subgoals by the participant. In these help desk scripts it is the data input that is elaborated by the service providers. Lack of elaboration by the customers indicates lack of interest in collecting data. Where the computer dialog is more elaborate than the service interaction dialog, there may be a mismatch between the service interaction and the supporting computer system. Then the dialogues should be simplified and other ways found of collecting the data of interest to the computer system outside the service interaction. It is the task of the computer system to serve the service interaction, not the service interaction to support the computer system.

Comparison of a number of customer and provider scripts may reveal pivotal events that may be deemed significant because they appear in a majority of

scripts and may be elaborated on. The small sample of scripts in this study suggests that AGREE PRIORITY is a pivotal point in the service encounter. This may be a point of stress, which not only needs to be investigated in service terms, but also may benefit from more detailed computer support and from being addressed in detail in the HCI design.

Service-Oriented HCI

These scripts raise a number of concerns relevant to HCI and suggest that a scripting exercise, conducted away from the computer screen, may be valuable in developing HCI designs. The driving emphasis in HCI on the technology and the computer application may obscure the importance of the service interaction in determining the perception of the HCI design. We would suggest that an approach to HCI that starts with an understanding of the service might yield valuable advances in HCI design. The following outlines some principles in such a service oriented approach:

- HCI design should be derived from service design. A focus on designing the service interaction should lead to a definition of the human-computer interface. HCI design that is derived from data structures may be inadequate in supporting service encounters;
- Dialog should be driven by customer needs and by the customer's perception of the service interaction, rather than by the provider's business processes. If the purpose of the service interaction is to satisfy a customer need, then all computer interaction should be directed to that goal. Both ordering of the computer dialog and data collected should be tuned to the service interaction;
- Service oriented HCI must be sensitive to the events and triggers that cause the service interaction. The design should take into account activities that have led up to the interaction and consider the knowledge set of the customer and provider at the point of interaction and the built-in expectations of both parties. Scripting provides a possible tool for eliciting such information;
- Service design should be integrated with HCI design. The process of service design and HCI design should be carried out as a joint exercise,

each design influencing the other, rather than be seen as separate sequential activities;

- HCI quality may be derived from reducing the gap between service customer and HCI designer. There may be a gap between the designer who defines the computer interface based on some input from a user representative, the programmer who builds the interface, and the final user who interprets the computer dialog on the basis of her own script. Each participant in the design has his or her own script concerning what should happen in the human-computer interaction. These are highly likely to differ. Scripting may encourage a focus on the user or customer's mental model and hence influence the computer interface design;
- Service-oriented HCI should align the service interaction dialog and the computer dialog. The effectiveness of the computer system in supporting the service interaction should arise from such alignment. Additionally, the HCI design should be flexible and able to absorb changes in the service interaction. The HCI design should be aware of previous interaction so that fixed, brittle dialog structures are avoided in which the same questions are asked several times.

Conclusion

This study suggests that scripting may be valuable as a system development tool for supporting the design and development of information systems to support service interactions, and particularly in developing the human-computer interface. Understanding service provider and customer scripts may enable the development of a common script that would raise service quality (Mohr & Bitner, 1991) and improve the use of supporting information systems. Script analysis may enable the development of computer dialogs that support the flow of the service interaction. The role of the computer system in the service interaction is itself an area for further research. In this study the scripts suggested that the computer system was not adequately supporting the service encounter and may have been imposing additional stress on what was already a stress-laden interaction.

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Chapter II

User Acceptance of Online Computer Games: Comparing Two Models in a Field Study

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Abstract

User interface design makes an important contribution to the effective presentation of online entertainment products. In this chapter, we examine two models in predicting user acceptance of online computer games. The first is the technology acceptance model (TAM) from the information systems field, while the second is a consumer behavior model based on marketing and advertising research. A field study was conducted to empirically test the two models. Results indicate that both models explain a significant amount of variance in our dependent variables: attitude toward the game and intention to return to the game, with TAM a more consistent predictor of both result variables. This study sheds light on research of Web-based product presentation in general and that of entertainment products such as online computer games in particular.

Introduction

Firms engage the Web in a wide range of activities from pure marketing and promotion, customer service, to direct sales and generation of advertising revenue (Berthon et al., 1996; Singh & Dalal, 1999). They have embraced Internet and Web technologies in various ways to reap the potential benefits brought by this relatively new medium (Berthon et al., 1996; Liu et al., 1997). Through this special medium, firms can disseminate more information inexpensively, market, promote, and sell products and services, and enhance customer support at a lower cost (Palmer & Griffith, 1998). One of the uses of the Web is the delivery of online entertainment, including online computer games. In such products, attributes like the navigational structure, the interactive media, online help functions, and search mechanism are significant factors contributing to visitor and player retention.

The relationship between such features and the effectiveness of the presentation of online computer games has not been widely explored in the literature. This chapter explores the application of two distinct streams of research, the consumer behavior theories in marketing research, and the technology acceptance model (TAM) in information systems. It compares the predictive powers of the two models in user attitude toward a computer game, and their intentions to return to the game.

Attitude Toward the Game (Ag)

To evaluate the attractiveness of an online computer game, attitude toward the game (Ag) is defined here in a similar way to that of a measure called attitude toward the site (Ast), developed in response to a need to evaluate Web site effectiveness. Attitude toward the site is considered a useful indicator of Web users' predispositions to respond favorably or unfavorably to Web content in natural exposure situations (Chen & Wells, 1999).

The theory of reasoned actions (TRA) has been a widely studied model in social psychology that demonstrates the relationship between attitude and behavioral intentions (Ajzen & Fishbein, 1980; Fishbein & Ajzen, 1975). According to TRA, a person's behavior is determined by his/her behavioral intentions, which in turn is determined by a person's attitude concerning such a behavior.

Additionally, a person's intention to revisit a Web site or come back to replay a game can also be seen as a result of his/her attitude toward using a technology that the person intends to use again in the future (TAM) (Davis, 1989; Davis et al., 1989). Thus we consider Ag an important indicator of game effectiveness in attracting current and potential players.

Intention to Return

Intention to revisit a Web site is another indicator of site effectiveness. Since online computer games are presented and played in the environment of a Web browser, we argue that a player's intention to come back to the game is to a large degree influenced by the presentation of the game in the form of a Web page or site. Repeat visits increase the number of times a consumer is exposed to a commercial message or product. For a store, loyal customers contribute to a store's profitability in the form of increased sales revenue and reduced customer acquisition costs. In the case of an online computer game, customer loyalty relates to increased stickiness of the site. Aaker (1995) suggests that the benefits of retaining loyal customers exceed those of gaining new prospects. For these reasons, it is in the sponsoring company's interest to develop an e-store that would retain customers, and online game that would attract repeat visits.

Nonetheless, a Web site is different from other forms of advertising on TV, radio, or in magazines, where product messages can be forced upon the viewers by means other than the ad itself. For example, advertisements can be embedded in programs like movies, sports programs, or radio talk shows that may be of interest to the viewer or listener. For a Web site, on the other hand, the value of the site itself and a consumer's attitude toward the site, formed after his/her initial visit, provide the incentive for his/her return to the site in the future. A visitor's attitude toward the site while visiting the site immediately influences his/her processing of site information and is reflected through his/her subsequent surfing behavior, for example, mouse clicks. This exploration behavior may have additional influences on her/his intention to return.

Such an intention may be affected by the perceived informativeness of the site, the enjoyment experienced by the visitor, the usefulness of the site, or the usefulness of a particular feature of the site. This study adopts this measure as

another important indicator of the overall effectiveness of a site, treating it as another dependent variable resulting from a visitor's experience with the site. In summary, Ag and intention to return are used as dependent variables in both models presented below to evaluate the effectiveness of an online computer game.

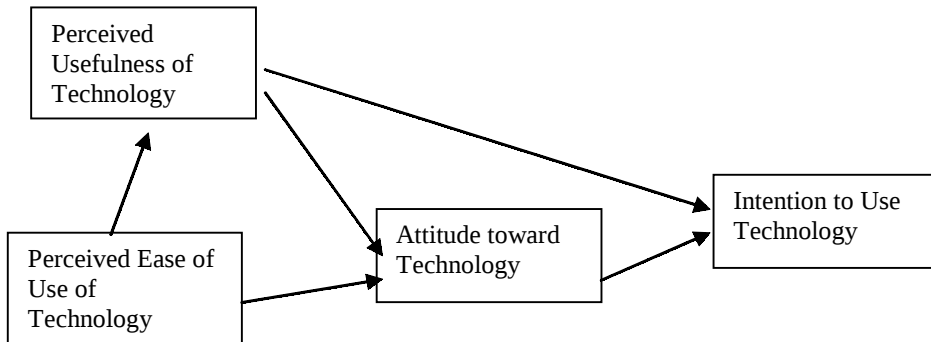
The Technology Acceptance Model (TAM) (Model 1)

In information systems research, a user's attitude toward technology is addressed in the Technology Acceptance Model (TAM) (Davis, 1989; Davis et al., 1989). TAM finds its root in the theory of reasoned actions (TRA) (Ajzen & Fishbein, 1980; Fishbein & Ajzen, 1975), and proposes that perceived ease of use and perceived usefulness of technology are antecedents to user attitude toward the use of technology and subsequent behavior. Due to its parsimonious nature and highly reliable constructs, TAM has been widely adopted in the research of user acceptance of technologies such as word processors (Davis et al., 1989), spreadsheet applications (Mathieson, 1991), e-mail (Szajna, 1996), and Web sites (Koufaris, 2002). This study applies the two constructs of the TAM model to online computer games and looks at the predictive power of each to user experience, reflected in his/her attitude toward the site and intention to play the game again.

Like a word processor that helps create work-related documents, and an e-mail system that facilitates communications at work, the collective design of an online computer game incorporates various types of current information technology to facilitate information retrieval and site navigation during a game play. The original TAM model is presented in Figure 1.

Some major design features of a online computer game site may include the game classification and menu structure, a how-to-play section, an internal search engine, a sitemap, and an online help function, among others, all of which are intended to enhance the experience of a visitor or player. However, our focus is on the microlevel of each individual game. Like that of a typical e-store site, design features within an online game are based on a combination of certain Web-based computing technologies such as frame, Java script, audio, video, and animation. The perceived ease of use and perceived usefulness of the game

Figure 1. The Technology Acceptance Model (based on Davis et al., 1989).



are perceptions derived from the collective functionality of the game site. Hence we consider TAM an appropriate model to use in this case to test the potential relationship between the two TAM constructs and attitude toward the game and intention to return.

H1a: Attitude toward the game is positively associated with perceived ease of use.

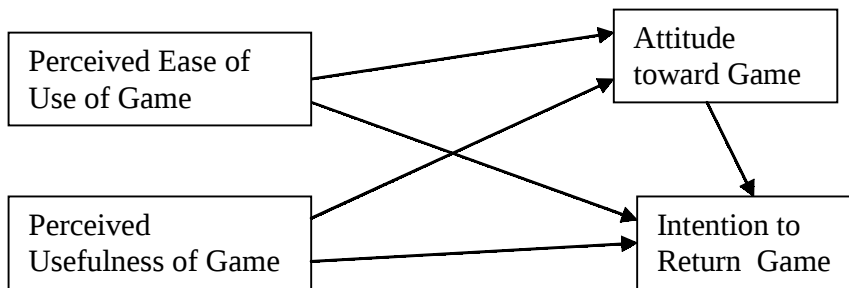
H1b: Intention to return to the game is positively associated with perceived ease of use.

H1c: Attitude toward the game is positively associated with perceived usefulness.

H1d: Intention to return to the game is positively associated with perceived usefulness.

We summarize our first model in Figure 2. Though we do not formally hypothesize the relationship between Ag and intention to return, we expect to see a high correlation between those dependent variables in our study.

Figure 2. TAM Applied to Online Computer Games.



Consumer Behavior Model (Model 2)

The World Wide Web is a valuable communications channel founded on a hypermedia system. The design and presentation of products and services, such as entertainment, are critical in influencing online visitors' attitude and intentions to return. Factors related to consumer behavior, attitude, and perception in the online environment have been gradually explored in recent research (Chen & Wells, 1999; Ducoffe, 1996; Eighmey, 1997; Koufaris, 2002). Attitude in turn mediates the effect of systems' characteristics on behavioral intentions such as intention to revisit and intention to purchase products from the sponsoring companies.

Entertainment

An online game's entertainment effect is an important source of value for visitors and players of the game, just like entertainment provides value to consumers through its ability to enhance the experience of visitors to a Web site (Ducoffe, 1996). Messages presented in an entertaining format were considered to impact attitude positively (Mitchell & Olson, 1981). Uses and gratifications research indicated that the entertainment value of a communications exchange lies in its ability to fulfill the audience's needs for escapism, diversion, aesthetic enjoyment, or emotional release (McQuail, 1983). Jupiter

Research (1999) finds 36% of respondents engage in entertainment activities, like viewing videos, listening to audio, playing fantasy games, and visiting movie or sports sites. This paper proposes that the entertainment of an online computer game similarly nurtures a favorable attitude in the player toward the computer game, and in turn provides incentive to come back in the future. We thus propose the following hypotheses.

H2a: Attitude toward the game is positively associated with perceived entertainment.

H2b: Intention to return to the game is positively associated with perceived entertainment.

Informativeness

Consumers consider information a major benefit of being exposed to any type of commercial messages (Ducoffe, 1996). Information is one of the need-satisfying functions derived from media communications, according to the extended uses and gratifications theory (McQuail, 1983). Consumers in the online environment value information just like those in the traditional media, with 48% of respondents in a Jupiter Research survey citing their major use of the Web for product research and gathering information (Jupiter Research, 1999). Eighmey (1997) finds that Web site users benefit from information that adds value in and of itself.

Being informative is being able to provide or convey information. In this study, we consider informativeness a perception. Online game sites can offer tutorials or demos of game plays as well as comprehensive FAQs and how-to lists to attract and retain new and novice players. Additionally, an informative game provides updated information on such items as cumulative points earned, top scores achieved by other players, and current actions available to the players. In this study, we focus on the microlevel of an online game and adapt the informativeness construct in terms of various aspects of the game, such as instruction clarity, progress report, performance updates, and related help functions.

H2c: Attitude toward the game is positively associated with perceived informativeness.

H2d: Intention to return to the game is positively associated with perceived informativeness.

Irritation

Irritation is an unintended outcome from visiting a Web site. It can be caused by tactics employed by site advertisers and game promoters that annoy, offend, and insult the audience, or that are overly manipulative (Ducoffe, 1996). It can also be a result of visitor feelings of confusion, distraction, and messiness due to the way a Web site or online game is presented and the features incorporated (Chen & Wells, 1999). In the traditional media, an irritating commercial is one that provokes and causes displeasure and momentary impatience (Aaker & Bruzzone, 1985; Greyser, 1973). In the Web context, irritation may arise from the negative feelings about the organization, a feature of the site, or the visitor's frustration with the computer game. Thus we hypothesize the following.

H2e: Attitude toward the game is negatively associated with perceived irritation.

H2f: Intention to return to the game is negatively associated with perceived irritation.

Figure 3. Consumer Behavior Model Applied to Online Computer Games.

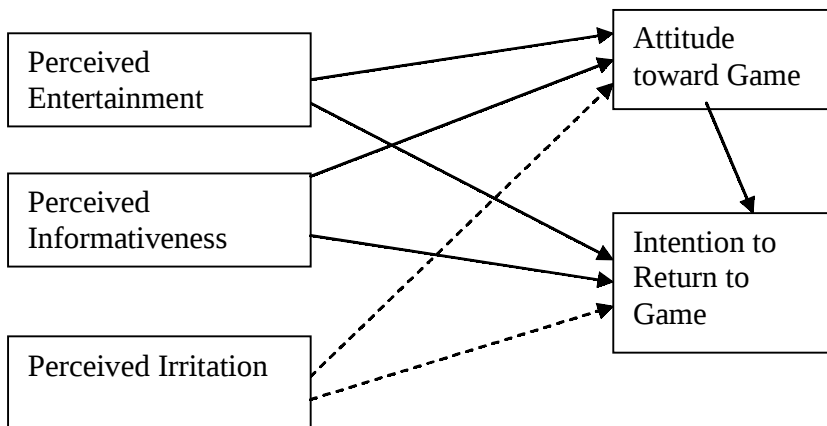


Figure 3 summarizes the second model in our research. The dashed lines connecting perceived irritation and the two dependent variables indicate negative relationships.

Methodology

Research has been done in getting consumer reactions to their shopping experience with real-world commercial sites. Jarvenpaa and Todd (1997) gathered consumer comments and responses to questions about electronic commerce after their visits to a real-world Web site. Koufaris (2002) conducted a field study to understand online consumer attitudes and behavior. Chen and Wells (1999) developed an attitude toward the site (Ast) construct through gathering visitor evaluations of Web sites. An advantage of studies using real Web sites is the higher level of external validity obtained. We adopted three real online computer games in our field study. The games include a card game, Black Jack, in a realistic table and chips environment, a simulated arcade game, Supertris (like the video Tetris game), and a somewhat literally challenging Word Painter game (a word puzzle).

Subjects were recruited through a gift incentive from undergraduate students of a northeastern college in the US. The field study was conducted in a computer lab. Each participant played two games and filled out a single-page questionnaire containing 7-point semantic differential scales for test variables. Sample demographic information with respect to age, gender, and prior experience with the net and online games was also taken. On average each participant spent 10 minutes trying out a game and filling out a survey for that game. The majority of the participants were computer-savvy, with most having played online games more than 10 times in the recent month. Additionally, they regularly spent over 20 hours a week surfing the net.

The Survey Instrument

All scale items used in this study were adapted from existing literature. Perceived ease of use and perceived usefulness were adapted from Davis (1989). With the consumer behavior model, perceived entertainment, per-

ceived informativeness, and perceived irritation were adapted from Ducoffe's (1996) consumer perceptions of Web advertising. Some scale items measuring the informativeness of a Web site were modified to measure the informativeness of a computer game. The intention to return construct was adapted from Madrigal (2000), and attitude toward the game (Ag) was adopted from Coyle and Thorson's (2001) scale of attitude toward the Web site. Participants were asked to indicate their agreement or disagreement with statements given on the survey on a 7-point differential scale. Appendix A shows the instrument items used in this survey.

Results

Within each model, two multiple regression analyses were conducted based on 105 useable data points collected from the field study. One model considered attitude toward the game as the dependent variable, and the other treated intention to return as the dependent variable. The scale items were tested for reliability. Cronbach's alphas on multi-item scales were summarized in the following table, which provides evidence of internal consistency of the scales adopted in this study. The two proposed models were then separately tested. In Model 1, perceived ease of use and perceived usefulness of the game explained about 34% of the variance (adjusted R-squared) in attitude toward the game. Both variables are significant at $p < .01$ as predictors of attitude. About 57% of the variance in intention to return to the game was explained by

Table 1. Scale Reliability.

Scale	Cronbach's Alpha
Perceived Ease of Use	.8834
Perceived Usefulness	.9459
Perceived Entertainment	.9438
Perceived Informativeness	.8223
Perceived Irritation	.7953
Attitude toward Game	.9782
Intention to Return	.9321

the same two variables, with each again significant at $p < .01$. Assumptions of regression analysis were tested: VIFs were low, indicating no multicollinearity; standardized residuals were normal; and scatter plots of standardized residual versus predicted value show no particular pattern indicating no heteroscedasticity. Thus we conclude that hypotheses H1a, H1b, H1c, and H1d were supported in this study.

In Model 2, both perceived entertainment and perceived irritation were significant predictors of attitude toward the game, at $p < .01$, while perceived informativeness was not significant ($p > .10$). The model explained 64% of variance in attitude. In the meantime, the three variables in Model 2 explained 80% of the variance in intention to return, with both perceived entertainment and perceived informativeness significant predictors of such intentions, while perceived irritation was not a significant predictor of intention to return ($p > .10$). As in the first model, assumptions of regression analysis were tested: VIFs were low, indicating no multicollinearity; standardized residuals were normal; and scatter plots of standardized residual versus predicted value show no particular pattern indicating no heteroscedasticity. In summary, we conclude that hypotheses H2a, H2b, H2d, and H2e were supported, and H2c and H2f were not.

Discussion

Model 1 based on TAM seems to provide a consistent framework to predict consumer acceptance of technology, including online computer games such as those tested in the field study. An immediate observation is that the two variables in the TAM model seem to be better predictors of intention to return to the game (play the game again). On the other hand, the three perceptual antecedents to online consumer behavior as a whole seem to explain a significant portion of variance in attitude and behavioral intentions, but did not serve as consistent predictors in the two regression runs. Replication of this study should further examine the roles played by each factor.

This study used college students (between ages 16 and 25, and some between 25 and 30) as participants, who are deemed appropriate subjects in that they make up a significant portion of the Internet population (GVU's 10th User Survey). With respect to demographics of computer game players, 34% of most frequent game players are under the age of 18, and 28% of most frequent game players are between the ages of 18 and 35, according to a report by Interactive Digital Software Association (IDSA, 2002). According to a

national survey of 1,162 college students by the Pew Internet & American Life Project in Washington, DC, 65% of students reported that they were regular game players (Gardyn, 2003).

While the use of students may threaten generalizability, that threat is mitigated by the fact that our student population was from a college in a densely populated suburban area. Such students are considered more representative of the general population and may be more appropriate for consumer behavioral studies than traditional college students that attend universities in remote rural areas (James & Sonner, 2001).

However, whether the general public will respond in the same way as the student sample did in this study is unknown. The games selected for this study were as broad as possible with the inclusion of three distinct types of games. Nonetheless, factors such as the amount of animation and interactivity could potentially influence the results.

Concluding Remarks

Findings of this study are encouraging. Perceptual antecedents to consumer attitude toward traditional communications and advertising media were compared to TAM in this study, and the majority of the relationships were validated via hypotheses tested. Like much prior research in consumer behavior and technology acceptance, this study was observational. Future research should explore experimental designs to study the effects of content factors such as color, animation, and audio, on attitudinal consequences. As the population of online game players will grow dramatically in the next few years, research into user acceptance of online computer games will turn out to be more and more important in understanding factors impacting the bottom line of online entertainment providers.

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Appendix A

Survey Instrument (Items were randomized in sequence when administered)

Please check the name of the game you played:

- ☐ Black Jack ☐ Word Painter ☐ Supertris ☐ Equal Out ☐ Other _____

Part A. Your Evaluation of the Game. Circle the number that best indicates your agreement or disagreement with each statement.

	Definitely Disagree <-----> Definitely Agree						
[perceived entertainment]							
This game is entertaining.	1	2	3	4	5	6	7
This game is enjoyable.	1	2	3	4	5	6	7
This game is fun.	1	2	3	4	5	6	7
[perceived informativeness]							
This game provides good information on rules of the game.	1	2	3	4	5	6	7
This game provides timely information on my progress.	1	2	3	4	5	6	7
This game is informative of my performance.	1	2	3	4	5	6	7
[perceived irritation]							
This game is annoying.	1	2	3	4	5	6	7
This game is irritating.	1	2	3	4	5	6	7
This game is frustrating.	1	2	3	4	5	6	7
[perceived ease of use]							
It was easy for me to learn to play this game.	1	2	3	4	5	6	7
My interaction with this game was clear and understandable.	1	2	3	4	5	6	7
It would be easy for me to become skillful at playing this game.	1	2	3	4	5	6	7
I find this game easy to play.	1	2	3	4	5	6	7
[intention to return]							
It is very likely that I will play this game again.	1	2	3	4	5	6	7
I will return to play this game when I need entertainment.	1	2	3	4	5	6	7
I will recommend this game to a friend.	1	2	3	4	5	6	7
[perceived usefulness]							
For the purpose of <i>future game plays in general</i> [the next four items],							
playing this game can improve my game performance	1	2	3	4	5	6	7
playing this game can improve my game proficiency	1	2	3	4	5	6	7
playing this game can improve my game effectiveness	1	2	3	4	5	6	7
I found playing this game useful.	1	2	3	4	5	6	7

Part B. Please indicate your overall impression of this game by checking a number on each row, with 1 being, e.g., that you consider the game very bad, 7 being, e.g., that you are very favorable of this game, and 4 being that you feel neutral about it.

[attitude toward the game (Ag)]

Bad	1	2	3	4	5	6	7	Good
Unfavorable	1	2	3	4	5	6	7	Favorable
Dislike	1	2	3	4	5	6	7	Like

Part C. Answers on this survey are anonymous. We appreciate your responses to the following questions.

1. How many hours a **week**, on average, do you spend online?
 - 0-5 – 6-10 – 10-20 – More than 20 hours
2. Have you played any online games before? – Yes – No

If yes, how many times in the past **month**?

 - 0-4 times – 5-10 times – > 10 times
3. Your age:
 - 16-20 – 21-25 – 26-30 – Over 30
4. Your gender: – F – M

Chapter III

Web-STAR: Development of Survey Tools for Use with Requirements Gathering in Web Site Development

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Abstract

This chapter introduces the research and application of the Web-STAR project, which began at Towson University in 2002. The main goal and purpose of the Web-STAR (Web-Survey Tool for Analyzing Requirements) project is to provide a standardized survey tool that developers can use to determine the user requirements for existing or new Web sites. The Web-STAR will allow this most vital stage in the development process to take place within a convenient, tested, and cost-effective method. Based on existing work in user evaluation design, Web-STAR will take sound

development practices and apply them to user requirements in the design of informational websites. This chapter presents the research-in-progress development, testing and current status of Web-STAR.

Introduction

User involvement in the development stage is critical to the success of a new information system (Hoffer, George, & Valacich, 2002). Web sites are theoretically no different; however, due to tight timelines for Web development projects, users typically have been left out of the development process. Increasingly, organizations are involving users in many different stages of their Web development projects, as it has clearly been shown to improve the user experience. This can lead to more repeat visitors and, in the case of e-commerce sites, higher sales. Examples of well-known companies and organizations that include user involvement in Web development projects include Eastman Kodak, Indiana University, the National Institutes of Health, IBM, and the National Football League (Clarke, 2001; Corry, Frick & Hansen, 1997; Lazar, 2001; Tedeschi, 1999; Yu, Prabhu & Neale, 1998). User input is necessary to determine what needs users have, both relating to the user interface (usability), and the content offered by the Web site (functionality). Also, there are multiple stages of development in which users can be involved. For instance, users can take part in usability testing, to help ensure that the interface is easy to use, as well as to find any interface components that may be confusing or problematic for users (Nielsen, 1994). In certain types of Web sites, such as e-commerce, search engines, and newspapers, the tasks may be well defined (Lazar, Ratner, Jacko & Sears, 2003). However, for the majority of informational Web sites user tasks are not well defined, and data collection (requirements gathering) needs to be done to determine what tasks the users actually need to perform. It is a common misperception that you will not know who the users of the Web site are until after the Web site is built, and people have begun to visit the Web site. Most Web sites are built with a certain target user population in mind (Lazar, 2001). This target user population may relate to age, gender, geographic location, topic of interest, job activity, or other factors. People that represent the demographics of the target user population are the ones that should be involved in requirements gathering. Even if the specific users involved do not visit the Web site, they are the ones best qualified to help determine what the task needs and usability needs of the Web site are.

There are a number of different methods for user involvement in requirements gathering, including focus groups, interviews, surveys, and card sorting. Surveys are especially popular because they allow data to be collected from a large number of people in a short amount of time. A recent study found that the two methods used most often for requirements gathering for Web site development are surveys and interviews (Lazar, Ratner et al., 2003). One of the strengths of surveys is that they can be distributed to a wide participant base and in a variety of formats such as paper, e-mail, Web site, or telephone (Dillman, 2000; Lazar & Preece, 2001). One challenge in using surveys is the start-up time required for creating, testing, and validating a survey. The goal of this chapter is to present the research-in-progress development and testing of a standardized survey tool that can be utilized for user requirements gathering for informational Web sites.

The Challenge of Requirements Gathering

More user involvement in a development project comes with a related cost (Bias & Mayhew, 1994). While it takes more time and money to involve the users and understand their usability and task needs, the result is a more appropriate system. The time required to create a survey for requirements gathering can be challenging, and many of those assigned with the responsibility may not be aware of how to do requirements gathering, or with the intricate challenges of Web usability. Part of the key to improving usability and user involvement for Web sites is to make it easier for designers by providing a toolbox (pre-tested surveys, interface guidelines, etc.) to assist them with user involvement. It is not as useful to tell designers “to build an interface that is easy to use,” as it is to say, “follow these 10 guidelines to make a good interface”. Popular sets of interface heuristics, such as Shneiderman’s “8 Golden Rules of Interface Design” (Shneiderman, 1998), can help translate the large concept of interface design into something more concrete and manageable. Similarly, it is a challenge to say to designers, “find out what the users need,” but it is easier to provide a survey tool that will help with understanding what user needs related to usability and functionality.

The best way to encourage more user involvement in the requirements gathering stage is to lower the cost (in time and effort) for the designers of doing so.

Providing well-written surveys that have already been developed and tested can increase the likelihood that surveys will be utilized for user involvement. A number of surveys have already been developed in the field of human-computer interaction for evaluating user interfaces after they have already been developed. These survey tools include the Questionnaire for User Interaction Satisfaction (Harper, Slaughter & Norman, 1997), the Web Analysis and Measurement Inventory (Kirakowski, Claridge & Whitehand, 1998), the Information Quality Survey (Zhang, Keeling & Pavur, 2000) and the WEBMac, a series of surveys dealing with motivational quality of a Web site (Small & Arnone, 2000). While all of these surveys can assist with evaluating a system after it has been built, a review of the literature shows that no surveys have been created for assisting with the requirements gathering stage of Web site development.

The goal of this research is to develop a survey tool that can be used for user requirements gathering in Web sites. We have named this project Web-STAR, the **Web** Survey Tool for **Analyzing Requirements**. Though there are different types of Web sites, such as e-commerce, informational, and entertainment (Lazar, 2001), the goal of Web-STAR is to assist with requirements gathering where it is needed most: for informational Web sites where tasks are relatively undefined. For instance, it is well-defined what tasks people want to perform at a newspaper Web site, since it is based on the paper version of the newspaper, which has existed for hundred of years. It is well defined what type of information people want to find with a search engine, and the methods for forming search queries have been well developed by the library science community (Marchionini, 1995). The tasks for an informational Web site can be much less clear-cut. For instance, consider the Web site re-design for the College of Science and Mathematics (CSM), one of six colleges at Towson University. A re-design for the CSM Web site was planned for Fall 2001. Requirements gathering surveys were created and distributed among the faculty, staff, and students in the college, to help determine what type of content they wanted to see on the site. More than 70 surveys were collected from representative users. Most respondents indicated that while they did not visit the CSM Web site on a regular basis, the content that would interest them did not currently exist on the Web site. Users responded that they were interested in resources such as lists of college-wide committees, and minutes of previous college council meetings. These resources had not been available on the previous version of the Web site, and without asking the users, there was no way to determine that this was the content that most interested them. Only by

passing out surveys was it possible to determine that this content needed to be added to the site. Neither of these resources had been previously available on the CSM Web site. Even if the site was 100% usable, users would not return to the Web site because over time, the content is what influences the user experience the most (Davern, Te'eni, & Moon, 2000; Sinha, Hearst, Ivory & Draisin, 2001). It was important to consult the users to determine what their task needs were for the College of Science and Mathematics at Towson University.

The Challenges of Web Usability

While it is important to determine what content users are interested in, there are also many challenges to making a Web site that is easy to use. Unless the designer is building a Web application that will be delivered to a well-defined organizational audience (such as a corporate intranet), it is not known in advance what browsers and connection speeds the users will have. For instance, Web sites can appear differently based on the browser brand, the version, and the platform (e.g., Microsoft Internet Explorer, 4.0, for the Macintosh). For designers, it is always a good idea to determine what browser is used by the majority of their target user population (Lazar, 2001). This way, testing can be done to ensure that the Web site will appear appropriately in the browsers that most users use. Another important concern is the connection speed. If a large number of targeted users have Internet connections that are relatively slow (such as 28.8 dial-up), then this means that the designers of a Web site need to focus on making sure that Web page file sizes are small (Lazar, 2001). When Web pages take a long time to download, it can change the user's perception of the Web page content. For instance, when it takes a long time for the Web page to download, this can change the user's perception of the quality of the content, or whether the content is perceived to be interesting (Jacko, Sears & Borella, 2000; Ramsay, Barbesi & Preece, 1998). These should be important concerns for the Web designer.

Use of plug-in applications (such as Flash or Acrobat reader) is not standard across the population of Web users. Therefore, plug-ins should be given as an option (e.g., click here for the Flash version of the site), not as a requirement (e.g., to view this page, you must have Flash installed). Only if requirements gathering confirms that nearly all of the targeted users have a plug-in installed

is it satisfactory to require use of a plug-in to view a Web page. In addition, it is a good idea to make sure that users with disabilities who may use assistive technology (such as screen readers) can access the Web site (Paciello, 2000). Testing with software tools (such as InFocus, RAMP, or BOBBY, more information available at: <<http://www.w3.org/wai>>) can help to make sure that a Web site can be utilized by users with assistive technologies. These are important considerations to make sure that a Web site is easy to use, and they are accounted for in the Web-STAR survey tool.

Survey Development Methodology

While no standardized survey tool exists for requirements gathering for Web sites, there are a number of case studies of Web development where surveys have been used for requirements gathering. Survey tools have also been developed for evaluating systems after they are built. Research has been performed to determine what causes people to return to a Web site and be satisfied with it. This existing knowledge from research and case studies was combined to create the Web-STAR survey tool. One point of interest is that Web-STAR can be used regardless of whether the Web site already exists or is a new Web site under development. This is an important distinction, since many Web sites were not originally developed with user involvement, but are including user involvement when they are redesigned (Lazar, 2001). The following topical areas were examined to look for the keys to providing a good user experience on a Web site:

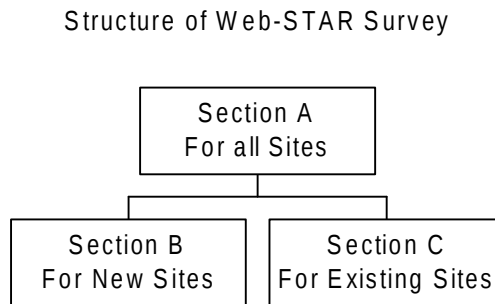
- Web usability (Lazar, 2001; Nielsen, 2000)
- Motivational quality of a Web site (Small & Arnone, 2000)
- User satisfaction (Harper et al., 1997)
- Information quality (Zhang et al., 2000)
- Survey design (Dillman, 2000; Oppenheim, 1992)
- Web accessibility (Paciello, 2000; Sullivan & Matson, 2000)

The survey tool was developed in order to address the issues described in these topical areas. In addition, based on examinations of Web site re-design

projects (Dong & Martin, 2000; Yu et al., 1998), it was determined that while some questions could be the same for both new Web sites and re-designed sites, some questions would need to be different. For example, it is important to evaluate the currently existing Web resources to determine how to improve them, but this is by definition impossible if Web resources have yet to be developed. Therefore, 50 informational Web sites were examined by the research team to look for possible content categories that could be helpful in determining what content might be useful on a site that does not currently exist. The 50 sites that were examined were chosen based on their inclusion in a previous research study (Lazar, Beere, Greenidge & Nagappa, 2003). These Web sites represented 10 different categories of informational sites: 1) colleges and universities, 2) medical/health care organizations, 3) non-profit organizations, 4) state and local governmental agencies, 5) information technology firms, 6) manufacturing firms, 7) private firms, 8) sports and recreation organizations, 9) Web development firms, and 10) software development companies. Based on the content categories that were offered on those sites, the Web-STAR survey offers possible content categories for new sites.

The Web-STAR survey was designed with three parts. Sample questions are in Table 1. Part A addresses data about the technological environment, browser version, and download speed of the users, as well as demographic information and previous computer experience. These data questions are important, regardless of whether a site is new or already exists (Lazar, 2001). Part B of Web-STAR addresses new Web sites by asking users what types of content would interest them on a new Web site for an organization. There are three different types of responses in this section. Users are given the opportunity to examine the content categories from other sites (such as schedule of events and contact information) to see if any would be useful. The designer can suggest possible content specific to this site (which would be written into the survey), to see if the users would be interested in such content. And the third option is that users can suggest their own content in an open-ended question. Part C of Web-STAR addresses currently-existing Web sites. Users are asked to indicate how often they visit the currently existing Web site, their overall perceptions of the Web site, as well as how they found out about the Web site. In addition, there is a section where the developers can indicate certain content that already exists on the Web site, and users are given the opportunity to comment on how useful that content is, through the use of a likert scale.

The chart in Figure 1 shows the structure of the Web-STAR survey. For the development of a new site, Section A and Section B would be completed and

Figure 1.*Table 1. Sample of Survey Questions.*

Section	Sample Questions
A (For all Sites)	Generally, what do you use the web for? a. Shopping b. Finding Information c. Entertainment d. Email e. Chat f. Education and Learning What platform do you use? a. Windows b. Macintosh c. Linux / Unix d. Not Sure
B (For new Sites)	What type of content would you hope to see on a website for this organization?
C (For currently existing Sites)	What was your overall perception of the content on the web site? a) not very useful b) somewhat useful c) useful d) extremely useful What was your overall perception of the structure and design of the web site? a) very confusing b) slightly confusing c) adequate d) intuitive e) very easy to use

for an existing site Section A and Section C would be completed. Table 1 contains an example of questions from the three sections of the survey.

Current Research Status and Future Directions

A prototype for Web-STAR survey can be viewed at the following Web site: <http://www.towson.edu/~jlazar/webstar.doc>. This survey tool has been tested in Web development projects since October 2002. From using the Web-STAR tool in a real-world setting, feedback was provided to improve the tool and validate the usefulness of the tool. The Web developers reported that the survey was useful, and it was easy to modify the survey tool to meet their needs. There is no quantitative feedback from the developers, but there have been specific requests to develop a Web-STAR for e-commerce sites. There are many other ways to improve and expand the Web-STAR project. To start with, pushing the widespread use of the survey and collecting more usage data about the survey is of particular value. With such data, feedback and results, the Web-STAR can be further tested, refined and expanded upon. There is also value in adding more sections and questions to the survey itself and increasing its modularity so that the project can adapt better to the variety of Web projects today and in the future. For instance, new questions could be added related to Web-based intranets. By utilizing the modular nature of the survey and perhaps by refining templates for possible content, the Web-STAR project may adapt for or include additional dedicated surveys for other categories of Web sites, such as e-commerce sites and online communities.

Summary

This chapter has described the Web Survey Tool for Analyzing Requirements project. First, the background on requirements gathering as it relates to Web development projects was introduced. An explanation was provided of the challenges of requirements gathering for Web sites, including the short timelines for development. Some examples from the survey were given and the current status of the project was described. The Web-STAR survey tool has been

developed based on the currently-existing knowledge on how users interact with Web sites and what makes a successful user experience on a Web site. The Web-STAR tool is flexible enough to be used in both new Web site development and re-designs of currently existing Web sites, and the survey can be easily modified to meet the Web content specifications of an organization. Web-STAR provides a conceptual foundation for a Web development team when designing an informational Web site for users. By properly gathering requirements for informational Web sites at the early stages of the development process, users will be more likely to visit and return to a Web site. As the Web-STAR tool is continuously examined and researched, more will be learned about the effectiveness of the tool, how it is used, and how to improve the tool. The complete Web-STAR survey in its current version is accessible online at: <http://www.towson.edu/~jlazar/webstar.doc>.

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Section II

Internet and End Users' Concerns

Chapter IV

The Use of Query Operators and Their Effect on the Results from Web Search Engines

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Abstract

Advice to improve searching performance typically includes recommendations to utilize query operators, such as Boolean or phrase searching. Many professionals assume that the use of these query operators techniques would improve the quality of results. In this chapter, we review the existing literature on this topic, and we test this assumption by examining the effects of query structure on the documents retrieved by Web search services. The results obtained using the queries with search operators from each search engine were compared to the results obtained by the original 100 queries with no operators from that search engine. Overall, increasing the complexity of the queries had only moderate effect

on the results, with an average 66% similarity between results from the simple and complex queries. Implications on the effectiveness of current searching techniques for future search engine design and for future research are discussed.

Introduction

Searchers rarely use advanced techniques, such as Boolean operators or phrase searching, (Borgman, 1996) when using information retrieval (IR) systems. This characteristic has been especially true for Web searchers, with the vast majority of Web and Internet queries containing no advanced searching operators. Several Web studies have noted this near absence of complex query operators (e.g., AND, OR, NOT, must appear operators, paraphrases, etc.) in Web queries (Hoelscher, 1998; Jansen, Spink & Saracevic, 2000; Spink, Jansen, Wolfram & Saracevic, 2002). The use of Boolean operators, typically about 8%, in these Web searching studies is lower than the rates reported in studies of searchers using traditional IR systems such as DIALOG or LEXIS/NEXIS, sometimes substantially. For example, research on the DIALOG system has reported Boolean usage of over 36%, which the researchers considered a low rate of usage (Siegfried, Bates & Wilde, 1993). These low rates of query operators usage occur even on academic Web sites, where one would assume their usage would be higher (Wang, Berry & Yang, 2003).

It has been assumed that correct use of advanced searching operators would increase the effectiveness of Web searches. These advanced searching techniques are well known, and one can find numerous articles and books on advanced searching strategies (Korfhage, 1997), tutorials on searching training (Sullivan, 2000a), and numerous educational courses on searching strategies. Based on the Web searching studies, it appears that the majority of Web searchers continue to use very simple queries, with little to no use of advanced searching operators. These searchers seem to be employing an ineffective and inefficient strategy for finding information.

Why are Web searchers not using more advanced queries? Some researchers have stated that Web searchers are just lazy (Zapur & Zhang, 2000) or that there is a design flaw with Web search engines (Clark, 2001). Neither of these assertions seems likely. Studies and data suggest that Web users may be finding the information they want using these simple queries. A survey of users on a

major Web search engine reports that almost 70% of the searchers stated that they had located relevant information on the search engine (Spink, Bateman & Jansen, 1999). Additionally, Web search engines continue to attract large numbers of Web searchers.

At the time of the data collection for the study this chapter reports, eight of the top 10 Web sites in terms of number of visitors were Web search engines (CyberAtlas, 2000b), implying at least that search engines are the best method available for finding information on the Web. Obviously, something is amiss. Web searchers are not utilizing advanced searching operators, but they appear to be finding information using a technique that should be ineffective or at least inefficient. Web search engines are providing seemingly naive methods for searchers to employ, but these search services continue to attract a large number of customers.

The objective of this chapter is to review the relevant literature in this area and to present the results of a study to determine the effect of query operators on the results retrieved by Web search engines. This knowledge is essential to understanding why users currently search the Web in the manner they do, for the development of instructional material for Web searching, and for design of search interfaces that support the information seeking process. In this paper, we present an overview of related literature, methodology, research results from various perspectives with discussion, and directions for future research.

Background

There has been little research comparing the retrieval results of different search engines using different approaches to query formulation (Eastman, 2002; Gudivada, Raghavan, Grosky & Kasanagottu, 1997; Jansen, 2000; Jansen & Eastman, 2003; Lucas & Topi, 2002; Petersen, 1997). Petersen (1997) presents comparisons using two queries, *embargo* and *Woodrow Wilson's Fourteen Points* as the phrase. Gudivada, Raghavan, Grosky and Kasanagottu (1997) present data again using only two queries, showing the number of hits retrieved for several search engines. The operators OR, AND, and phrase are compared. The query with the AND operator generally retrieved fewer hits than the OR version. The phrase version retrieved fewer than the query with the AND operator. Neither of these studies examined the similarity between retrieved results.

Jansen (2000) examines the changes in results for 15 queries submitted to five search engines when different searching operators are utilized. The researcher reports a 70% similarity in results between queries with no operators and the queries with operators. Lucas and Topi (2002) used eight search topics from which naïve and expert queries were formulated and submitted to several Web search engines to evaluate relevancy. Terms could change between the naïve and expert queries. The researchers report that terms selection and incorrectly formulated queries were the primary cause for most of the relevancy variation. Eastman (2002) explored the precision of search engines using a variety of topics and query formulations. The researcher notes that precision did not necessarily improve with the use of the advanced query operators. Jansen and Eastman (2003) investigate the effect of query operators on three search engines, America Online, Google, and Microsoft Network. The researchers note that queries' operators had moderate effect on the results.

Others studies have examined the difference between the average Web query and more sophisticated queries. Spink et al. (2002) show a Boolean usage rate of about 10% for Excite users. Silverstein et al. (1999) reported an advanced operator usage of approximately 20% for Alta Vista users. In a study of novice and expert users of Fireball (Hölscher & Strube, 2000), a European based search engine, the researchers reported greater use of the advanced searching options for the experts.

Other than Jansen and Eastman (2003), we could locate no study focusing on the change in results from a large number of queries across multiple search engines that also controlled for term changes. Controlling for query terms is important in such studies as research shows that term selection can dramatically alter retrieved results (Spink, 1995). There have been some studies that have examined the similarity among results retrieved by Web search engines over time (Ding & Marchionini, 1996; Nicholson, 2000).

Major Thrust of the Chapter

We investigate the effect of complex queries (i.e., those using advanced syntax, such as Boolean operators) on the results retrieved by Web search services relative to the results retrieved by simple queries (i.e., those with no advanced syntax).

Hypothesis

Our hypothesis is: The use of query operators will not result in a change in results retrieved by Web search engines.

Methodology

The methodology of our research is outlined in the following.

Selection of Queries

Research shows that Web queries generally have two terms (Jansen, Spink, Bateman & Saracevic, 1998; Silverstein, Henzinger, Marais & Moricz, 1999), cover a variety of topics (Wolfram, 1999), and are primarily noun phrases (Jansen & Pooch, 2001; Kirsch, 1998). Specific Web query lengths reported by Jansen et al. (2000) are listed in Table 1.

The mean query length (i.e., the number of terms in the query) was 2.21 terms, with a standard deviation of 1.05 terms. These statistics are in line with those reported by other Web studies (Kirsch, 1998; Silverstein, Henzinger, Marais & Moricz, 1999).

Table 1. Query Length.

Terms in query	Number of queries	Percent of all queries
More than 6	1018	2
6	617	1
5	2,158	4
4	3,789	7
3	9,242	18
2	16,191	32
1	15,854	31
0	2,584	5
Total	51,453	100

Based on the information in Table 1, approximately 93% of these Web queries contain between zero and four terms. Since it is not meaningful to add operators to queries of zero or one term(s), this study focused on queries with lengths between two and four terms. This range represents a majority of Web queries, or approximately 57%. We did not consider in this study queries containing five or more terms. Based on the general distribution from Table 1, the queries of the following lengths were selected for this study: 10 queries of four terms, 31 queries of three terms, and 59 queries of two terms.

From a transaction log of a major Web search engine, all queries containing query operators were removed from the transaction log. Additionally, queries that appear on the popular query lists (Searchwords.com, 2000) or that referenced popular entertainers, popular locations, popular songs, and so forth were eliminated since Web search engines sometimes cache results from these highly queried topics (Lesk, Cutting, Pedersen, Noreault & Kolli, 1997). For similar reasons, all queries that were obviously queries for pornography were eliminated. The remaining queries were split into four transaction logs of all four-term queries, all three-term queries, all two-term queries, and all queries with more than four terms. From the transaction logs, with the four, three and two-term queries, the appropriate number of queries was randomly selected.

Selection of Documents

Studies show that most Web searchers, usually about 80%, never view more than 10 results (Hoelscher, 1998; Jansen, Spink, & Saracevic, 2000; Silverstein, Henzinger, Marais, & Moricz, 1999). Based on this Web searcher behavior, only the first 10 results in the results list were selected for comparison. Moreover, we examined these results only for changes in the first 10 results; relevance judgments were not made concerning the results. The ability of Web search engines to successfully retrieve relevant documents has been investigated several times (Leighton & Srivastava, 1999; Zumalt & Pasicznyuk, 1998) and that the use of advanced operators may not improve the precision of Web search engines (Eastman, 2002).

Searching Environment

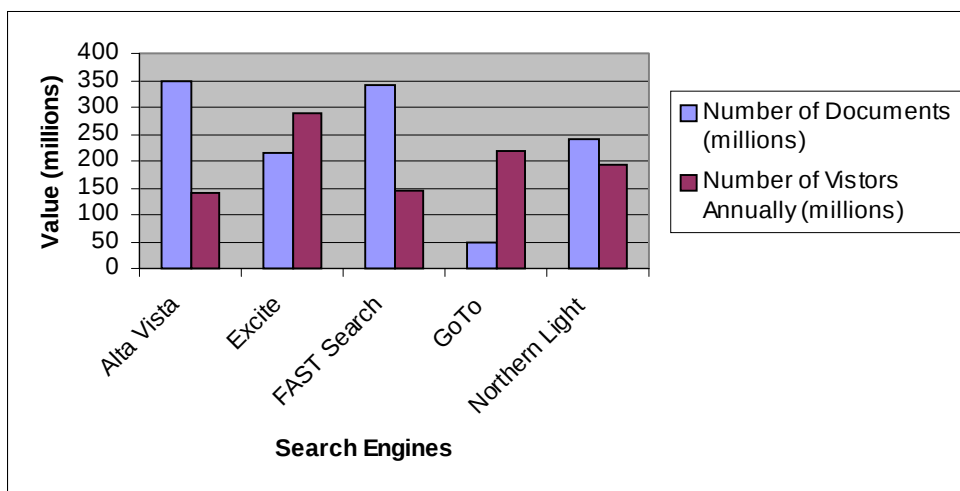
Many Web sites offer searching capabilities; however, this research focuses specifically on Web search engines. Search engines are the major portals for

users of the Web, with 71% of Web users accessing search engines to locate other Web sites (CommerceNet/NielsenMedia, 1997). One in every 28 (3.5%) pages viewed on the Web is a search results page (AlexaInsider, 2000). Search engines are, without a doubt, the major IR systems of the Web. There are approximately 3,200 search engines on the Web (Sullivan, 2000b). Those utilized in this research are Alta Vista, Excite, FAST Search, GoTo, and Northern Light.

At the time of the research, three of these Web search engines were rated in the top 25 Web sites in terms of unique visitors. These were Excite (5), Alta Vista (8) and GoTo (24) (CyberAtlas, 2000a). Naturally, the “hot” search engines are always changing. To facilitate comparison, the sizes of the document collections and number of searchers at the time of the research are displayed in Figure 1 (Sullivan, 2000a).

As we can see from Figure 1, the number of unique visitors to these search engines varies widely, although all five sites attract an extremely large number of visitors. With thousands of unique visitors per month, combined with extremely large document collections, these search services must be able to respond to and provide for a wide variety of topics and information needs.

Figure 1. Size of Search Engine Document Collections and Number of Searchers as of June 2000.



Searching Rules

These five search engines offer a variety of advanced searching options and these rules are always changing to some degree. Additionally, some searching options are available from each search engine's main search page. For other searching options, one must go to a "power" searching page.

For this research, only those advanced searching options available from the search engines' main page were utilized. Of the five search engines, two offer four advanced search options (+, ", AND, and OR) from the main page, and three search engines offer two advanced searching options (+, and "). All of the search engines offer dropdown boxes (e.g., language of results, document collections to search) for refining the search. When dropdown boxes were present on the main search page, the default options were utilized.

Research Structure

Each of the 100 original queries was submitted to the five search engines for a total of 500 queries. The query was then modified with the advanced searching operators supported by the various search engines. The entire process of submitting the simple and advanced queries took five minutes or less. For example, the simple query *palomino horse breeder association* could be modified using the must appear operator (+*palomino +horse +breeder +association*), phrase searching operator ("*palomino horse breeder association*"), the AND operator (*palomino AND horse AND breeder AND association*), and the OR operator (*palomino OR horse OR breeder OR association*). These modified queries are the complex queries.

Results

Of the simple queries, 498 returned at least 10 results. One query returned three results, and one query returned no results. Therefore, there were 4,983 results to use as the baseline (i.e., $498 \times 10 + 3$). As mentioned earlier, results that appeared after the 10th in the results list were not utilized.

There were a total of 1,400 complex queries submitted. With each search engine offering different search options, the number of complex queries varied for each search engine, as outlined in Table 2.

Table 2. Number of Queries by Search Engine and Operator.

Search Engine	Total Number of Queries	Number of Simple Queries	Number of Complex Queries	Search Options Supported and Number of Queries			
				+	"	AND	OR
Alta Vista	300	100	200	100	100		
Excite	500	100	400	100	100	100	100
FAST Search	300	100	200	100	100		
GoTo	300	100	200	100	100		
Northern Light	500	100	400	100	100	100	100
Total Queries	1900	500	1400	500	500	200	200

From Table 2, all search engines supported the must appear (+) and phrase searching (") operators for a total of 1000 queries. Excite and Northern Light supported the Boolean operators AND and OR for a total of 400 queries. Submission of each set of queries on a given search engine took about five to 10 minutes. Therefore, the opportunity for the index on a given search engine to change during the test was limited.

Table 3 presents data on the number of results returned.

Table 3. Results from Complex Queries.

Number of Results	Number of Occurrences	Number of Results
10	1,325	13,250
9	0	0
8	2	16
7	1	7
6	5	30
5	1	5
4	4	16
3	2	6
2	3	6
1	13	13
0	44	0
Total	1,400	13,349

Of the 1,400 complex queries, 1,325 returned 10 or more results. There were 31 queries that returned fewer than 10 results but more than zero results. There were 44 queries that returned no results. Altogether, there were 13,349 results returned by the complex queries. Combined with the 4,983 results from the simple queries, a total of 18,332 results were used in the analysis.

The match had to be exact when comparing the results between the simple and complex queries; that is, the documents listed had to be the identical page at the same site. Different pages from the same site were not counted as matches. The identical pages at different sites were not counted as matches. Furthermore, if results appeared in both lists but in a different order, they were counted as matches as long as both were displayed in the first 10 results.

Simple versus Complex Query Comparison

The aggregate results of the analysis of the 18,256 results are displayed in Table 4.

The baseline mean for the simple queries was 9.99, and the mean for the complex queries was 6.55. On average, 6.55 of the 10 results retrieved by the complex queries also appeared in the baseline results for the corresponding simple query on that search engine. The results were analyzed using a paired sample t test, as reported in Table 4. The analysis revealed a significant difference between the two groups ($t=40.287$; $p<0.01$).

Table 4. Comparison of Simple vs. Complex Queries on Major Web Search Engines.

Category	Average Number of Results that Appear in Baseline	Standard Deviation	Mode	Paired sample t
Simple Queries	9.99	0.03	10	-
Complex Queries	6.55	3.77	10	40.287
				$p < 0.01$

Results by Search Engine

A comparison was conducted for each search engine. These results are displayed in Table 5.

From examining Table 5, we can see that Excite, FAST Search, and GoTo will on average return approximately seven to eight identical results, regardless of whether the query is simple or complex. The means for Alta Vista and Northern Light are lower, at approximately four and five, respectively. Alta Vista has the largest standard deviation at 4.2. The modes of all five search engines were 10. The results from each search engine were analyzed using a paired sample t test, reported in Table 5. The analysis revealed a significant difference between the groups of simple and complex query results for all search engines.

Table 5. Results by Search Engine.

Search Engine	Mean of Simple Queries	Average Number of Results that Appear in Baseline	Standard Deviation	Mode	Paired sample t
Alta Vista	10	4.5	4.2	10	18.143
Excite	10	7.8	3.8	10	12.304
FAST Search	10	7.1	3.7	10	10.759
GoTo	9.93	8.4	2.8	10	7.704
Northern Light	10	5.4	3.9	10	23.433
					p < 0.01

Results by Query Operator

A comparison was also conducted for each search operator. These results are displayed in Table 6.

Table 6 shows that the highest correlation with the baseline results is with the must appear searching operator, the '+' mark. With this operator, approximately eight of the 10 results, irrespective of search engine, would also appear in the results list without the advanced search operator. With the other operators, phrase searching, Boolean intersection operator (AND) and Boolean union operator (OR), approximately five or six of the documents in the results list would have appeared without the use of the advanced operators. The mode for all operators was 10. The results were analyzed using a paired sample t test, reported in Table 6. The analysis revealed a significant difference

Table 6. Comparison of Results by Query Operator.

Query Operator	Average Number of Results that Appear in Baseline	Standard Deviation	Mode	Paired sample t
+	8.1	3.4	10	12.166
"	5.6	3.7	10	25.219
AND	5.5	4.0	10	15.840
OR	6.3	4.3	10	12.354
				p < 0.01

between the query results when using an advanced searching operator compared to the results when using a simple query for all operators.

Results by Query

The analysis was also conducted for each query. As a synopsis, the top 10 queries with the greatest overlap of results are displayed in Table 7.

On average, about eight or more of the 10 results for these queries were identical, regardless of the presence or absence of advanced query syntax. Of these 15 queries, 12 are two-term queries, two are three-term queries, and zero are four-term queries.

Table 7. Comparison of Results by Query.

Query	Average Number of Results that Appear in Baseline	Standard Deviation	Mode
bonsai trees	9.3	1.3	10
fuzzy logic	9.2	1.4	10
ear cleaning	8.8	2.0	10
grape seed extract	8.7	2.1	10
bread machines	8.6	1.9	10
self esteem	8.6	2.9	10
car insurance	8.5	2.8	10
bull riding	8.5	2.2	10
adult friend finders	8.4	2.5	10
morgan horse	8.4	2.2	10

Table 8. Comparison of Results by Query.

Query	Average Number of Results that Appear in Baseline	Standard Deviation	Mode
prime time workout videos	3.4	4.2	1
internet capitalist	3.6	4.5	0
tanning bed sanitizer	4.0	4.3	0
super high speed photography	4.2	4.3	0
hotdog cart rental	4.2	4.5	0
international law department justice	4.3	4.5	0
red wine goblets	4.3	4.3	0
vinyl upholstery instructions	4.4	4.8	1
liability waiver	4.4	4.3	0
accelerator safety	4.6	4.3	10

At the other end of the spectrum, the 10 queries with the lowest average are displayed in Table 8.

On average, about 4 of the 10 results for these queries were identical to the results obtained from the simple version of the query, regardless of the presence or absence of advanced query syntax. Of these 15 queries, four are two-term queries, six of the three-term queries, and five are four-term queries. Compared to the 15 queries with the greatest overlap displayed in Table 7, the standard deviations are approximately twice as large. The modes were significantly lower, with the exception of the queries *accelerator safety*, *processed hair origin*, *palomino horse breeder association*, and *submarine cable consulting*, which all had modes of 10.

Results by Query Length

An aggregate analysis was also conducted for query length, as displayed in Table 9.

Table 9. Comparison of Results by Query.

Query Length	Number of Queries of this Length	Average Number of Matching Results	Standard Deviation	Mode	Paired Sample t
2	59	7.0	3.8	10	18.303
3	31	6.2	4.0	10	18.227
4	10	5.0	4.2	10	21.401
					p<0.01

The average number of matching results decreased by approximately one result as the length of the query increased, from 7.0 for two-term queries to 5.0 for four-term queries. The standard deviations for all three query lengths were approximately four results. The modes for all three queries lengths were 10. The results were analyzed using a paired sample t test, reported in Table 9. The analysis revealed a significant difference between the two groups of simple and complex queries results for all three query lengths.

Results by Query Length, Search Engine and Query Operator

The analysis was also conducted for query operators by search engine, with the results displayed in Table 10.

The first column in Table 10 is the heading for the number of matching results. The top row lists the searching engine; the second row displays the corresponding advanced query operator. Using column 1, one can move right across the table to the occurrences for each in the No. column, which is the number of times that the results from the complex queries contained that number of exact matches. For example, there were 651 complex queries that return 10 results identical to the corresponding simple queries. Moving further to the right, each column presents the number of occurrences for each search engine and operator for a given number of matching results. The average number of matching results and the standard deviation is also given.

Table 10. Comparison of Results by Search Engine and Operator.

Matching Results	No.	AV	EX	FS	GT	NL	AV	Ex	FS	GT	NL	EX	NL	Ex	NL
		+	+	+	+	+	"	"	"	"	"	AND	AND	OR	OR
Average		3.0	7.9	10	9.4	10	6.0	5.0	3.8	7.2	6.0	7.9	3.1	10	2.57
SD		3.2	3.5	0.0	1.5	0.0	4.5	3.8	2.9	3.4	2.8	3.5	2.9	0.0	2.9
Paired sample t*		21.110	6.008	-	3.738	-	8.541	12.628	19.694	7.459	23.363	6.039	23.363	-	25.530
10	651	9	67	100	77	100	48	21	1	44	7	67	5	100	5
0	163	25	7	0	0	0	20	18	20	1	3	7	26	0	36
NR	55	5	0	0	1	0	9	9	12	14	5	0	0	0	0
Total	1400	100	100	100	100	100	100	100	100	100	100	100	100	100	100

Note: (1) AV – Alta Vista, EX – Excite, FS – FAST Search, GT – GoTo, NL – Northern Light, NR – No Results returned by query. (2) Missing pair-t values could not be calculated due to a zero standard deviation. * $p < 0.01$

As Table 10 shows, the effect of specific operators varied, depending on the search engine involved. With Alta Vista, the average for the must appear operator was half of what it was for phrase searching. With Excite, the average for phrase searching was about half of the other three operators. With FAST Search, there was a marked drop using phrase searching. The matching results of the GoTo operators were both greater than seven matches. It is also apparent what the default algorithms are for Excite, FAST Search, and Northern Light, with 100% matches between the simple and complex queries.

Overall, Table 10 illustrates that there were 651 (47%) complex queries that retrieved identical results as the simple queries. All 10 results from these 651 complex queries were identical to the results from the simple queries. This occurrence is by far the most frequent; the next highest occurrence was 163 (12%) complex queries that retrieve no matching results.

The results were analyzed using a paired sample t test, as reported in Table 10, fifth row. The analysis revealed a significant difference between the results of each search engine operator relative to the results retrieved by the simple queries on the respective search engines.

We conducted a regression analysis to determine any significant relationship among the variables, query length, search engine, and query operator on the results retrieved. The overall model was significant ($F = 21.99, p < 0.01$). Query length was a significant predictor of results ($t = -6.156, p < 0.01$), with a beta weight of -0.164 . As query length increased, the number of matching results decreased. Query operator was also a significant predictor ($t = 6.156, p < 0.01$), with a beta weight of 0.145 . Although significant, as the beta weights show, neither query length nor query operator had a substantial impact on the number of matching results. Search engine was an insignificant predictor of matching results.

Future Trends

The 100 original queries used for this research structurally represent the majority of Web queries that are more than one term. These 100 queries were submitted to five search engines. These queries were modified with advanced searching operators and also were submitted to the same five search engines. Approximately 66% of the results were identical regardless of how the searcher entered the query. Referring to the data displayed in Table 4, a paired sample

t-test ($t = 40.287$, $p < 0.01$) shows that the results from the simple queries are significantly different from the results for complex queries. However, as with all tests of statistical significance, one must ask, what difference does this make in the “real world”?

Does it make sense to learn and utilize the more complex searching operators if on average it is only going to present the searcher with about three or four results that are different from those retrieved by just entering the query terms? Are the three or four different results worth the increased probability of entering a complex query incorrectly? As the complexity of queries increases, so does the probability of error.

The findings of this research suggest that the use of complex queries is generally not worth the effort for the typical Web searcher (i.e., who uses two terms and is interested only in the first ten results). Based on their conduct, it appears that most Web searchers do not think it is worth the trouble either. The behavior of Web searchers adheres to the principle of least effort (Zipf, 1949), which postulates that there are “useful” behaviors that are quick and easy to perform. The very existence of these quick, easy behaviors causes individuals to choose them even when they may not necessarily be the best behavior from a functional point of view. However, these useful behaviors are good enough, and people will generally expend the least amount of effort to achieve what they want. Zipf’s theory can explain the behavior of Web searchers. The results obtained from Web search engines via simple queries are good enough. In IR jargon, the precision of simple Web queries meets the information needs of most Web searchers.

The use of simple queries versus complex queries is also compelling when one compares the modes presented in Table 4. The modes for the simple and the complex queries are both 10, meaning that more than any other occurrence, the results from a simple query and complex queries will be the same. As noted in Table 10, 651 (47%) of the 1,400 complex queries returned identical results to those from the corresponding simple queries.

Naturally, we acknowledge that there are cases where one is interested in all possibly relevant results. In these cases, the three or so new results may be worthwhile. Even in these cases, it would make sense to enter the simple query as well as the complex queries. Nevertheless, this type of information need, where one is interested in recall as well as precision, does not appear to be the typical information need for Web searchers. Not only are Web queries short and simple and the number of results viewed small, but also the session length (the number of queries submitted during a session) of the typical Web searcher

is one or two queries (Jansen & Pooch, 2001), reinforcing the notion that Web searching is a precision-based service. By its characteristics, the typical Web search does not represent a recall-based information need.

In reviewing the analysis by search engine, outlined in Table 5, there was a great deal of overlap between query results for most search engines, ranging from 45% for Alta Vista to 84% for GoTo. The mode for all five search engines was 10. Studies and presentations show that the failure rates among Web searchers using advanced syntax are high (Jansen, Spink & Saracevic, 1998). Why give searchers the opportunity to make mistakes? This rule seems to be the tactic followed by FAST Search and GoTo, which both limit the searcher's options. It also appears to be the tactic pursued by Excite, where at least 78% of the results are identical, regardless of the presence or absence of advanced searching operators.

These results would seem to indicate that system designers have developed the Web search engines so as to minimize the need to utilize advanced searching operators. Web searchers seldom utilize advanced searching techniques, so designing IR systems to account for this characteristic seems like a reasonable course of action. However, one must then question, why offer advanced searching options at all?

Concerning the lower mean of Alta Vista (4.5), it appears that this search engine uses a different ranking algorithm when the must appear operator (+) is used. Based on the rather random results retrieved with this operator, Alta Vista may adhere to the theoretical model of no ranking feature when Boolean-like operators are used in a query.

In the analysis of the various advanced search operators, illustrated in Table 6, all had means of five or higher, meaning on average approximately five or more of the 10 results were the same, regardless of whether the query was simple or complex. The must appear and the OR operators had means of eight and six results respectively. The mode for all operators was 10. It appears that no particular operator has a drastic impact on results, with the must appear operator being slightly higher than the other three.

It is interesting that the results from the must appear operator (+) and the Boolean intersection operator (AND) are not the same. One would expect the results from these two operators to be the same. With Excite, the results were identical. With Northern Light, the results varied between the two operators. Similar to Alta Vista, Northern Light may turn off ranking when Boolean operators are utilized.

In comparing individual queries using Table 7, Table 8, Figure 2, and Table 9, one sees that as the query length increases, the mean for number of matching results decreases by about one result for each additional term added to the query. However, referring to Figure 2, there appears to be a good deal of overlap among the queries, regardless of length, although there is a drop in matching with 4-term queries.

The results of the analysis of search engine and advanced search operators (see Table 10) show that the effect of advanced search operators varies based on that particular search engine. There were high occurrences of exact matches between simple and complex queries among all search engines and all operators; however, Excite and GoTo had extremely high occurrences of identical results, regardless of query operators. There were substantial differences between the simple and complex query results with Alta Vista and Northern Light when Boolean-like or Boolean operators were utilized.

Conclusion

This research indicates that use of complex queries appears to have a moderate impact on the results retrieved. On average, approximately 66% of the top 10 results will be the same, regardless of how the query is entered. The approximately three or four different results on average may not be worth the increased effort required to learn the advanced searching rules or the increased risk of making a mistake. One can say that the typical Web searcher is adhering to a reasonable course of action by entering simple queries when using Web search engines. Results in other studies are similar, even with other search engines such as Google (Jansen & Eastman, 2003).

These results also indicate that Web search engine designers are doing a proper job of designing Web interfaces and ranking algorithms. Given that the typical Web searcher seldom uses advanced operators, Web search engines are to be compensating for the naïve the searching characteristics of their customers. Based on the results of this research, one can conjecture that the ranking algorithms of these search engines adhere, albeit loosely, to the following rule: *Place those documents that contain all the query terms and that have all the query terms near each other at the top of the results list.* This is an oversimplification of the complexity of searching and ranking algorithms.

However, with a ranking rule like this, the use of or lack of use of advanced search operators would have little impact on the results at the top of the list.

However, it does appear that some search engines alter their ranking algorithm based on the search operator utilized. Alta Vista and Northern Light appear to utilize different ranking algorithms when certain Boolean operators appear in a query.

There are several avenues for future investigation. The first would be to examine the effect of the advanced searching operators on the relevance (e.g., precision) of the results. This study measured the change in the results list of complex versus simple queries. The natural next step is to measure the change in relative precision. One might expect that the complex queries would improve precision; however, this assumption would have to be tested. There are indications that precision actually decreases (Eastman, 2002).

Returning to our research question, it appears that the increased usage of advanced searching techniques by Web searchers has only moderate effect on the results from Web search engines. Therefore, the use of these operators by Web searchers may not be that helpful. Results of this and similar studies may indicate the need for a refinement in the teaching of appropriate searching techniques given the underlying sophistication of current Web search systems. It also appears that the designers of Web search engines are targeting the general naïve searcher, perhaps at the expense of the more sophisticated searchers who desire to utilize advanced query operators.

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Chapter V

Interactive Proxy for URL Correction

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Abstract

This chapter will address the issues of Uniform Resource Locator (URL) correction techniques in proxy servers. The proxy servers are more and more important in the World Wide Web (WWW), and they provide Web page caches for browsing the Web pages quickly, and also reduce unnecessary network traffic. Traditional proxy servers use the URL to identify their cache, and it is a cache-miss when the request URL is non-existent in its caches. However, for general users, there must be some regularity and scope in browsing the Web. It would be very convenient for users when they do not need to enter the whole long URL, or if they still could see the Web content even though they forgot some part of the URL, especially for those personal favorite Web sites. We will introduce one URL correction mechanism into the personal proxy server to achieve this goal.

Introduction

With the rapid expansion of the World Wide Web (WWW), more and more Web-based applications have caused serious performance degradation on the Internet. Caching is the process of storing Web elements (pages, files, images) on proxy servers. The use of proxy server makes serving information on the Internet more efficient in terms of reducing bandwidth costs and server utilization. The Internet Caching Resource Center (www.caching.com) estimates that caching can reduce the need for bandwidth by at least 35%. Consequently, the proxy servers have been widely deployed to reduce the bandwidth for the same Web page requests; they could accelerate the browsing speed by storing current Web pages for future requests. Nowadays, proxy servers are necessary for the WWW community.

In the traditional proxy server, when it receives a request URL, first it has to check the validation of the URL by the Domain Name System (DNS) lookup. Then the request URL is matched with all URLs in its caches. The proxy server will immediately send back the requested page from its cache if found. Otherwise it has to directly connect to the original server to get the requested page, send it back, and store it in its cache database at the same time. The general proxy server mainly depends on the request URL to operate.

However, this is inconvenient and insufficient for users, especially when they type in the incorrect URL. For example, the correct URL of the Starbucks company is <http://www.starbucks.com>. We would just get some error messages from the proxy server for the wrong URL (www.starbuck.com), unless we correct it by ourselves.

However for general users, there must be some regularity and scope in browsing the Web, for example, the portals or news Web sites that users browse every day, or some specific Web-based systems. It would be very convenient for users when they enter one word, such as “google” or even with some error, “goggle,” and then would eventually be taken to www.google.com. Therefore, it is a very important and useful function to support the URL correction mechanism based on the personal browsing access logs.

On the other hand, online security has drawn increasing attention, especially for home users. There are several personal proxy tools supporting the functions to block cookies, Web bugs, Web referrers, ads and scripts and stop them from collecting online information. Almost all these tools save the personal access logs into text files. However, they do not utilize these logs to correct URLs.

In this chapter, we will introduce one URL correction mechanism based on the personal browsing access logs to achieve our goal. To accomplish the URL correction mechanism, we design one URL preprocessor and URL correction algorithm. Normally, the proxy server works as usual when the request URL is correct. If non-existent, it first operates the URL preprocessor to get the canonical form of request URL by the user setting rules, and then operates the approximate URL matching to correct the request URL. If there is more than one choice for correction, users will see the possible URLs listed in their browsers, and they could browse the Web pages just by one click. The interactive mechanism is very convenient for users.

In the URL correction model, we choose the “edit distance” (www.merriam-pack.com/ld.htm) as the URL similarity measurement. This measurement has a clear definition and is also widely used in many fields of applications. Furthermore, we have designed one algorithm to utilize three filter conditions (Pan, Yang & Lee, 2002) based on the n-gram technique to perform the URL correction mechanism.

Background

Web caching is still a highly active research area. However, most of the research focuses on improving the proxy server performance, or analyzing the proxy access logs to list the top 10 popular Web sites, or predicting the user’s action by the proxy access logs, and pre-fetching the Web pages for users.

By now, maintaining the proxy server is almost the responsibility of network administrators. The main goal is to accelerate the response time of proxy servers, and enhance the hit rate to reduce the network bandwidth. What they care about is the performance, not considering the different users’ needs.

No matter that in the general proxy server or personal proxy server, there is no existent technique to correct the wrong URL. However, we could use the approximate string matching technique to support the function.

In the field of approximate string matching, many researches and solutions have been published. For two strings of length n and m , there exists a dynamic programming algorithm to compute the edit distance between them in $O(nm)$ time and space (Smith & Waterman, 1981), and some improvements to the average and worst case have also appeared (Chang & Lawler, 1990; Cole &

Hariharan, 1998). The definition of the approximate string matching problem is: Given a text T of length n and a pattern P of length m ($m \ll n$), and a maximal number of errors allowed $0 < k < m$, we want to find all text positions where the pattern matches the text with up to k errors.

The problem is different from our problem mostly in the length m . In the approximate string matching, the pattern length is far smaller than the text length; it is like the full text search problem. However in our problem, the length of the request URL is almost the same as the length of other URLs. Many solutions for the approximate string matching are not suitable for a large amount of short URL strings. Therefore, we need to design one index method to handle this problem.

Especially in one paper (Gravano, Jagadish, Koudas, Muthukrishnan & Srivastava, 2001), researchers solve the problem of approximate string joins in a very large database by using three n -gram filter conditions. However, such techniques have to be supported by another database management system (DBMS) (Bozkaya & Ozsoyoglu, 1999). Later, we also design another technique without the support of DBMS (Pan, Yang & Lee, 2002).

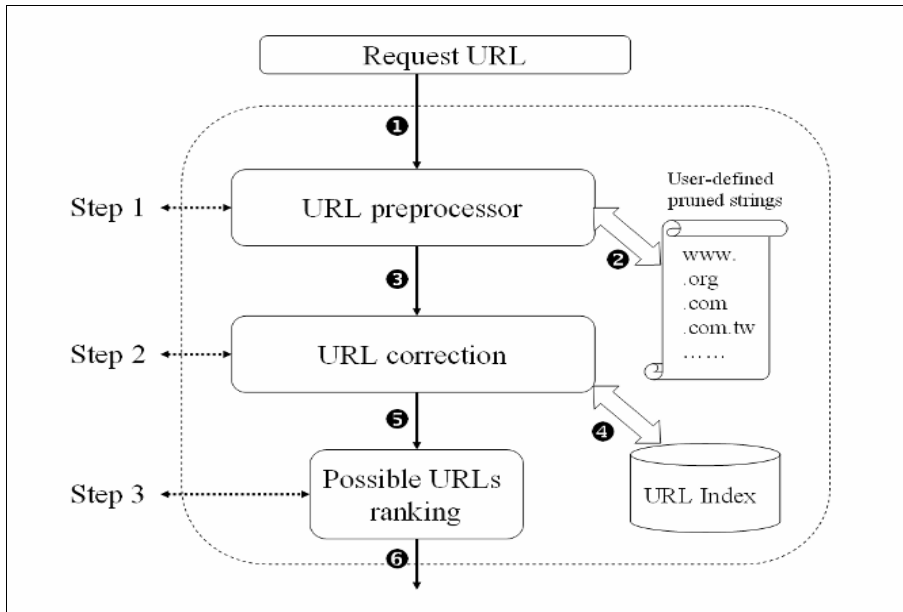
Basic Concepts

In this section, we will briefly describe the concept architecture of our system and some basic definitions about the URL correction. First we will introduce the *edit distance* that is used to measure the similarity of two URLs. Secondly we will outline the URL preprocessor. It processes all the URLs and gets its canonical forms before the URL correction process. Thirdly we will begin to discuss the URL correction mechanism, including the concept of n -gram for the URL index, and how the performance of URL correction can be enhanced by it. Finally, three filter conditions will be described for the URL algorithm.

System Concept Architecture

The concept architecture of URL correction mechanism is shown in Figure 1. After the request URL is accepted by the system (❶), the URL preprocessor handles it in step 1. By using the user-defined pruned strings, the request URL will be pruned without some redundant information (❷, ❸). In step 2, the URL

Figure 1. Concept Architecture of URL Correction Mechanism.



correction algorithm will find out all possible URL strings (4, 5). Finally, all the possible URL strings will be ranked and returned to the user in step 3 (6).

Edit Distance (The URL Similarity Measurement)

In order to know how similar the two URLs are, we have to find a simple and clear measurement method. We choose edit distance here because it has been widely applied in many fields such as string matching, DNA matching, and so forth. Here is the definition of it:

The edit distance $d(x,y)$ between two URLs x and y is the minimum cost of a sequence of operations that transform x into y . The cost of a sequence of operations is the sum of the costs of the individual operations. In this chapter, we use and only allow these three standard operations of cost 1, such as follows.

- Insertion: inserting the letter a .
- Deletion: deleting the letter a .
- Replacement or Substitution: for $a \neq b$, replacing a by b .

Example [edit distancer]: Suppose there are four strings: U1:google, U2:googlee, U3:gogle, U4:goggle. U2, U3, and U4 all have the same edit distance = 1 with U1. U2 is one insertion *e* on U1. U3 is one deletion *o* on U1. U4 is one replacement (*o*→*g*) on U1.

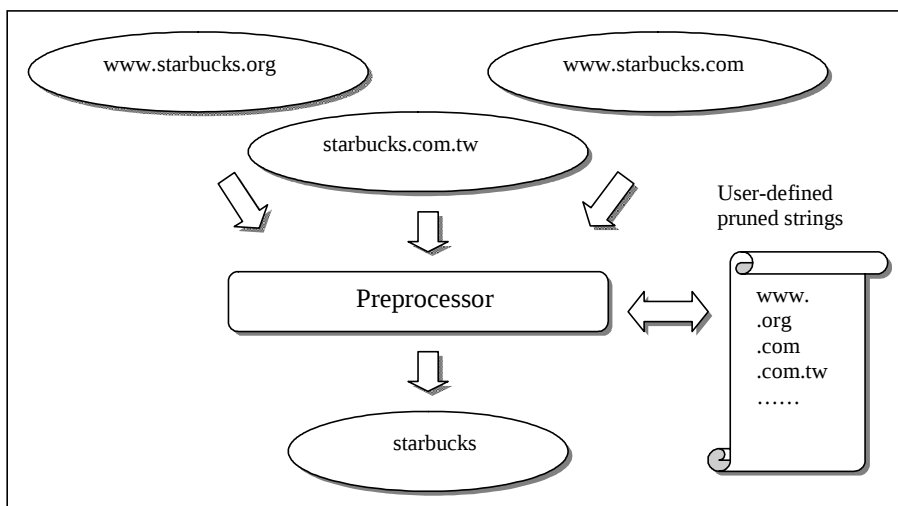
URL Preprocessor

After we have the measurement method, there is one important preprocessor we need to understand. For each request URL, the preprocessor prunes some user-defined prefixes or suffixes of URL, such as: “www.,” “.com,” “.org,” “.gov,” “.tw,” and so forth. The main purpose of it is to reduce some redundant parts before performing the URL correction.

We also use the same preprocessor on all URLs stored in proxy cache. The benefit of the preprocessor is that users only need to type the important parts of URL, and do not need to consider what the prefix or suffix is. The following example shows the influence.

Example [Preprocessor]: As Figure 2 shows, there are three URL strings about Starbucks: *www.starbucks.com*, *www.starbucks.org*, *starbucks.com.tw*. The preprocessor prunes the three URLs to the same

Figure 2. Preprocess Prunes URL Strings into Some Important Keyword.



string *starbucks*. It is very convenient to just enter *starbucks* to find these three URLs.

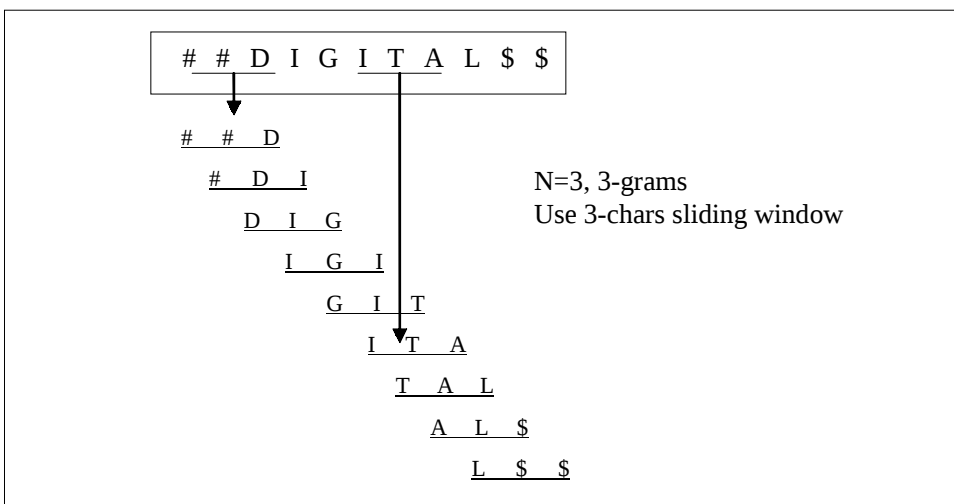
N-Grams

We will introduce the index of URL in the section. For a given pruned URL (denoted s), all n -grams of s are obtained by “sliding” a window of length n over the characters of s . Since n -grams at the beginning and the end of s have fewer than n characters, we introduce new characters “#” and “\$,” and conceptually extend the string by prefixing it with occurrences of “#” and suffixing it with occurrences of “\$”. Thus, each n -gram contains exactly n characters. As shown in Figure 3, the pruned URL s is “DIGITAL,” and its 3-grams are: “##D,” “#DI,” “DIG,” “IGI,” “GIT,” “ITA,” “TAL,” “AL\$,” “L\$”.

The concept behind using n -grams is that when two strings a and b are within a small edit distance, they must have a large number of n -grams in common.

For string s of length $|s|$, we can easily find out the number of its n -gram, which is $|s| + n - 1$. For Figure 3, the number of 3-grams is $9 (= 7(\text{length}) + 3(n) - 1)$.

Figure 3. 3-Grams of String “DIGITAL”.



Filter Conditions

In our URL correction mechanism, given k as the predefined similarity threshold, we use these three filter conditions (Gravano, Ipeirotis, Jagadish, Koudas, Muthukrishnan & Srivastava, 2001) to quickly filter out impossible URLs with edit distance $> k$. The key objective here is to efficiently identify approximate URLs before we use the “expansive” time-consuming distance function to compute their distance. The three filter conditions are defined as follows:

Count Filtering: Consider strings s_1 and s_2 , of lengths $|s_1|$ and $|s_2|$, respectively. If the equation $d(s_1, s_2) \leq k$ holds, then the two strings must have at least $(\max(|s_1|, |s_2|) - 1 - (k - 1) * n)$ the same n -grams.

Position Filtering: If strings s_1 and s_2 are within an edit distance of k , one n -gram of s_1 in one position cannot correspond to one n -gram of s_2 in another position that differs from it by more than k positions.

Length Filtering: The last condition is about the length of string providing useful information to filter out strings. If two strings s_1 and s_2 are within edit distance k , their lengths cannot differ by more than k .

URL Correction Mechanism

In this section we will introduce our URL correction mechanism, including the index architecture and our correction algorithm based on the filter conditions in the previous section.

Index Architecture

In the proxy server, each Web element has its own URL and is stored in its cache. Then the proxy server performs the preprocessor on URLs in its cache, and computes all its n -grams as indices. All the n -grams are put into a large table (“URL Index Table”) that contains four fields: (1) n -gram, (2) URL string length

Figure 4. Indices for URL String “HELLO” Using 3-Grams.

N-grams	Length	Position	URL_ID
##H	3	1	00001
#HE	3	2	00001
HEL	3	3	00001
ELL	3	4	00001
LLO	3	5	00001
LO\$	3	6	00001
O\$\$	3	7	00001

(denote L), (3) position (the position at which n -gram appears), and (4) URL_ID (the unique identification of each URL). The following example shows the details.

Example [URL N-gram Index]: Assume that there is one URL string s “HELLO” with length 5, and we use the 3-grams as indices ($n = 3$). All its 3-grams are:

$$G_{3,1} = "##H", G_{3,2} = "#HE", G_{3,3} = "HEL", G_{3,4} = "ELL", G_{3,5} = "LLO", G_{3,6} = "LO$", G_{3,7} = "O$$"$$

We insert all the 3-grams into URL Index Table as Figure 4 shows.

URL Correction Algorithm

Now, we will introduce our URL correction algorithm. After proxy server builds all the indices of URLs in its cache, and puts them into URL Index Table, the server sorts all indices by the field order (length, URL_id, position). On the other hand, when one request URL s arrives, the proxy server will perform the following URL Correction Algorithm to get the answer.

URL Correction Algorithm:

1. For s , we firstly perform the preprocessor and then get all the n -grams of s .

2. Retrieve each block in the URL Index Table corresponding to each n -gram.
3. For the blocks corresponding with n -grams, we first sort them by the block size, and number the smallest block with 1, and so on. For the block 1 to j , we design one merge algorithm that runs j iterations to merge all records in block 1 to j . Each iteration k ($1 \leq k \leq j$) focuses on the block k and the previous merged result list $k-1$, and it sorts records in result list by URL_ID field. The merge algorithm is like the merge-sort algorithm, and the following lists show the results:

(1) Block 1 $\Rightarrow$ Result List 1 (initiation).

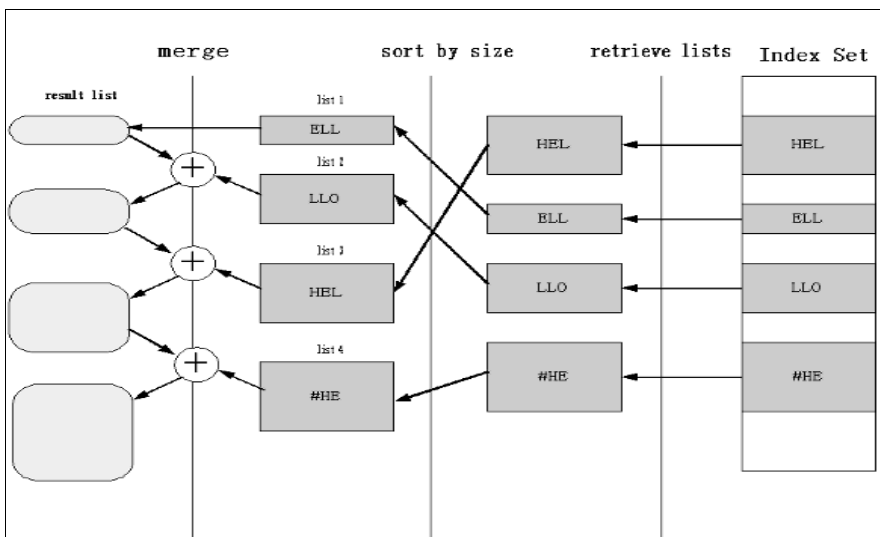
(2) Block 2 $\oplus$ Result List 1 $\Rightarrow$ Result List 2 (The records are sorted by URL_ID in result list, so the merging time is in time $O(n)$).

.....

(J) List $j \oplus$ Result List $j-1 \Rightarrow$ Result List j

The $\oplus$ symbol is the merging and filtering process. In this process, we count the records with the same URL_ID. If it is greater then the *Count Filtering*, the record with the URL_ID is possibly the answer; otherwise is not. Then we check it for the *Length Filtering*, and insert the record into the result list if it passes the filter condition.

Figure 5. Our URL Correction Algorithm and Inside Data Structures.



4. Use the distance function to compute the real edit distance for each record in the result list j .

Figure 5 shows the details.

Ranking and Returning

After the URL correction algorithm, the proxy server could get some possible URLs, and it ranks them by similarity to the request URL, and finally reports the top 10 URLs back to user.

Browser Setting

In order to have better efficiency in browsing the Web, it is necessary for the user to set the proxy server in the Web browser. This helps to make more efficient use of bandwidth and reduce the chances of getting duplicated copies of the same data from overseas. Two common browsers, Netscape Navigator and Internet Explorer, have to be configured to use the proxy server; especially in the IE browser, we have to check the check box of “*Access the Internet using a proxy server*” and cancel “*Bypass proxy server for local (Intranet) addresses*”. The latter action is very important, because the IE browser would automatically append local domains to the request URL when it is just one word; if we do not cancel the latter check box, the proxy server would not receive any request URL.

Experimental Results

We used about 500,000 URL strings to evaluate the performance of the URL correction algorithm and produce more than 5,000,000 n -gram data. In our experiments, almost all tests finished in 1 to 3 seconds; the performance of the filtering is acceptable.

In our previous research (Pan, Yang & Lee, 2002), we found that n value is very important for the performance. If n is too large, the filter conditions do not work, and the performance decreases. If n is too small, the index size increases, and the performance also decreases. Therefore, one suitable n value is very

important too, and n (=3 to 5) is suitable for common situations in our experience.

Conclusion

We design the URL correction algorithm in the personal proxy server, and it will take users to a convenient environment when browsing the Internet. Even though users enter URLs with errors, they still will be taken to the correct Web pages. This is our major contribution.

There are two different correction levels in our URL correction mechanism. The first part comes from the preprocessor. It could correct the “google” into the “www.google.com”. The second part is the URL correction algorithm based on filter conditions. It could correct the “goggle” into the “www.google.com”. On the other hand, the configuration of proxy server could be changed for various approximate levels depending on different needs.

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Chapter VI

Emerging Practices and Standards for Designing Business Web Sites: Recommendations for Developers

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Abstract

A well-designed and implemented Web site can give a business the edge in the online environment. In part this can be achieved by utilising the appropriate encoding language, incorporating metadata into Web pages and addressing accessibility issues for the disabled. These aspects of Web site implementation tend to be technically tangible and thus relatively easily definable. However, some of the subjective aspects of Web site development associated with information design, such as information quality, effective information visualisation and presentation also contribute to a successful Web site strategy. In this chapter we report on some of the

emerging technical and information design practices that a developer should consider in the implementation of business Web sites.

Introduction

There can be little doubt that an increasing amount of business is being done on the Internet. The Web sites that are at the center of this new way of thinking and working are a constantly growing and evolving entity. It is also clear that a Web site must evolve with time to reflect the changing needs of the organisation it represents and the organisation's Web site community. Web sites that have been designed appropriately will have a definite edge in attracting users and increase the trend to electronic commerce (Fisher, 1999). Forrester's Research has found that simplicity in Web site design is of paramount importance in that it contributes to successful Web site use (Cavanagh, 1999) and simple Web design has been advocated as the differentiator between a successful and unsuccessful Web site (Internet.au, 2002; Nielsen, 2000). Nielsen, one of the champions of usability and simplicity of Web site designs, indicates:

"Design is done for a reason, and if you do it well your business will prosper. If you do it poorly, people will leave your website" (Nielsen, 2002, p. 26).

Furthermore, Web site design is also an evolving practice (Sellitto & Wenn, 2000), with early work by Brody (1996) suggesting that good design should aim at making information visible and manageable — good design needs constant re-design. Appropriate Web design should utilise information as its currency with interface design being a vehicle for conveying that information. The anarchic nature of the Internet, with its constantly changing form, presentation, visualisation and interactivity, does not allow guidelines and standards to be easily applied and adapted to Web site design. When you consider that much of the software used on the Web (browsers, plugins, applets, animation players, etc.) is proprietary in nature, there is no incentive for these software owners to adhere to a form of regulatory control that may result in reduced market share and company profitability. The consequences for the Web user community have been and in some areas still are reflected in episodes of poor cross-platform compatibility, browser interoperability and non-scalable Web

documents. However, within the general Internet community there are various groups that have provided an open forum for discussion on development of Web design guidelines. Groups such as the World Wide Web Consortium (W3C), the Web Accessibility Initiative (WAI) and the Dublin Core Metadata Consortium all have been instrumental in formulating a set of self-regulating specifications. The use of these specifications is encouraged in the interests of software interoperability and cross-platform hardware compatibility.

In this chapter, we draw on our previous work (Sellitto & Wenn, 2000, 2003; Wenn & Sellitto, 2001) to recommend a Web site design framework that encompasses some of the relatively technical based features associated with accessibility, proper HTML encoding and metadata elements. Furthermore, we also incorporate into the framework some of the more subjective features of Web site development, focusing on issues associated with the visual and information design aspects of Web sites, and include the areas of information quality, effective information visualisation and presentation design.

Markup Language – Encoding Standards

When using appropriate mark-up for Web page development, site builders may tend to overlook the selection of recommended specifications. In an environment of proprietary Web development software, as well as browser monopoly (Internet Explorer V6.x), any initiatives undertaken by international groups such as the Web Accessibility Initiative (WAI) to “regulate” or set direction for aspects of Web design can result in increased international community awareness and the eventual acceptance of guidelines. Today, the World Wide Web Consortium (W3C) provides a united and directing body that addresses the development of interoperable technologies through specifications, guidelines, software, and tools. Invariably the consortium aims at allowing the Web to achieve full potential as a global information and communication medium that is used by business and community groups.

The W3C takes on the responsibility of determining the specifications for Hypertext Markup Language (HTML), the publishing language of the World Wide Web. In January 2000, XHTML became a recommended mark-up language for Web site development. Extensible hypertext mark-up language (XHTML) is a reformulation of HTML that imparts strictness on code

presentation. The current specification for Web development is for XHTML 1.0, with a draft version XHTML 2.0 being formulated in May 2003 (W3C, 2003).

XHTML

XHTML extends and replaces HTML 4.01 as a specification bridge to the more complex eXtensible Markup Language (XML). Some of main differences between HTML 4.01 and XHTML 1.0 are:

- XHTML is “well formed,” where the specification encourages the specific nesting and closing of element tags. Developers need to pay more attention to syntax than HTML requirements.
- Case sensitivity—XHTML is lower case specific.
- Tag closure—Previous versions of HTML did not enforce the closing of some tags. The XHTML protocol specification is to have all element tags closed.

XHTML has gained industry-wide recognition since January 2000, when the W3C recommended the format as the current preferred specification. The beauty of XHTML is that it enforces stricter and neater mark-up coding. This will allow developers to approach coding tasks better prepared for the shift to XML. The W3C considers XML to be an open standard for the definition of data—a metalanguage that allows you to describe other languages. XML, like HTML is a subset of the more complete SGML—Standard Generalised Markup Language (Holzschlag, 2000). Because of the developing standards around the XML format the W3C has proposed that XHTML will be a transition language until there is a widely accepted and supported industry standard for XML.

Tools for Checking Proper HTML Encoding

When editing or creating HTML documents, various errors in coding can, and undoubtedly do occur. The W3C in an attempt to promote the reliability and

fidelity that is part of the Web communications initiative has introduced open source tools that are freely available and allow proper checking of HTML code. Some of the more reputable and widely supported tools are HTML Tidy and HTML Validator.

HTML Tidy

HTML Tidy, when used appropriately, allows incorrectly coded Web pages to be *tidied up* by flagging a wide range of errors evident on pages. Furthermore, the application has the ability to convert existing HTML Web pages to a form considered to be well-formed XML, which can be subsequently displaced as XHTML. Tidy, as the tool is sometimes referred to, was developed by Dave Raggett in 1997; however, it is now maintained by a cluster of developers that provide a set of cross-platform compatible versions of the tool as well as a set of libraries that will allow Tidy to be easily incorporated into other applications. Tidy is available online at <http://tidy.sourceforge.net/>. Figure 1 gives an example of a *cleaned-up* code fragment using the jEdit editor.

Figure 1. Editors such as jEdit (www.jedit.org) have a Plug-In Version of Tidy. (When an HTML document has been tidied, the signature is inserted as a metatag.)

```
<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Transitional//EN"
"http://www.w3.org/TR/xhtml1/DTD/xhtml1-transitional.dtd">

<html lang="en-gb" xmlns="http://www.w3.org/1999/xhtml">
  <head>
    <meta name="generator" content="HTML Tidy for Linux/x86 (vers 1st March 2002), see www.w3.org" />
    <meta http-equiv="content-type" content="text/html; charset=ISO-8859-1" />
```

HTML Validator

This is one of the free and open source validation tools recommended by the W3C. Use of HTML Validator can give developers and designers an indication of how a Web page conforms to the W3C recommended encoding practices that aid cross-browser and computer platform display, thereby ensuring a maximum audience for a Web site. In addition, it can be used to check for

conformity against previous versions of HTML, including the W3C recommendation for HTML 4.01 and 3.2 and the Internet Engineering Task Force's (IETF) HTML 2.0 standard. HTML Validator is available online at <http://validator.w3.org/>.

Recommendations for Encoding Good Practice

In the interests of multi-browser interoperability and adherence to conformity with W3C specifications, Web page mark-up should:

- Use XHTML 1.0 specifications as a minimum requirement.
- Be aware of the fundamental differences between XHTML and the versions of HTML. XHTML is highly recommended as the coding language of choice.
- Utilise an open source tool for validation of code on existing and new Web pages.

Accessibility Standards

Web access for many is not problematic. However, access can be restrictive for a great many individuals who have a disability or who are members of the aging population (Holzschlag, 1999; Newman, 2000). The power of the Web is its universality in which all have access, even those with disabilities. In the US, there is a legislated requirement that all federal agencies make their electronic information accessible to individuals with disabilities—this regulation, known as Section 508 (<http://www.section508.gov/>), has itself become a Web page accessibility standard. The provision of accessible Web pages on sites needs to be considered in the context of the large number of individuals that have some form of disability. The Watchfire™ corporation, the company that in 2002 commercially licensed the widely known accessibility assessment tool Bobby™ indicates that some 10% of individuals who use the Internet are deemed to be disabled. Moreover, the collective discretionary income of these people is some over \$US 700 billion— which makes them a niche group that really cannot be ignored (Watchfire, 2003). Other countries have similar disabled

groups that need to be acknowledged and considered when developing Web sites; for example Australia has some 3.6 million individuals who have a disability of some sort (Ridge, 2000). Clearly, the firms with accessible Web sites may benefit from positive publicity and have a greater opportunity to sell to this disabled audience. This action by a business also enacts a form of protective policy that may avoid potential litigation, costly settlements and unfavourable publicity that may stem from a poorly accessible Web site. This litigation aspect is no more obvious than in the civil case of Maguire v. The Sydney Organizing Committee for the Olympic Games (SOCOG). In August 2000, Maguire complained that the Sydney Olympic Games Web site was inaccessible to him as a result of his disability—blindness. Maguire’s text reader was not able to properly interpret the Web site’s content due to poor formatting and non-conformance to accessibility guides such as Section 508. Maguire was successful against SOCOG, with the courts fining the organisation A \$20,000 and Maguire receiving compensation (NUblog, 2001). During the court case it was pertinently argued and highlighted that issues associated with Web site accessibility could have easily been addressed if the SOCOG Web site developers (IBM) had adhered to the W3C accessibility guidelines—fundamental accessibility guidelines for Web site content creators to follow.

Web sites that are poorly designed from an accessibility perspective tend to be particularly unfriendly for various disabled groups, causing numerous problems for them. Some problems include:

- Screen-readers being rendered useless for people with visual disabilities.
- The feeling of being lost due to absent navigational elements for individuals who have cognitive disabilities.
- Loss of content in video clips or audio streaming when no captioning is provided — important for individuals with a hearing impediment.

The various guidelines mentioned during the Maguire case are addressed by the W3C, which provides 14 checkpoint accessibility guidelines. Implementation of these guidelines will not only improve Internet access for the disabled but also improve the design of a site for people who may be operating in a non-standard computer environment (Powell, 2002). These guidelines should be viewed as evolving standards, detailing a set of conventions that have been agreed upon to promote easier accessibility for the disabled in a Web environment (W3C, 2000). They cover:

- Provision of text equivalents for all non-text elements (i.e., images, animations, audio, video)
- Information conveyed with colour being also available in an equivalent form
- Organising content clearly and in a logically manner
- Provision of alternative content for potentially non-browser supported features such as applets or plug-ins
- Provision of summaries of graphs and charts

Furthermore, the W3C is aware of differentials in applying all guidelines to all Web sites at one time. Hence, part of the consortium's working party has recommended various priority levels for implementing Web site features based on their perceived impact on accessibility. These priority guidelines for Web page design are:

- Priority 1 – This is a mandatory requirement for Web site developers. Failure to meet the accessibility guidelines at this level results in one or more groups being unable to access information satisfactorily online.
- Priority 2 – Web site developers should aim at addressing this accessibility level. Addressing this level will remove significant barriers to accessing Web documents.
- Priority 3 – Web site developers may wish to aim at meeting this level of accessibility. An attempt at satisfying this level will enhance information access on Web documents.

Online Accessibility Assessment Tools

Part of generating appropriately accessible Web pages is having the appropriate tools to assess Web page accessibility. The Centre for Applied Special Technology (CAST) is a non-profit organisation that uses computer technology to expand opportunities for people with disabilities. CAST developed an online accessibility tool, Bobby™ (<http://www.cast.org/bobby/>), which as previously indicated was licensed to Watchfire™ Bobby™ is one of the most renowned online Web-based validation tools that analyse Web pages for accessibility for people with disabilities, as well as their compatibility with

various browsers. Bobby's analysis of accessibility is based on the W3C's Web content accessibility priority guidelines.

Recommendations for Accessibility Good Practice

In the interests of equal access to the Web for the disabled, Web page development should:

- Adhere to W3C recommended specifications for accessibility.
- Be certified with an open source validation tool that analyses Web pages for their accessibility to people with disabilities. Achieving a rating of W3C priority 1 is mandatory.
- If possible, developers should aim at addressing all three priority levels.

Standards for Metadata Activity

Metadata is a resource descriptor that can be considered to be similar to information found in a library catalogue — in essence metadata are data about other data. Important and accurate metadata can be conveniently incorporated into an electronic document when it is being created. Incorporation of metadata retrospectively can prove to be expensive, time consuming and may incur inaccuracy; it may prove to be impossible. Digital resources are dependent on computers and appropriate document creation software; consequently it is at the point of creation of an electronic record that important data/information attributes and descriptions can be easily recorded. Appropriate use of metadata at the point of creation allows for:

- Long term access, which is important when considering information preservation and information re-use.
- Easy access and discovery allowing proprietary intra-organisational search engines that may be part of a data-warehousing implementation to return more relevant returns after user enquiries (Little & Gibson, 2003). Furthermore, improved Web site searches with engines such as Google

and Altvista can be achieved after incorporating metadata into Web page documents.

- Metadata can be used to uniquely identify document or sub-document pages through a universal resource locator (URL).

The Web was originally organised around the way that individuals comprehended and understood information. Clearly, with exponential increase in online information it is difficult to manage Web content manually and there is a reliance on automated indexing and cataloguing. In an effort to refine the automatic indexing of Web pages, the W3C advocates the use of a resource description framework (RDF) with metadata used to describe Web page content (W3C, 1999). The RDF provides a fundamental schema for representing document properties and relationships — one of the RDF frameworks that has emerged as a standard since the early 1990s was initiated by the library community, and revolves around a vocabulary called the Dublin Core (DC). (The original workshop for establishing the DC metadata vocabulary was held in Dublin, Ohio in 1995, hence the term “Dublin Core.”) The DC utilises a basic list of descriptive elements that is aimed at providing long-term access to digital resources. Since 1995, annual workshops have been held to discuss the latest framework adoptions, proposals and recommendations — hence the DC appears to be a well accepted and constantly evolving standard that is formulated by the information community (see for example, Borgman, 2000).

The functional characteristics of the DC is that it is relatively simple in providing the basic foundations for semantic interoperability and is defined in the form of a set of elements for resource description. The DC metadata element set (version 1.1) is composed of 15 elements within the W3C Resource Description Framework (RDF) and is considered to be one of the most comprehensive schemas for resource description. It appears to be the format of choice for Web site description attempting to define bibliographic categories for Web pages (DCMI, 2003). Incorporation of metadata into Web pages is achieved via the <meta> tag set with elements being embedded into pages at two different levels:

Simple Level

A simple metadata template will includes base elements such as *title*, *creator*, *subject*, *type*, *identifier*, *language* and *date*. This is a minimum and manda-

Figure 2. Simple Metadata Tags: title, keywords, description, author, rights, and creation-date. (These examples were created by hand but tools exist to enable the task to be more or less automated.)

```
<html lang="en-gb" xmlns="http://www.w3.org/1999/xhtml">
<head>
  <meta name="generator" content="HTML Tidy for Linux/x86 (vers 1st March 2002), see www.w3.org" />
  <meta http-equiv="content-type" content="text/html; charset=ISO-8859-1" />

  <title>BC03044 Web-Enabled Business Research</title>

  <meta name="title" content="BC03044 Web-Enabled Business Research" />
  <meta name="keywords" content="andrew wenn, lecture notes, assignments, web-enabled business research, bco3044, webr" />
  <meta name="description" content="Visit this site to obtain the lecture, tutorial notes, and assignments for bco3044
Web-enabled Business Research" />
  <meta name="author" content="Andrew Wenn" />
  <meta name="rights" content="© 2002 Andrew Wenn" />
  <meta name="creation-date" content="2002-7-27" />

  <link rel="stylesheet" type="text/css" href="webr_styles.css" title="webr" />
</head>
```

tory requirement and proposed as a simple core based on the original Nordic metadata project in 1996 (Sellitto & Wenn, 2000).

Complete Level

This is the full listing of the Dublin Core Elements and includes *title*, *creator*, *subject*, *description*, *publisher*, *contributor*, *date*, *type*, *format*, *identifier*, *source*, *language*, *relation*, *coverage*, and *rights*. The full use of the DC is recommended and encouraged, with the DC 15- element set template available online at <http://dublincore.org/documents/dcmi-terms/#H2>. An example of metadata elements is depicted in Figure 2.

Online Tools for Creating Metadata

As stated previously, one of the aims of the W3C has been to encourage developers to incorporate metadata into Web pages. Many proprietary Web development software applications provide the means for doing this. However, numerous DC and W3C endorsed metadata generating tools are available online that will allow creation of metadata for Web pages. Two easy and simple to use tools include:

- The metadata creator that is provided by the Nordic Metadata Project utilises a template that allows the basic 15-metadata element set to be synthesised. The metadata creator is online and available at <http://www.lub.lu.se/cgi-bin/nmdc.pl>.
- DC-dot is a metadata editor that extracts and validates metadata from existing HTML Web pages and MS Office files. DC-dot is maintained by the University of Bath in the UK, and provides a service that allows a Web page to be retrieved and metadata to be automatically generated. DC-dot is available online at <http://www.ukoln.ac.uk/metadata/dcdot/>.

Recommendations for Metadata Good Practice

- Metadata should be incorporated into electronic documents when they are created.
- Defined Dublin Core Elements should be the only elements used (no new elements should be defined).
- The incorporation of the simple level of base elements of the Dublin Core is a minimum expectation for all Web pages.
- The complete level of 15 Dublin Core elements is strongly recommended.

Information Quality

The Web is a valuable resource for people seeking information; however, because information on the Web is subject to change, up-grade and alteration it is difficult to assess quality and accuracy (Sellitto, 2001a). Traditionally, many information publications such as books, journals, and manuscripts have been required to meet an editorial review process before being printed, which has assisted in implementing a quality control mechanism. However, with the proliferation of the World Wide Web, this review process can be circumvented, allowing individuals to easily publish online (Sellitto, 2002). Consequently, issues associated with information quality become important for all Web developers.

Not all Web information is created equally and some Web information is more valuable than others. Web information quality can be gauged by factors such

as value, reliability, currency, content and source (Davenport, 1997; Sellitto, 2002). The quality of online information is thus integral to Web design. Poor quality of information can be considered to be a reflection on Web design. The library community has historically evaluated information quality in the traditional print media using criteria such as content, purpose, scope, currency and cost (Gordon-Murnane, 1999). When it comes to evaluating Web information, the library community has provided numerous suggestions for establishing criteria for determining online information quality. In addition to this list, Phillips (1998) from UC Berkeley suggests that if there are links to external sites, then an evaluation of these links should be provided. A *critical thinking* approach to Web information evaluation has been suggested by Grassian (1998), where sources of the information form the primary criteria for information validity.

The Grassian list of assessment criteria includes:

- Content and Evaluation – Who does the site represent? Is the information based on research or scholarly undertakings? Are references available?
- Source and Date – Who is the author and what expertise does he or she have? When was the Web page produced, updated, revised and authorised?
- Structure – Is the structure and presentation style of the information consistent with the discipline that it represents?

Another methodology for evaluating online information is based on applying a series of questions to an informational Web page (Alexander & Tate, 1999). Each affirmative response to a question posed about the information would suggest the information is of a high quality (high scores equate high quality information).

Alexander and Tate identify five criteria on which to evaluate and score information quality:

- Authority – Can the author of the information be identified? Is there a telephone number or postal address stated? Is there a copyright or disclaimer?
- Accuracy – Can the information be corroborated from other sources? Are there referees listed for further investigation?
- Currency – Are there dates indicating when the Web page was first created, updated and/or revised? Is the information current?

- Objectivity – Is the information provided as a public source (.gov or .org URL inclusion)? Is the information free of advertising? If advertising exists is it related to the information content?
- Coverage – Is the information complete? Is the information part of a larger piece of work?

Berkman (1998) provides a business perspective to online information evaluation. The assessment criteria he suggests addresses business requirements for using information to gain market advantage and strategic position. Berkman's checklist for assessing the quality of business resources includes measures such as how searchable the information is, timeliness, how frequently updated and information storage. The assumption is that such assessment is applied to sources after they have been found to be credible. Davenport (1997), on the other hand, identifies information and knowledge as being integral to an organisation and suggests six categories for assessing information— accuracy, timeliness, accessibility, engagement, applicability and rarity.

Recommendations for Good Practice in Evaluating and Promoting Information Quality

The following set of good practice guidelines for evaluating and promoting information quality is proposed:

- Achieving information authority and currency
 - Display the company or an author's name on all Web pages.
 - A date of the last Web page modification or revision should always be displayed.
 - A contact e-mail and either a telephone number and/or postal address needs to be provided.
- Meeting information accuracy
 - References and sources should be provided when factual or corporate information is listed.
 - If linking to other sites then provide a brief assessment of each link.

- Addressing information structure
 - The information should be presented in the style that the Web site's visitor community would be accustomed to.

Information Presentation Aspects of Web Design

Standards that relate to the visual and presentation aspects of Web design are not clearly defined. Numerous authors (Nielsen, 2000; Norman, 1998; Schneidermann, 1999) advocate the practice of simplicity and elegance in Web page design to convey the greatest amount of information to the user. The success of a Web site is not solely reliant on the implementation of technical standards, considering that a site with numerous encoding errors and/or poor accessibility adaptation can be very successful (Sellitto & Wenn, 2000).

Good design for human interface interaction can be achieved by using an uncluttered screen layout, which in turn encourages the fluid delivery of information (Brody, 1996). Fuccella and Pizzolato (1999) suggest that a well designed Web site needs to incorporate a successful fusion of important Web entities and elements, including navigation, graphics, content and interface layout. Lynch and Horton (1999) further indicate that Web site and Web page design need to address aspects of navigation, interface design, graphics and multimedia. Small and Amone (1999) argue that motivational aspects of a Web site are important design features. These encourage the users to be "sticky" and keep coming back. Thus it appears that some of the important issues that good Web design practice should address and encompass are Web site navigation, graphics and images and information presentation and display. These are discussed in the following section.

Web Site Navigation

Online navigation is not easy. Users can arrive at a Web page from numerous points ranging from links that are internal to a site, a source external to the site or a search engine listing. Consequently, some key questions that users find themselves asking (Powell, 2000) are:

- Where am I?
- Where can I go to next?
- Have I been there before?
- Can I get home from here?
- How did I get here?

Users do not see some Web page links because they are not evident; thus links must be clearly designated to remove uncertainty on the part of users. To instil a sense of control when moving about a site, navigation cues should be provided on each page of a Web site (Nielsen, 2000). Research has shown that when users were given visual cues to locate links, as opposed to using the pointer to search for links, they were able to find the information seven times faster (Bailey et al., 2000).

Appropriate navigation cues can be easily achieved by simple and elegant menu bars located at the top or bottom of a page. It has been found that important links and information needs to be positioned higher on a Web page (Bailey, Koyani et al., 2000). This will allow users to move *through* a Web site with some sense of control and not have the feeling of being lost. Web sites that have deeply nested pages should provide a means of letting a user know where he or she is located, which can easily be achieved by using a visual trail (for example, a breadcrumb trail) or a hierarchical map (Nielsen, 2000).

Unvisited links need to be blue and underlined and users should not be required to move the mouse to determine where links are on a page (Lynch & Horton, 1999; Nielsen, 2000). It has become standard to show visited links as purple, allowing Web site visitors to see where they have been, and it is good practice to distinguish between internally directed links and links that point to a different Web site (Spool et al., 1997). Spool and colleagues further suggest that because users can be slowed down when they are confronted with similar looking links it is appropriate that links be descriptively labelled so that users can discriminate between them. A text link is favourable to a graphic link, considering that graphics take longer to download and do not change colour after being selected (Bailey, Koyani et al., 2000).

A corporate logo is a form of identity (branding) and may also serve as a sub-conscience navigational aid for users (O'Brien, 2000) by providing them with a sense of location that allows them to confirm where they are — have I left the site? The logo also serves as a reinforcement of the quality of information that

may be found on the page—this is a reputable organisation, and the information is likely to be truthful. A logo can also be used as a navigational aid that allows a user to return to the HOME page—I can go back to the corporate HOME if I get lost. Links that lead to dead ends (the dreaded “error 404. The page cannot be displayed”) are a consequence of poor Web page maintenance, a concept that Nielsen (2000) refers to as *linkrot*.

Figure 3. Sequence of Pages from the Same Web Site Illustrating a Hierarchical Menu Structure that Gives the User a Sense of Place. (Each of the pages has a submenu and a link back to the superior page with the logo/button linking the user to the home page (VENIAM). The length of each line of text has also been curtailed to approximately 80 characters to ensure readability. Although not shown here, for space reasons, each page has a last updated date. Note also contact details are provided.)

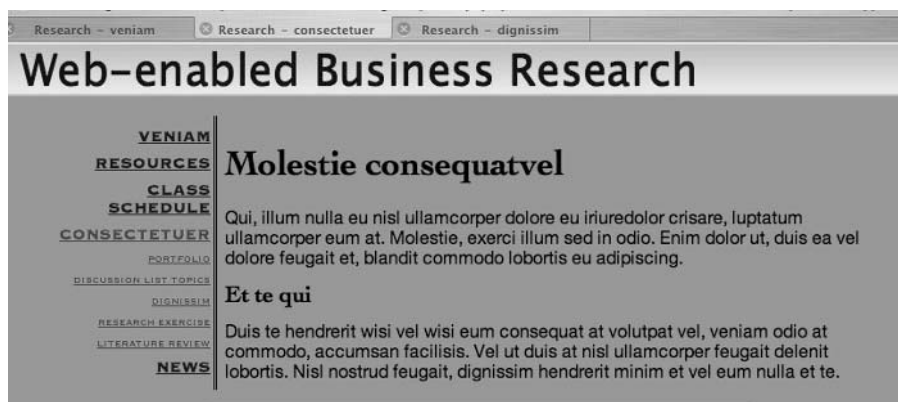
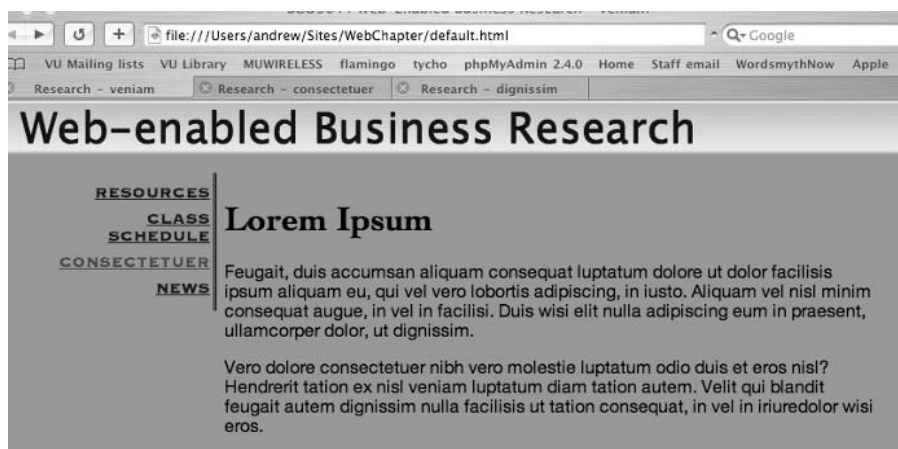


Figure 3. continued



Links should always be active or be removed to reduce user frustration and the back button should not be relied upon as the primary source of assistance in returning to previous pages. Figure 3 gives an example of fundamental features that enhance user navigation of a Web page and site.

Information Architecture

Information architecture refers to the way that information is effectively and successfully presented on a Web page (Davenport, 1997; Powell, 2000; Wurman, 1996). Aspects of displaying information online include the positioning and presentation of text on the screen, page scrolling, text size, font variation, margins and white space (Nielsen & Tahir, 2002; Schriver, 1997). Positioning dark text on a white background appears to increase the legibility of text when compared to other combinations of background colour and text (Spencer, 1969). Schriver (1997) indicates that keeping within the same font family enhances online legibility and that no more than two different font types should be used for online presentation.

Reading practices in the Western world are orchestrated around a left to right and up-down prospective. Web page design should attempt to mimic the

vertical perspective that the human eye is accustomed to when reading text (Lynch & Horton, 1999). Thus, horizontal scrolling of a page is counter to normal visual reading behaviour and is not a good design practice. This also highlights another important issue, the role of culture in information presentation and the need to consider the prospective audience.

Sentence length is also important and can be a significant factor in influencing reading rate; however, it appears that comprehension is unaffected by line length (Dyson & Kipping, 1999). It has been shown that users find it difficult to read edge to edge on a screen and that readers experience eye strain, and have difficulty discerning the start of new lines — more often losing their point of reference (Schrivver, 1997). Thus, text on Web pages should occupy a central location and should be sufficiently indented to prevent text running edge to edge. Horton (1994) advocates that the optimum length of screen line length should be no more than 40 characters, and line lengths of less than 20 characters have been found to affect the visual and spatial association between words, leading to a reduction in legibility. Dyson and Kipping's (1999) research suggests that line lengths of about 100 characters are read faster than shorter lines; however the longer line length is more difficult to read. These authors advocate 55 characters per line as optimum Web page line length.

Because reading from an electronic screen is slower and more tiring than reading text on paper, sentence length and reduced word counts on a Web page have led to people scanning for key words in order to find relevant information (Nielsen, 2000). Morkes and Nielsen (1997) observed that people scan text on the screen moving to deeper levels of the information content as they require. A consequence of this *scanning and drill-down* behaviour is that many users do not like long pages. For instance, Black (1997, p. 53) states that 75% of people only ever read the top of a Web page and never scroll. Web page content should be such that it increases in volume as one navigates *into* the Web site. Hierarchical navigation should be utilised with each tier encountered containing more information as users seek out further resources about a particular area of interest (Nielsen, 2000). Users should be able to move from page to page by selecting links (paging) without always scrolling to important information. This is particularly true for home pages and menu pages, where users fail to scroll past the first page when they reach a site unless the information is relevant and useful — thus, page scroll should be kept to a minimum (Dyson & Kipping, 1999).

Web Page Download

Excessive download time is a problem that has been encountered by Web users for many years and shows little sign of diminishing (Nah, 2000). Several studies indicate that fast Web page download is the definitive feature that determines the success of a Web site and that users will not wait more than 10 seconds for a page to download using a 28.8kbps modem (Nielsen, 2000; Pockley, 1998; Spool, Scanlon et al., 1997). Others suggest that it is not unreasonable to expect a page to load in less than 8 seconds with a 56kbps modem (O'Brien, 2000). Graphics, artwork and images constitute the Web page components that determine the relative speed of page delivery. A Web page that includes a large number of graphic files will take a relatively long time to download to reach a user. In a restrictive bandwidth environment, where many users operate with modem speeds of no greater than 28kbps even though they have a 56kb modem — file size becomes critical for fast download. Consequently good Web design should aim at building Web pages that will download sufficiently fast to meet the expectations of the majority of users of that Web site.

Recommendations for Good Practice in Presenting Web Information

The following set of good practice guidelines for presenting Web site information is proposed:

- Navigation
 - All links must be coloured blue and underlined; visited links should be purple.
 - All links need to be active (avoid *linkrot*).
 - It is preferable to use text rather than image links.
 - All Web pages must have some form of navigation cue.
 - Position important links higher up on Web pages.
 - Deeply nested hierarchical sites should let users know their location by using, for example, a breadcrumb trail.
 - Each page should allow the visitor to return to the Home page.

- Information Architecture
 - Use a dark text on a white or lighter background.
 - No more than two different font types should be used.
 - In pages predominately aimed at a Western culture use a left to right and vertical perspective in page layout.
 - Text on Web pages should occupy a central location.
 - Line length should be between 40-60 characters.
 - Keep page scroll to a minimum (one to two pages).
 - Horizontal scrolling of pages should be avoided.
- Web Page Download
 - Balance download time against the value of information content.
 - Aim at download times of no more than 10 seconds with a 28kbps modem and eight seconds with a 56kbps connection.

Conclusion

There are many aspects to producing a well designed, informative, and useable Web site that is cross-platform compatible and highly maintainable. We have discussed various aspects that developers can undertake to assist in meeting these goals. The more tangible and concrete technical based activities relate to HTML encoding, accessibility standards, and metadata usage for which we have identified what we regard as best practice procedures and made recommendations regarding easy-to-use tools that may assist in successfully implementing or evaluating these procedures. Moreover, we have endeavoured to address aspects of Web site design that have a higher degree of subjectivity and are more difficult to evaluate. The more subjective areas discussed encompass visual and information design that deal with quality, presentation and navigation. These latter Web design areas are more prone to being inadvertently misunderstood and thus ignored by developers; hence we have made a concerted attempt to specifically identify a series of features and practices, and made recommendations that address this subjective area of Web site implementation. Furthermore, we regard good Web design practices to be constantly evolving and are by no means complete. Future Web site interface design will need to

address issues associated with the next generation of Internet technology applications — for example the use of the PDA, mobile telephones, Web TV and other Internet capable devices for delivering e-commerce services. These will add to the evolving constructs associated with Web site design and development. Clearly, future best practices and standards will be required to address these new developments.

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Section III

IT and Issues Regarding Human Resources Management

Chapter VII

A Framework for Defining E-Business IT Skills Portfolio

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Abstract

When a firm moves from an e-commerce to an e-business enterprise, the technology-driven transformation generates new demand on their IT services and capability. Successful deployment of e-business solutions requires business process change and Internet-based enterprise systems to support inter-enterprise collaboration. These directions challenge firms to re-evaluate their IT skills portfolio. This chapter examines current demand on IT workforce, IT skills portfolio management, changing skill requirements for e-business, and gaps between industry demand and academic preparation. It also addresses trends shaping IT skills for an e-business in terms of architecture, implementation, organizational change, application development, and tools and technology. Based on the review of these issues and trends, a framework is proposed to guide the development of a desired skills portfolio for e-business transformation. The chapter concludes with a research agenda.

Introduction

The Internet has a profound impact on companies. Widespread adoption of Internet business solutions across industries, in the US as well as in the UK, France, and Germany, attests to the contribution of e-business to the economic growth of these countries (Varian, Litan, Elder & Shutter, 2002). Organizations of all sizes have deployed Internet-based business solutions for lowering operating costs and increasing revenues. Typical e-business solutions include enterprise systems for managing relationships with customers and partners, coordinating supply chains, and supporting organizational business processes. Therefore, e-business differs from e-commerce, which focuses on using the Internet to support business-to-consumer and business-to-business *transactions* that involves marketing, sales, and post-sale services.

Successful deployment of e-business solutions is predicated on two requirements: business process change and Internet-based enterprise systems. Companies need to redesign and integrate their internal business processes with those affecting customers and business partners in order to achieve productivity gains. Industry leaders, such as Dell and Cisco, have pointed out that productivity gains accelerate only after companies have adjusted their business processes to new technology (Mullaney, Green, Arndt, Hof & Himelstein, 2003). Inter- and intra- enterprise systems enable organizations to exchange information and deliver end-to-end services. However, it is costly and difficult to implement and integrate enterprise systems. Both process redesign and implementation of complex enterprise systems present many challenges for IT professionals.

Information technology plays a pivotal role in delivering integrated services and relationships with customers, business partners, and employees. When companies move towards e-business, they need to acquire and develop new IT technology capacity. During the past two decades, waves of technology advancement have forced organizations to constantly address changing skill demands (Nakayama & Sutcliffe, 2001b). What's different for e-business now?

Several prominent technology and business trends are redefining a firm's IT skills portfolio. For example, the increasing pressure for industry-wide collaboration requires organizations to establish an e-business architecture that integrates strategies with application and technology architecture (Kalakota & Robinson, 2001). An understanding of enterprise architecture is necessary for

systems integration and application development. Furthermore, deployment of complex enterprise systems that span across supply chain partners will demand deep knowledge of inter-enterprise processes. Additionally, the emerging technology of Web services (Lim & Wen, 2003) promises new technological and business solutions where firms can search for and consume services provided by other firms, eliminating the need to develop those services internally. Hence, knowledge in how to apply new technologies is critical to inter-organizational collaboration.

This chapter focuses on the identification of a firm's IT skills portfolio for supporting e-business. Industries are accelerating the pace of e-business transformation. A solid understanding of changing requirements for IT services in an e-business environment enables companies to gauge the gaps in their IT capability and to devise appropriate strategies for managing their IT skills portfolios.

This chapter is organized into four sections. The first section provides a review of research on e-business. The second section identifies five issues pertinent to the e-business IT workforce: (1) demand, (2) IT workforce, (3) skills portfolio, (4) changing IT skills portfolio, and (5) gaps between industry demand and academic programs. The third section addresses five trends shaping IT skills for an e-business — (1) architecture, (2) implementation, (3) organizational change, (4) application development, and (5) tools and technology. Based on these trends, a framework is proposed to guide the identification and management of IT skills portfolio. The last section presents research questions and conclusion.

E-Business Transformation

Defining E-Business

The concept of e-business has gained broad acceptance as organizations have adopted Internet-based solutions for increasing productivity and service (Varian et al., 2002). However, there exist many different definitions of *e-business* (Alter, Ein-Dor, Markus, Scott & Vessey, 2001). Among the first to promote e-business, IBM defines e-business as Internet-based transactions of business as well as the efforts that combine resources of traditional information systems with the World Wide Web, intranets and extranets ([Copyright © 2004, Idea Group Inc. Copying or distributing in print or electronic forms without written permission of Idea Group Inc. is prohibited.](http://www-</p>
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3.ibm.com/ibm/terminology/goc/gatmst09.htm). Furthermore, an e-business emphasizes the connection of critical systems for customers, employees and suppliers. Online processes enable the dynamic exchange of information with constituencies to improve service, profitability, and relationships.

The term “e-business” also refers to the “complex fusion of business processes, enterprise applications, and organizational structure necessary to create a high-performance business model” (Kalakota & Robinson, 2001, p. xx). When transitioning towards e-business, companies have to undergo a structural transformation on many fronts. Essential to this transformation is the dis-aggregation and re-aggregation of a firm’s value chain. Dis-aggregation of the value chain requires a company to determine its core competency and to identify external resources and partners for improving its competitiveness. Re-aggregation leads a company to collaborate with industry partners along the supply chain to optimize their collective competitiveness.

An e-business firm operates within an increasingly dynamic and collaborative environment. Traditional vertically integrated supply chains are being replaced by business webs that encompass complex partnerships and technology architecture (Tapscott, 2001; Tapscott, Ticoll & Lowy, 2000). It is critical in delivering a company’s end-to-end services through seamless integration of sales and marketing, customer service, and its value chain with those of business partners.

Weill and Vitale (2001) define e-business as the conduct of business and business processes over open networks. Business processes include: “marketing, buying, selling, delivering, servicing, and paying for products, services, and information across open networks linking an enterprise and its prospects, customers, agents, suppliers, competitors, allies, and complementors” (p. 5). Lee and Whang (2001, p. 2) view e-business in the context of supply chain integration as “the planning and the execution of the front-end and back-end operations in a supply chain using the Internet”.

Characteristics of E-Business

The four definitions of e-business discussed above share several important characteristics. Primarily, an e-business is an integral part of a business web in which organizational boundaries become more permeable. Multiple organizations and heterogeneous users outside of the organization need to access e-business systems (Alter et al., 2001). Thus, an e-business can be viewed as an

integral part of the business web, inseparable from the organization itself and the organization's business partners. The organization's hardware, software, communications, and users extend beyond the enterprise and may not be easy to identify (Tapscott et al., 2000). In many ways, information systems in an e-business can be viewed as a web of information systems (Alter et al., 2001).

Second, enterprise systems have been widely adopted as the backbone for e-businesses (Norris, Hurley, Hartley, Dunleavy & Balls, 2000). These systems include: traditional enterprise resource planning (ERP) packages and systems to support customer relationship management (CRM), supply chain management (SCM), business intelligence (BI), data warehouse (DW), e-procurement (EP), sales force automation (SFA), and various portals. Integration of these interconnected systems and data presents serious challenges. Existing enterprise systems are not designed to support collaborative business processes. The emerging framework of ERP II promises to support a firm's transition towards e-business (Genovese, Bond, Zrimsek & Frey, 2001). ERP II, as the next generation ERP system, will incorporate Web services and componentized modules to support collaboration across the industry value chain. These issues will be examined later in the chapter.

Third, information plays a critical role in e-business. E-business, electronic marketplaces in particular, enable significant improvements in the quality and timeliness of information, which are not possible without the support of Internet technology (Kalakota & Robinson, 2001). Organizations can create new values—new products and services—from information through personalization, real-time price and product comparisons, and different pricing mechanisms (Rayport & Svioka, 1995). As users of e-business solutions become more heterogeneous and the use of information becomes more critical, it is necessary to empower non-technical users as well as consumers who now use information more extensively (Atler et al., 2001).

Fourth, in companies engaged in e-business transformation, in-house IS specialists are less involved in building and maintaining internal systems according to traditional methods. Instead, system integration becomes their more important task. They are increasingly providing IT support for both external customers and internal users of the organization. Systems that were traditionally developed and managed as internal resources are now increasingly being developed and managed as external resources. This change implies that system developers need to understand inter-organizational behavior and the value chain essential to an e-business web. Companies need to acquire new IT knowledge and skills in distributed systems architectures, prototyping in Web-

based systems development, business and systems, integrated enterprise systems, and integration of Web-based systems with enterprise systems

Fifth, in addition to technologies, organizations must consider transformation strategies that can go hand in hand with the deployment of new technology. An e-business includes human resource strategies and organization change strategies. Proper project team development is considered one of the critical factors towards the success of e-business ventures (Lientz & Rea, 2001; Turban, 2000).

Related Research

Is the Demand Still There?

Despite the fallout of dot-coms and the post-2000 economic downturn, the digital economy continues to thrive. Industry forecasts proceed to project a slower but consistent growth in e-commerce during 2002-2007. Forrester Research projects online retailing will grow at a cumulative annual growth rate of 25% to reach a sale volume of \$217.8 billion by 2007 (Hirsh, 2002). In 1999, Forrester projected that U.S. B2B would reach \$1.3 trillion by 2003. The networked B2B transactions now stand at \$2.4 trillion (Mullaney et al., 2003). In Europe, B2B e-commerce transactions have grown at an annual rate of 100%, reaching \$200 billion in 2002, a four-fold increase from B2B transactions in 2000 (Reinhardt & Majidi, 2003). In China, the number of Internet users is expected to increase 1,184% by 2006 (Vinas, 2002). E-commerce growth and productivity gains from e-commerce have exceeded earlier projections. Internet-driven business is now deemed “a real business transformation because it survived the economic downturn” (Mullaney et al., 2003).

Long-term impacts of Internet technology on global e-business are evident in all industries. American and European companies have adopted a wide range of Internet-based business solutions at a steady pace (Varian et al., 2002). Among the US companies, 70% of the enterprises in the wholesale/retail sector and the financial service sector, as well as 88% in telecommunication sector, have adopted e-business solutions such as SCM, CRM, and EP. Most commonly adopted solutions are those supporting customers, and for financial

and HR functions. The benefits are aimed at improvements in workforce efficiency, inventory management, customer relationships, and operating costs. Although IT spending has declined 6.2% since 2001, e-business budgets increased by 11% in 2002 and are projected to outpace technology spending for at least two more years (Mullaney et al., 2003). These trends affirm a continued need for IT talents with a solid foundation in Internet-based technologies and business strategies.

IT Workforce Issues

During the past three years, the IT workforce has experienced drastic changes as a result of economic slowdown. The total IT workforce peaked in size in 2000, then 500,000 IT jobs were lost in 2001 due to the dot-com failures. The IT workforce appears to have bottomed out at the start of 2002 with small but steady quarter-to-quarter gains since then (ITAA, 2003). ITAA's 2003 survey finds that future demand for IT workers continues to drop even as companies lay off fewer workers and the overall size of the IT workforce stabilizes (ITAA, 2003).

IT employment dropped more than 5% during the period from 2000 to 2002. Despite the loss of many IT jobs, the available positions, which went unfilled due to a lack of qualified workers, have remained consistently around 50% of total demand (ITAA, 2000, 2001, 2002). Such a "gap" implies that employers have greater difficulty finding the right mix of IT talents than hiring IT workers. In 2003 the demand in many job categories fell sharply, particularly in technical support representatives and Web developers (ITAA, 2003). In the short run, demand remains highly volatile as organizations shift to meet changing market conditions.

Outsourcing is a common tactic for meeting e-business needs. A major problem with many e-business development teams is that members of the team often come from different organizations, including outsourced service provider organizations and independent contractors. In typical IS organizations, sometimes about half of the e-business expertise will come from outside resources, such as consultants and contracted labor (Gomolski et al., 2001). However, with the current state of the economy, many organizations have been forced to eliminate their outsourcing relationships and seek alternative means of developing e-business, mainly through the use of their own internal workforce (Paulson, 2001).

Offshore IT outsourcing has emerged as a mainstream practice that is already affecting the U.S. IT workforce. Increasing cost pressure and a need for business agility have motivated more U.S. companies to shift their IT work offshore. Additionally, offshore outsourcing is attractive because companies can use time zone differences to add a second or third shift as a means of opening markets and reducing costs. This sourcing model has been in existence for many years. Only in recent years, economic reasons and increased quality of service have propelled offshore outsourcing to the mainstream. It is likely that more than 80% of U.S. companies will explore this new option of IT services, and 40% will engage in pilot initiatives (Thibodeau, 2003).

Industry projections suggest that offshore outsourcing will focus initially on low-end “commodity” work, such as legacy application maintenance, enterprise resource planning enhancement, application support, and help desks. Increasingly, companies may also use offshore services for project-based work in Web services and in enterprise system integration and implementation (Morello, 2003). ITAA 2003 Survey finds that programming and software engineering jobs are most likely to go overseas (67%), followed by network design (37%) and Web development (30%) (ITAA, 2003). These findings suggest that the offshore development trend is both real and expanding to include more sophisticated, value added jobs. Offshore outsourcing will have a significant impact on how firms manage their IT skills portfolios. IT professionals need to redirect their personal skills portfolios towards higher-value competencies and towards processes and applications specific to their industries (Morello, 2003).

IT Skills Portfolio Management

A rapid pace of innovation continues to characterize the IT field, where it often triggers organizational changes. Shortage of IT skills remains a chronic challenge for companies. When firms transition to a more advanced technology-supported environment, IT services and personnel need to be redefined. Andres and Niederman (1998) have introduced an IT personnel transition evolution model to address the IT skills requirements needed during such periods. They propose to view both current and future states as being comprised of skills and personnel. Defining skills inventory in both states helps firms to identify gaps. Firms have two sources of leverage when managing IT skills during transition: the development of new skills with existing personnel and skills gained through outsourcing.

CIO magazine (2002) has conducted a series of four IT staffing surveys during the period from November 2000 to July 2002, which was characterized by economy slowdown, decreased IT budget, and job stability. IT managers reported less difficulty in IT hiring and retention during this period. In mid-year 2002, 34% of IT executives participating in the survey agreed that they were experiencing neither a staffing crisis (i.e., too few applicants) nor a skills crisis (i.e., an adequate number of applicants but lacking specific skills for open positions.) However, 56% of survey participants agreed that they were experiencing a skills crisis of matching available skill sets with their companies' IT needs. This result suggests that having the right mix of skills is more important to firms than having enough applicants.

Based on a review of 102 papers published in the ACM SIGCPR conference proceedings, Nakayama and Sutcliffe (2001a, 2001b) have proposed a skills portfolio approach for firms to manage IT human resources. They emphasize that employers have found that acquiring the right mix of skills is far more difficult than simply finding IT workers, as confirmed by CIO Magazine's survey results. Furthermore, firms are experiencing increasing difficulty in determining their optimal skills portfolio and in acquiring and managing that portfolio in turbulent times. When undergoing e-business transformation, the skills portfolio approach seems appropriate to firms for developing skills acquisition strategies.

A skills portfolio management framework is comprised of skills acquisition, development, and maintenance at the firm level, as defined in the following:

- Skills acquisition refers to recruitment for skills, building skills inventory, and outsourcing.
- Skills development focuses on determining the desired firm-level skills portfolio, skills requirements, and designing and implementing skills enhancement plans.
- Skills maintenance strategies focus on retaining IT talents and updating skills.

Therefore, identifying the skill sets essential to acquisition, development, and maintenance can help firms to better manage IT skills during e-business transformation.

Changing Skills Portfolio for E-Business

Gaps in a firm's skills portfolio remain a challenge for IT managers even at the current state of low demand for IT workers. What skills are in demand for e-business? One may draw the answers from several studies discussed below.

In early 2000, application development, networking, Internet development, e-commerce, and data mining ranked high among hiring needs reported by IT managers (Goff, 2000a). CIO Magazine's survey, conducted in July 2002, shows that IT skills most in demand are: application development (53% of respondents), project management (50%), networking (48%), and database management (47%). These four areas have maintained the "most in-demand" status over the two-year period between November 2000 and July 2002. In contrast, the gap for Web developers has narrowed since the dot-com failure (ITAA, 2003).

E-business strategies drive IT demand. Enterprise systems, such as CRM, SCM, and ERP, capture a larger share of IT budget than in previous years. High on a company's agenda are skills that support its e-business initiatives such as supplier-facing extranets, customer-facing Web-based applications, and collaboration on industry exchanges and marketplaces (Goff, 2000b). Most companies will have to retrain staff for CRM systems, data warehousing and data mining, e-commerce applications development, Internet applications development, and ERP.

Are technical skills sufficient for e-business transformation? Based on a case study of five companies, Bailey and Stefaniak (2000) identify eight job clusters important to IT professionals in the new millennium. These job clusters include computer programmers, systems/business analysts, computer engineers, database administrators, computer support specialists, network specialists, telecommunication analysts, and Internet specialists. However, as IT roles shift at an accelerated pace, technical skills alone are no longer sufficient for success in IT professions. Soft skills like communication, problem solving, adaptability to new technology, and teamwork are increasingly important. Business skills (understanding the customer mentality, investigative skills for asking probing questions, idea initiation, project management) are also critical to IT professionals' success.

The Electronic Commerce (EC) Institute (www.ecinstitute.org) has proposed a body of e-commerce knowledge as a basis for professional development and training. The proposal represents a joint effort of industry and

university members in defining requisite skills for e-business. It encompasses 16 foundation topics, five skill sets for e-commerce principles, dynamics and strategies, and seven skill sets about tools, technologies and techniques (EC Institute, 2001). Key topics address e-business processes, process redesign, change management, technology deployment, application integration, and interoperability.

Gaps between Industry Needs and Academic Preparation

Higher education institutions play a critical role in producing IT workers who can meet the industry demand for e-business IT talents. Rapid changes in business models and technologies necessitate universities and colleges to undertake continuous curricular innovation (Chan, 2001). IS and EC curricula must closely follow the application of technology in business and industry (Augustine, Surynt & Jeancola, 2002). The challenge is to determine which newly introduced technologies are trends and which are fads.

Two trends are forming in the marketplace. On one hand, companies are seeking advanced IT skills in architecture, systems integration, collaborative systems development, and complex business processes. On the other hand, offshore outsourcing will reduce the demands on traditional IT jobs in programming, systems development, ERP maintenance, and technology support. Together, these two trends demand IS and EC programs to re-evaluate their roles in the IT workforce preparation.

Educators have begun to address the importance of systems integration (Chan, 2001) and next generation enterprise systems (Lederer-Antonucci et al., 2003) in curricular offerings. Students need to develop both an understanding of strategies and processes as well as technology know-how. Nevertheless, the majority of IS and EC programs primarily address the business side of this complex e-business development.

A recent review of academic e-commerce programs reveals that most EC programs are housed in business schools where business topics receive greater attention than technical ones, with a 2.5-to-1 ratio favoring business courses (White, Steinbach & Knight, 2003). However, technically oriented graduate e-commerce programs tend to give business education equal importance to technical education in the category of essential courses. The same study reveals that networking, project course, and marketing are courses most commonly

offered in both graduate and undergraduate technical EC programs. Surprisingly, database and server-side Web application development were considered as non-essential courses.

In terms of technical skills, Lomerson and Schwager (2002) have examined specific e-commerce technologies being taught in IS programs. Using a 6-point scale to measure the degree of emphasis (6 as full course coverage and 1 as little coverage), they report that the most commonly taught client side technologies are: Web site design (average = 3.3), XML (3.3), Web design tools (3.0), and JavaScript (3.0). HTML (2.7), DHTML (2.5), and CSS (2.5) received less attention. On the server side, technologies most frequently covered are: SQL (3.4), Active Server Pages (3.0), Java (3.0), ODBC (2.8), Apache (2.6), Unix/Linux (2.6), PHP (2.6), and Java Server Pages (2.6). These findings indicate that most academic programs only cover basic Web development skills and technologies. Students may not receive adequate preparation to address advanced technologies and systems development.

As companies need support for complex Internet-based e-business solutions, skills in new technology, such as .NET, JSP, SOAP (Simple Object Access protocol), UDDI (Universal Description, Discovery, and Integration), WSDL (Web Services Description Language), Web mining, systems integration, and Linux will be critical.

An employer survey¹ conducted by the first author's home institution in 2002 confirms that analytical tools, such as data mining, and technologies to support collaboration, such as XML and e-business XML (ebXML), will become even more important in the near future (see Figures 1-3 below). All three figures show: (1) employers' perception of how important an IT area was at the time of the survey (i.e., summer 2002), measured on a 5-point scale; (2) employers' perception of the importance of an IT topic three years later (i.e., 2005); and (3) changes (or gaps) of perceived importance between the two time periods. Figure 1 concerns business applications, including many e-business enterprise systems. Figure 2 reveals a skill shortage for positions in security, project management, e-business analysis, data mining, and user interface designs. Figure 3 focuses on skill shortage in XML, UNIX, Java, and JSP.

While technical skills are important, researchers have found that IT professionals rated "soft" skills such as team work, working under pressure, and meeting deadlines as more important than "hard" skills, such as database design, client/server applications, and operating systems (Turner & Lowry, 2002). This implies that IS and EC programs should address both technology and skills for change management.

Figure 1. Employer Survey: Changes in Perceived Importance by Application Areas.¹

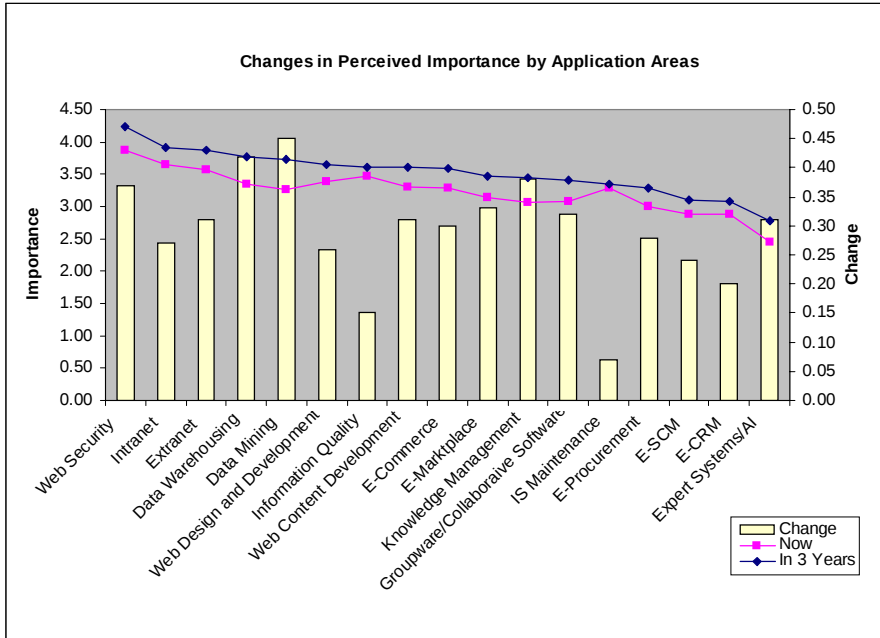


Figure 2. Employer Survey: Changes in Perceived Importance by Positions.¹

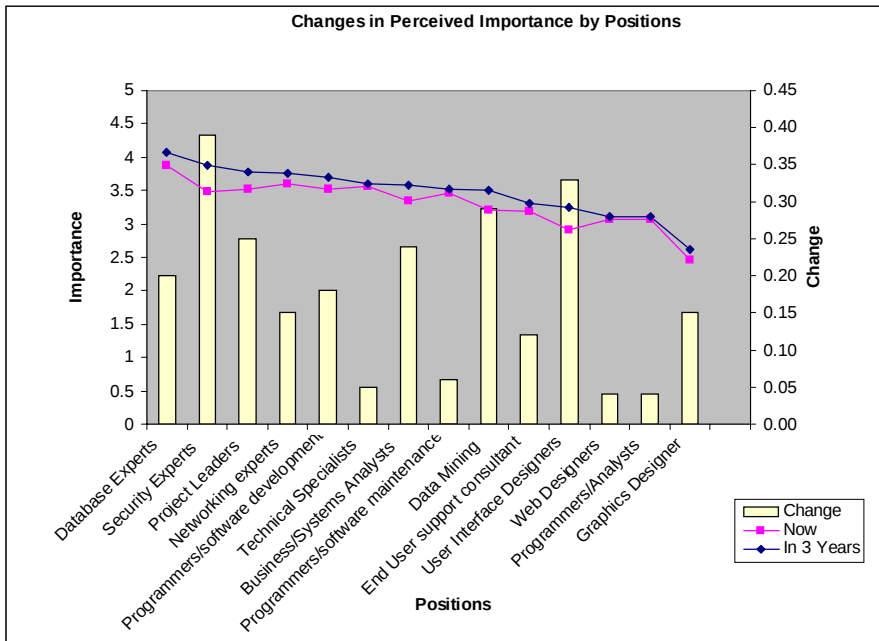
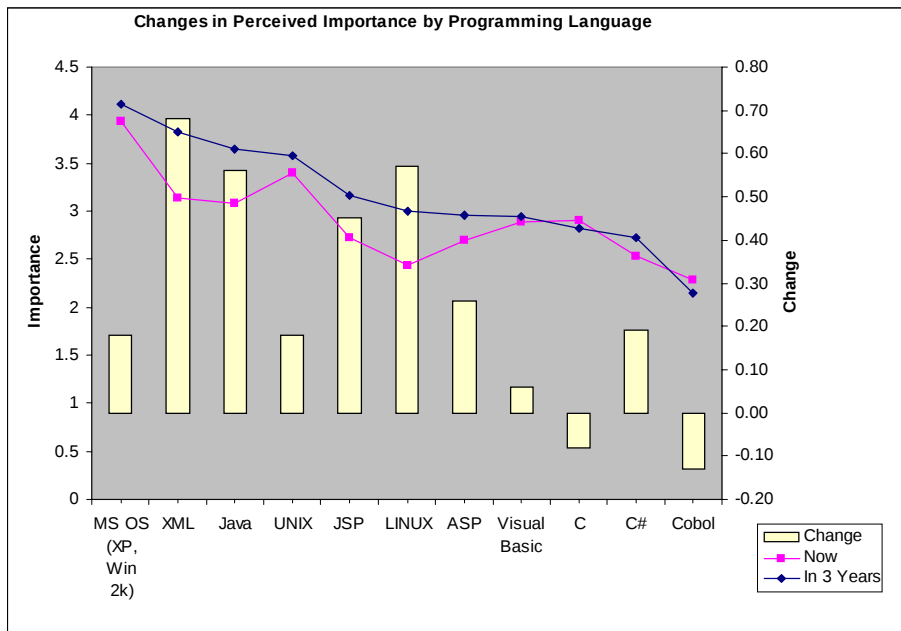


Figure 3. Employer Survey: Changes in Perceived Importance by Programming Languages.¹



Requirements for E-Business IT Skills Portfolio

E-business transformation presents enormous IT challenges because both the processes and technical requirements are complex. There are at least five sets of issues affecting IT skills acquisition and development. These issues pertain to an e-business firm's architecture, system implementation strategies, organizational change processes, application development approaches, and the choice of tools and techniques.

Architectural Issues

An efficient architectural design is critical for a firm to perform effectively in an e-business Web environment. A firm's technology architecture involves business systems, data exchange, and infrastructure design. E-business application architecture will likely include CRM, SCM, business intelligence (BI), selling chain management, data warehousing, data mining functions, and EAI (Kalakota & Robinson, 2001). Beyond the enterprise boundaries, the e-business architecture supports interactions with partners and customers through public and private e-marketplaces and transaction-based online retail Web sites (Genovese et al., 2001). An architecture design also needs to consider interactions with legacy systems and with application service providers (ASP), as some systems may be supported by external service providers.

During the 1990s many organizations failed to implement ERP systems as a backbone for data sharing (Krasner, 2000). It is more complex to manage e-business architecture because it encompasses systems of partners and suppliers not controlled by the firm. EAI packages try to integrate a firm's internal enterprise systems with customers' and suppliers' ERP systems. Nevertheless, this is a very complex proposition considering the large number of systems and applications that still need to be integrated (Lee, Siau & Hong, 2003).

For the next generation of enterprise systems, the ERP II framework envisions an e-business architecture that emphasizes collaboration and external needs (Genovese et al., 2001). Component-based application architecture will allow deeper functionalities and unique features for vertical markets, which are absent in many existing enterprise systems. These changes will satisfy a firm's desire for differentiation as well as its need to participate in industry-wide collaboration.

For the e-business IT staff, dealing with complex application and technology architecture requires different skills than those required in a traditional IT environment. E-business technical architects play a critical role in e-business development. These roles encompass both a high degree of domain knowledge and strong technical background (Driver & Flatau-Reynoso, 2000). Architects focus on issues ranging from technology selection to system infrastructure and design. These individuals need to possess deep knowledge of operating systems, databases and middleware, as well as architectural development process knowledge. Positions for technical architects are difficult to fill and best supported by in-house IT resources.

Furthermore, from the perspective of knowledge management, e-business transformation enables an enterprise to evolve into a knowledge-based organization. In such environments, the skill mix will involve information management and knowledge management (Abell & Oxbrow, 2001).

Implementation Issues

It is a complex endeavor to integrate enterprise systems supported by multiple vendors on different technology platforms. Such implementation affects an organization's interactions with customers, employees, stakeholders, business partners, and suppliers. Existing enterprise systems typically offer generic solutions that require fine-tuning, customization, and integration with other applications and/or legacy systems. Since different vendor solutions use different standards of development, each system implement requires a new skill set. A shortage of these skills hampers e-business strategy implementation (Hawking & Stein, 2002).

E-business project implementation differs from traditional IT project implementation (Lientz & Rea, 2001). These projects are characterized by rapidly evolving business requirements, a short development schedule, and the involvement of different divisions. It is often difficult to coordinate and reach agreement among different divisions on project results. Complexity increases for implementation of inter-organization projects because participating organizations must reach common objectives, requirements, and benefits. In addition, typical e-business IT staff also needs to concurrently support traditional systems and e-business projects (Agarwal & Ferratt, 2002).

Furthermore, competing technology standards impede collaboration among partner firms. For example, while RosettaNet and the ebXML both claim to support collaborative commerce, firms have to fully evaluate these options to determine which of these standards is the most mature and which will survive the coming shakeout in the integration standards arena (Miklovic & Altman, 2001).

The demand for integrated enterprise applications and collaboration systems implies that companies will need more IT talents with a solid foundation in project management, systems integration, and change management. System developers need to acquire a better understanding about inter-organizational behavior and the value chain essential to an e-business web. EAI specialists and

legacy extension programmers are critical to the success of long-term strategic projects. Because these developers typically work very closely with existing IT services, they are less likely to be outsourced than developers focused solely on coding. Skills essential to e-business implementation are legacy technology skills, workflow, and business process integration skills (Driver & Flatau-Reynoso, 2000).

Organization Change Issues

Enterprise-wide process change that accompanies e-business and collaborative commerce presents new challenges to IT staff. According to Krasner (2000), a successful e-business implementation must carefully deal with issues of e-business strategy, project management, and end-use resistance resulting from complex systems implementation.

The IT management and workforce must play a major role in training and facilitating process change in order for users to embrace the new system. Collaboration across industry and global supply chain demands more profound changes in business processes than what enterprises have experienced to date.

Tow and Miklovic (2001) point out that enterprises intending to take advantage of collaboration should be prepared to address process disruptions that accompany e-business transformations. While ERP projects in the past have focused on internal operational efficiency, supply chain collaboration processes, which were once hidden, will be transparent to partner firms. It is necessary to develop new processes to handle collaboration with suppliers, customers and partners in order to engage in higher levels of information sharing (Lee & Whang, 2001). Everything from data ownership to project management will be affected. Many process flows must be adapted to accommodate the interaction that collaboration demands. ERP applications need to be re-configured in preparation to support workflow coordination.

Process innovations for enhancing collaboration are driven and defined by external factors. Such process changes rely more on information technology and will have to be implemented at a faster pace than past change initiatives. IT professionals will need to acquire a broad knowledge about the complex structure of a company's value chain, CRM, change management, and human factors.

Application Development Issues

Dynamic e-business strategies will be built on analytical information and business intelligence. Therefore, e-business application development will go beyond Web development. Enterprise portals, drawing data from integrated applications, industry e-marketplaces, and decision support tools, will provide employees and industry partners the gateway to analytical and transactional information. Companies will need a strong competency in systems integration and analysis using data mining and BI tools. Capability for object-oriented (OO) database and knowledge management tools will be in demand.

Driver and Flatau-Reynoso (2000) have identified several important roles and skills for e-business development teams:

- E-business analysts need to develop intimate domain knowledge of evolving business models. As a result, these resources are the most difficult roles to outsource. Skills essential to this role are requirements analysis, OO analysis, and strong communication skills.
- HTML authors, Web site designers, and graphic artists can be outsourced or developed in-house. Skills required for these roles include strong visual design skills, information and content management, and user interface usability analysis.
- Component developers and systems administrators provide necessary technical support to an e-business development team. Key skills for programmers and system administrators include strong analytical skills, expertise with specific tools, strong OO methodology skills and component-based development skills.

Tools and Technology Issues

There are many tools and technologies for developing e-business applications. These tools and technologies span various platforms and application types. Certain tools run on Windows-based machines, while others run on Unix-based machines. The lack of standards on many of the available development tools increases the complexity of e-business applications development and the required skill sets. Another noticeable issue with Web development tools is

their incredible “rate of birth;” many new tools are developed before IT staff even begins to master older ones. The continuous emergence of new Web tools and technologies makes it difficult to develop a highly experienced IT workforce. Different development tools have been adopted by different development communities. A simple example with regard to server-side Web development tools can be presented, where the Linux and open source community has adopted tools such as Perl and PHP for programming and MySQL for database. Others have adopted proprietary tools such as Microsoft’s ASP and SQL Server. More recently, .Net technologies have gained popularity. Other major vendors such as IBM and Oracle have also developed e-business suites that help in the development process. Hundreds of other smaller companies are also competing in the tools market.

Web services are the latest additions to the fast growing set of Web technologies. Web services are developed using standardized tools such as XML, SOAP, WSDL, and UDDI. Using Web services, applications can be developed and shared through the Internet with other corporate divisions, customers, partners, and even competitors, regardless of the underlying application platform. Such new developments will greatly simplify the sharing of existing digital resources rather than having to develop new ones from scratch.

Such new developments and advancements in tools and technologies call for continuous skills maintenance and update through education and training. The type and length of training to pursue for a firm’s IT workforce are not easy decisions to make. These decisions need to reflect the projected value of the tools and technologies and the increased market value of the IT worker. Training for technologies and tools with short life span will waste company’s resources. A well-trained worker may seek employment opportunities elsewhere.

Framework for E-Business IT Skills Portfolio

Based on the above analysis, we propose the following framework to determine skills required for e-business transformation. As shown in Table 1, this framework summarizes the issues pertaining to each of the five factors related to IT support for e-business. The list of IT skills required can be used to build a skills inventory and for determining the desired skills portfolio.

Table 1. A Proposed Framework for E-Business IT Skills Portfolio.

Factors	Issues	IT Skills Requirements
Architecture	Application architecture Distributed systems Infrastructure architecture Collaboration Information structuring & architecture	Internet/Web architecture Application architecture Network administration Database management Middleware Security, document management Legacy systems Information management Knowledge management Technology planning E-business strategy
Implementation	ERP and Web systems integration Effective project management Process change management Enterprise systems Integration of Web systems and enterprise systems	Systems integration SCM, CRM, IM Data warehousing, Data mining Project management Interpersonal skills Process re-engineering
Organization Change	Process change driven by external demand Permeable org boundaries External users and consumers Complex process Collaboration	ERP, CRM, SCM, Value chain Change management Human factors
Application Development	A shift of development efforts from simple Web development to analytic capability and system/application integration Web based interface design	Project management E-business analysis Structured programming methods Web development and design Object-Oriented development Data mining Human computer interaction Workflow analysis Domain knowledge
Tools and Technology	Wide-range of tools and technology New tools and technology Lack of standardization Proper education and training	Unix, Linux, Windows .Net technologies CGI, Perl, C++, C#, ASP PHP, SQL, MySQL, XML, Java, SOAP, UDDI, WSDL, ebXML

Conclusion and Future Research

In this chapter, we have discussed a firm-level IT skills portfolio essential for e-business transformation. E-business emphasizes collaboration supported by network technology. Information sharing, process and product synchronization, and workflow coordination all depend on well-designed e-business architecture and systems integration. These trends present enormous challenges to a firm's capability in managing its IT skills portfolio. We also identified

new e-business IT skill sets, including enterprise architecture design, integrated enterprise systems, change management, as well as emerging tools and technologies.

The proposed framework can serve as a starting point for determining skill sets required for e-business IT skills portfolio management. The framework can also guide the development of a research agenda on e-business IT skills portfolios. Case studies and surveys could potentially be conducted to: (1) compare skill sets during e-business transformation, (2) confirm the validity of the proposed framework and skill sets, (3) identify specific strategies employed by enterprises in meeting skill demand, and (4) map specific sourcing strategies for different skill sets. Several roles of emerging importance, such as e-business architects and systems integrators, deserve a close look.

E-business demands advanced knowledge of business, process, and technology. Skills for architecture design, systems integration, workflow analysis, process design and management of intra-organizational systems have not received sufficient attention in existing academic programs. In addition, universities and colleges need to address next-generation ERP systems that are more complex in process and technology. Collaboration between technical and business programs within the same university to support such complexity may be an approach worth consideration.

Researchers in the past have documented the “expectation gap” between industry needs and academic preparation (Trauth, Farwell & Lee, 1993). A call for closer collaboration between academic and industry is worth repeating. Universities need to place a greater emphasis on the integration of technologies, applications, data, and business functions, and less on outmoded and formal system development. For e-business, universities also need to address advanced technical skills in architecture, systems integration, process design, and knowledge management.

Endnotes

- ¹ Findings were drawn from a 2002 survey of employers of graduates from the first author’s home institution. The results are based on more than 70 employers in the metropolitan area.

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Chapter VIII

Issues in End-User Behavior

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Abstract

What happens when end users do not respect the IS organization and have high computer self-efficacy? Will the end users develop usable systems and will they ignore IS? This chapter reports on a study of end-user computing within the engineering organizations of an electric utility undergoing deregulation. The study was initiated when management perceived that too much engineering time was spent doing IS functions. The study found that there was significant effort being expended on system development, support, and ad hoc use. Several issues were identified affecting system development, use of programming standards, documentation, infrastructure integration, and system support.

Introduction

Due to market deregulation causing uncertainty with respect to budget, the subject utility assessed its staffing. One organization assessed was engineering, where it was determined that staffing needed to be reduced by approximately 25%. A change management team was formed for identifying where and how work effort could be reduced. During this process it was noticed that the engineering organizations were spending significant amounts of time and effort on information technology (IT) related tasks. To assess this IT usage a team was formed consisting of engineering and information systems (IS) representatives and led by the author, a former member of the engineering organization and at the time of the study, a member of IS. The team collected an inventory of IT products and resources used by engineering organizations but not supplied, supported, or controlled by IS. The team also assessed how IT usage could be better managed by engineering.

The team found a significant amount of effort expended by engineering on IT, including system development and significant system support and ad hoc reporting efforts. Analysis of these efforts found several problems that caused additional wasted efforts and significant expenditure of additional funds. This analysis provides insight into how an organization can better manage end-user computing (EUC). This chapter focuses on the end-user system development issues identified during the study. To accomplish this the chapter will provide a background on the organization, end-user computing, and end-user system development. This is followed by a discussion on the methodology used for the study, a summary of the study's findings with respect to amount of investment and effort in IS by the end users, an analysis of the findings, and conclusions.

Background

The End-User Organization

The subject engineering organization consisted of approximately 460 engineers disbursed among several different engineering groups spread across four management structures that were being reorganized into a single management structure with 330 engineers. Many of the engineering groups consisted of

subgroups. Computer use in all groups/subgroups included use of the site work process systems and the basic software such as e-mail, WordPerfect, and QuatroPro, plus whatever other software/hardware was deemed necessary to accomplish their mission.

The subject organization's Year 2000 (Y2K) effort documented 151 applications not supported by IS that were used and supported by engineering, where the support consists of personnel and/or annual renewal/licensing costs. IS does support another 11 applications used by engineering. Additionally, discussions with various managers and supervisors indicated that there were a number of "local" databases and programs developed and/or supported within engineering not included on either inventory. Finally, there was a perception that significant engineering resources were being used to support IT needs due to a lack of support by IS for engineering IT needs.

End-User Computing/System Development

End-user computing is the adoption and use of IT by personnel outside of the IS organization to develop applications to support organizational tasks (Powell & Moore, 2002). EUC, and in particular end-user system development, usually involves end users using personal computers (PCs) and Fourth Generation Languages (4GLs) and general or special purpose report writers to develop business solutions (Miric, 1999). Grindley (1995) predicted that by 1998, 80% of all system development would be done by end users or their consultants using the previously listed tools. This chapter does not confirm this prediction but does show how widespread end-user development can be in an organization. However, there are several issues associated with end-user system development that will be discussed in the following paragraphs.

Dodson (1995) believes that the trend towards end-user system development is an "Achilles heel" for the enterprise, as attempts to integrate end-user databases and systems into the enterprise infrastructure encounter problems that raise the cost for or prevent full integration. Dodson (1995) lists issues such as lack of documentation, no planning for maintenance, improper application of design methodologies, and poor communication and understanding of requirements as the main problems associated with end-user developed systems. To prevent or mitigate these issues, Dodson (1995) suggests organizations focus on five areas of standardization: business analysis and system design methodologies, communications structures, software architecture/li-

braries, documentation, and training. Dodson (1995) does not suggest that IS force end users to follow IS system analysis and design methodologies, but rather create hybrid methodologies that end users understand, can implement, and can use to identify, capture, and model user requirements. Communication structures reflect that end users should use the same project communications used in non-IS projects for IS projects, and Dodson (1995) suggests the widespread adoption of Joint Application Design (JAD) and Joint Implementation Process (JIP), as formal communication structures would improve stakeholder understanding and participation. Dodson (1995) recommends that organizations standardize products available for use to end users. This includes IS making their object, component, and module libraries available for use by end users in system development and IS creating standard design environments. Dodson (1995) suggests that IS specify standard documents that must be produced for all system development projects. The generation and promulgation of standard document templates that can be tailored to the size and complexity of the project facilitate this. Finally, end users need to be trained to use these tools and processes to produce systems.

Miric (1999) warned that the lack of programming standards and planning leads to large numbers of errors in end-user created spreadsheets. KPMG Management Consulting studied end-user created spreadsheets in their client organizations and found that 95% of the spreadsheets utilized models with significant errors and 59% of the spreadsheets had poor model design (Miric, 1999). To prevent these errors, Miric (1999) suggests that spreadsheet development should be treated no differently than system development and that users need to be trained to use organizational programming standards, determine and document system requirements, perform testing, and use automated tools when available.

Munkvold (2002) found that high computer skill self-efficacy within end users coupled with a low regard for IS leads to end-user system/application development. Wagner (2000) investigated the use of end users as expert system developers and found that end users have significant domain knowledge. However, it was also found that end users had difficulty knowing and expressing what they know, making their contribution limited in content, quality, size, and scalability. Taylor et al. (1998) agree that end users do not produce good systems and identified duplication of effort, low quality, and lack of training in system development methodology as issues. Note that low quality is reflected as a lack of documentation, standard development practices, and/or programming standards. Additionally, McBride (2002) found that imposing

system development methodology on end users might be regarded as an attempt to impose IT culture and thus be rejected by the end users. Finally, Adelakun and Jennex (2002) found that end-user development issues with respect to failing to meet requirements or failure to gather the appropriate requirements could be caused by end users not identifying appropriate stakeholders for project involvement and assessing success of the developed systems.

Methodology

This chapter utilizes action research as described by Baskerville and Wood-Harper (1994). The research was performed with the intention of influencing organizational decisions with respect to the allocation and management of IS and engineering resources and was conducted by a team of researchers. The team consisted of engineers serving as computer representatives/liaisons, considered to be subject matter experts (SMEs) and IS personnel serving in the engineering support systems group. The author served as project manager. The author was selected as project manager because he had 15 years' experience working in the engineering organization and three years' experience as a IS project manager. It was believed that by having experience in both organizations the author would be better able to gain the trust of both organizations and collect more accurate data.

The team collected data using various informal surveys and interviews while the project manager conducted 40 structured interviews. The process was to first generate an inventory of IT applications used by the engineering organizations but not maintained by the IS group. The scope of the inventory was any specialized software/hardware for data collection, testing, and analysis, specialized databases, any software used for system development, any generic software that was being customized through the generation of macros, scripts, or programs, and any other software/hardware assessed to be important to engineering and worthy of inclusion. A first cut inventory was generated using the Y2K inventory. This was validated using surveys/interviews to validate the Y2K inventory and to expand the inventory as necessary.

The second step was to generate a list of IT resources existing within each engineering organization. IT resources were considered to be engineers with IT skills in demand by their coworkers such that they spent significant amounts of

time assisting management or their group with IT support. The initial list of resources was developed by the SMEs. After conducting 40 interviews of selected individuals, the list was finalized by the project manager. A set script was used for determining what amount of IT support was being provided by engineers to engineers, any additional inventory items, general levels of automation and needed IT, and what issues were involved in using IT in engineering. Interview subjects were selected based on input from the SMEs and known expertise and/or participation in IT development.

The final step was to take the gathered data, analyze them with respect to dollars and time invested as well as issues identified, and generate a set of recommendations for improving management of the IT effort in the engineering organizations. This was documented in a final report by Jennex et al. (2000) that was presented to IS and engineering management and is used as the data source for this chapter.

Findings

The assessment found a significant but poorly managed investment in IT in terms of money, time, and expertise. With respect to the management of IT, it was observed that IS is tasked with managing the infrastructure, networks, and enterprise-level applications. This provides an overall organizational perspective and strategy for managing these assets. Engineering IT is managed at the division level and was found to lack an overall engineering strategy for the use, adaptation, and implementation of IT. Additionally, IT was unevenly applied throughout the engineering organizations. Some groups were fully automated, others had process steps automated but not the overall process, and still others were not automated at all. The net effect was that IT assets were not performing as effectively as they could and many engineers were expending more time and resources than they should to obtain the information and data they needed. Specifics on these findings are provided in the following paragraphs.

Investment

The inventory recorded 267 applications with supporting hardware. This number excludes enterprise work process systems, basic personal productivity

applications (MSOffice, WordPerfect, Access, etc.), and plant control applications. Included are the analysis tools, graphics packages, scheduling tools, equipment databases, image and Web editing and authoring tools, and data collection tools used by engineers. The team was confident this number reflected at least 90% of what was in use. The investment in terms of dollars and effort was not totally determined; not all numbers were known and not all groups were willing or able to report all costs. However, with about 30% of the inventoried applications reporting these data it was found that approximately \$1,650,000.00 had been spent to purchase these applications with an additional five person years (during the last two years) expended on development. Additionally, \$290,000.00 was spent annually on license or maintenance fees and 10 full-time equivalent engineers (FTEs) were expended maintaining these applications. Finally, an additional approximate 10 FTEs were expended assisting other engineers in the use of these tools. For political reasons there were significant exclusions from these figures, including 45 FTEs and \$335,000.00 in annual licensing cost supporting plant control IT. The team was confident that purchase and support costs and efforts would at least double if all the information was available. For perspective, these numbers were not expected and were considered by management to be extremely excessive, although Panko (1988) found in the 1980s that 25-40% of IT expenditures were in EUC and not under IS control.

Engineer Involvement in IT

It was observed that engineers supported IT three ways: supporting other engineers' use/acquisition of IT and learning to use the IT; maintaining applications, building queries, macros, and reports for special/ad hoc information requests; and developing IT solutions for supporting engineering processes. It was reported previously that at least 20 FTEs were expended supporting other engineers, learning to use IT, and maintaining IT, and approximately five person/years were expended (over the last two years) supporting system development. Doubling these values (per the team's estimate) gives 45 FTEs/year for items one and three. The second item was found to take approximately 5% of each engineer's time. Taken as a whole this is a fairly extensive activity, approximately 21 FTEs yearly. Combining these efforts and excluding assets dedicated to plant IT support (50 FTEs), approximately 66 FTEs/year (16%) are spent on end-user IT functions. This was considered excessive, and if eliminated, could almost provide the necessary workforce reduction.

The ability to do ad hoc reporting was considered a tremendous strength. The team did not see the need for ad hoc reporting decreasing. However, there were several issues that caused the time needed for this activity to be greater than it needed to be. Chief among these are a lack of standard query/reporting tools, advanced training in the use of the available tools, a central repository for queries with the result that many queries were written over and over, and integration of the site databases resulting in more complex and time consuming query/report generation.

The ability to develop new systems for addressing specific engineering problems was considered a strength and a need by the engineering organizations. The team agreed that this function would continue to require engineering involvement. However, this is the function least understood by engineering with respect to cost and process. Engineers followed minimal IS development processes and considered the Capability Maturity Model (CMM) processes followed by IS to be a waste of time and money (IS is a CMM Level 2 shop). This was a very interesting finding, as the nuclear design process is a formal, documentation intensive process designed to ensure repeatability and it was expected that the engineers would understand and appreciate the need for a formal IS development process. The IS CMM development process is a formal, documentation intensive process designed to make IS development repeatable, and yet the engineers considered the documentation and activities generated by CMM to be excessive, of little value, and wasteful of time, effort, and money. While the scope of systems developed by engineers may require less process than the larger, more complex systems developed by IS, engineers still need to follow some formal process, and the processes followed by engineering need to be formalized so that resources applied to project development are accounted for, the highest priority projects are performed first, projects are performed cost effectively, and the resulting systems are documented and designed to IS standards (this reduces maintenance and conversion to enterprise application costs).

The engineers justified the need for engineering to provide its own IT support through several reasons that could be combined into primarily three issues. The first is that engineering applications are generally not supported by IS, so expertise to assist engineers with these applications only exists in engineering. The second is that due to lack of standardization there are multiple products supporting the same function; this makes having central support prohibitively expensive, as experts would be needed for over 200 applications and devices

that in many cases are only used by a few people. The third was an overall poor relationship between engineers and IS.

Analysis

What these findings show is that left unmanaged, EUC can cause organizations to shift significant resources away from their central focus or function. This is most likely with a group that has computer expertise and a low regard for IS, as in this case and as predicted by Munkvold (2002). As McBride (2002) has shown, this will also be a hard problem to get under control, as any attempt by IS to enforce standardization will be perceived by the end users as an attempt to impose IS culture and process on engineering. The findings also show that an IS group that focuses on providing enterprise level systems can fail to support specific user needs, leading users to do for themselves.

While these are predominantly IS/end user management issues, there are issues in this case very specific to IS development. These are lack of IS standards/maintainability in development, lack of documentation, excessive ad hoc reporting, obsolescence of systems, and security. Lack of standards, maintainability, and documentation were identified in the literature. Excessive ad hoc reporting, obsolescence of systems, and security are new issues. The following paragraphs discuss these issues.

Lack of IS Standards/Maintainability in Development

This study found that end-user applications that did not follow IS development standards or use IS programming standards tended to not meet requirements, were hard to modify, and/or were designed such that they could not interface with the organizational infrastructure. These systems result in much higher maintenance costs than expected. To illustrate these problems, two applications were found that the team was told “unofficially” cost a total of approximately \$1,000,000.00 (approximately \$500,000.00 each,) with neither able to perform the function it was purchased for due in total or in part to incompatibility with the infrastructure and failure to fully identify requirements. The engineering group paid IS approximately \$40,000.00 in labor costs to make one application work. This entailed identifying all the requirements, correcting

defects, and modifying the system to work with the IS infrastructure. The other application was abandoned after IS spent approximately one-person week working with the vendor to see if it could be made to work with the IS infrastructure and determining that it could not. Additionally, meetings with other stakeholders involved in the process found that the application added data entry burdens that those groups did not have the resources to support. Both applications were built without consideration of IS standards for the operating environment and consulting the appropriate stakeholders for identifying requirements, with the result that neither worked. Additionally, neither utilized IS standard interfaces or programming guidelines, causing poor quality and making both difficult to understand and work with from the IS developer viewpoint. While these two examples are the extreme, they were not isolated cases. Numerous examples were found in which engineering groups bought or developed hardware and/or software without regard for IS development standards, with the result that additional effort was required to get the hardware and/or software to initially work or to maintain it over its useful life. An interesting post mortem on these applications is that after reviewing them, IS estimated they could have built both of them for approximately \$250,000.00, or a fourth of the amount paid to the vendors by engineering.

Another example of a lack of standards is the rapidly growing use of digital cameras and digital images. Their use has had a very positive impact on productivity. However, due to a lack of standards on types of equipment, software, and formats, there existed competing hardware and software packages and file formats, and the potential for the benefits of the productivity improvement to be lost due to clogged networks (caused by widespread e-mailing of images), dealing with different formats, and incorporating images into processes not designed to handle them. Maintainability is also an issue due to the increased knowledge requirements needed to support the large variety of hardware and software.

A final example is the use of Web design and management tools. No standard tools exist and organizations have purchased their own, making it difficult for IS to support the use of the tools or to maintain sites created by non-IS endorsed tools. Additionally, use of intranet-based systems has failed to radically improve productivity, as a lack of standard design practices and interfaces have resulted in many sites and applications being created with marginal usability and/or purpose.

Lack of Documentation

There is a potentially large problem with those applications and systems developed without documentation. There is a great deal of memory stored in systems or products created and/or supported by engineering. Also, there is a great deal of knowledge as to why things are done a certain way built into macros, programs, reports, databases, and models that is not captured in a retrievable manner. As engineering undergoes change there is a potential for a great deal of this knowledge to be lost. Additionally, engineering's current knowledge management practices assume a static work force and will not work well with a changing work force.

An example was an application developed to model the fire protection system. The application is used to evaluate potential work activities to determine impact on the fire protection system and to determine what compensatory measures need to be taken to ensure the fire protection system will still function when portions of it are taken out of service for maintenance. The application was designed, built, maintained, and supported by the fire protection engineer. No documentation was found. The concern is what happens if this engineer leaves as a replacement has nothing to learn from. The organization has grown to rely on this application and its loss would severely impact the organization. Again, this was not an isolated case. Numerous examples were found of special reports, databases, spreadsheets, and applications that were built to satisfy specific needs but which are not documented. All rely on the engineer using them to maintain and enhance them and would be lost should the engineer leave or the report, database, spreadsheet, or application have a failure or need to be modified.

What makes these issues significant to this and all organizations is that it has the potential to lead to inaccurate data and incorrect decision-making. As processes change, the systems supporting the processes must be modified. Without documentation or system models to guide developers as to why the system is the way it is, it is easy for the developer to make wrong assumptions that can result in the incorrect modification of key calculations or algorithms. This can result in the system providing inaccurate data and results. This is of particular concern for this case, as the subject organization operated a nuclear site and was subject to a great deal of regulatory required reports and data whose inaccurate generation could result in the site being shut down.

Excessive Ad Hoc Reporting

Another issue is the large amount of ad hoc reporting. This can be reflective of several problems. It can be due to simply having lots of unstructured questions requiring ad hoc searches and queries. It can also be due to enterprise database systems not addressing requirements of sub-organizations and being poorly organized and documented. Interviews recorded numerous complaints of end users not knowing where data were located. Engineers that spent significant time assisting in ad hoc reports and queries stated that their time was taken in assisting with SQL and finding out where data was kept. To address this the organization is considering publishing a data road map. Another problem is standard reports. There is no process for tracking end-user reports to determine if they are used in sufficient quantity to warrant inclusion in the enterprise system. The team did not consider this very important but from the interviews it appeared that there were several organizations doing the same or similar reports. Discussions with IS and end-user managers found no awareness of what reports and queries were being run, although both groups expressed interest in making repeatedly run reports and queries part of the formal system. This leads to the key issue of IS focusing on the enterprise level and allowing end users to go their own way. This case is an example of more effort than necessary being expended on ad hoc reporting because the enterprise database structure was not available to the end users and no effort was being made to monitor end-user usage for common reports and queries. Dodson (1995) found that these are common problems when IS focuses solely on the organizational systems. What makes this issue more significant is the ability to generalize the average of 5% time spent on ad hoc reports to other organizations. This was considered excessive by the engineering organizations' management and would probably be considered excessive in most organizations. One of the more interesting questions for further research is what level of ad hoc reports and queries is acceptable. Perhaps the most interesting observation during the study was the generally held opinion that the ability to do ad hoc reports was a great strength. While this is an indication of system flexibility and end-user ability, it did not occur to anyone that large amounts of ad hoc reports and queries could also be a negative indicator.

Obsolescence of Systems

There were many plant and engineering digital systems that were approaching the end of lives and needed to be replaced or updated. The team found systems running on Windows 3.1 and DOS as well as using 8" and 5 1/4" floppy drive technology. Expertise and hardware for maintaining these systems is disappearing. Problems arise as replacements are investigated for these systems and as new equipment/software is purchased for resolving new problems. The subject organization's infrastructure was standardized on proven technology and was not leading edge. Products bought on the open market tend to be leading or even bleeding edge. This results in some new products not being able to function within the IS environment and requiring engineers to purchase equipment of an older standard. However, it is not good practice to develop replacement systems for the older infrastructure in place; instead, developers need to anticipate where the infrastructure is going and design for that. The issue is that IS needs to create a process for assessing the incorporation of leading edge solutions needed by engineering into the IS infrastructure while maintaining the reliability and coherence of the infrastructure. Additionally, procurement standards and processes need to be created for engineering to use and follow in the procurement of replacement systems and components. Another side of this issue is that lack of documentation for these systems makes selecting and purchasing, or developing, replacement systems difficult, as requirements are not documented and available for use in specifying the needs for the replacement systems.

Security

The team observed that the demarcation between the business systems maintained by IS and plant systems maintained by engineering was blurring. Plant information flows across the business network on a routine basis. Plant processes have been developed that rely on e-mail and the business network to transmit data. Plant support productivity has improved by using the business networks to access and maintain plant systems. The key issue is to recognize that the boundary for protecting plant information now extends to the intranet firewalls. IS and site management need to work together to create a security plan that recognizes this reality and allows for the creation of standards and processes for ensuring that systems developed by end users support the

security plan. An example of this issue was the use by an engineering group of the business network to access plant equipment from remote locations such as their homes. This greatly increased productivity and reduced overtime costs but failed to take into account security needs. When interviewed and asked about security processes for ensuring proper access and user authorization, the group's manager stated that business network login procedures were all that was necessary, as he trusted his people to properly access and use the remote access process to modify plant equipment when needed.

Conclusion

The major conclusion is that end users with computer skills left on their own can be costly. This is especially true for end-user system development and leads to the proposition that end-user system development should be performed just like IS system development. The earlier examples of the two systems purchased for approximately \$1,000,000.00 that did not work are even more striking when it is realized that the IS department estimated they could have designed and built both systems for approximately \$250,000.00. This estimate was based on using in-house knowledge and expertise, standard objects from the IS object library, and existing infrastructure. That the IS department was not considered for this work is indicative of the low level of trust between the organizations. The primary recommendation for getting end-user system development to implement IS design standards is to create end-user led development teams that use IS developers as resources. Another possibility is training and qualifying end-user system developer as IS developers and including training on IS design standards. Ultimately, the findings of Wagner (2000) and Taylor et al. (1988) are reflected in this case.

A secondary conclusion is that EUC should be monitored and expectations as to what are acceptable levels of activity established. The purpose of this monitoring is to ensure that productivity improvements due to incorporating common end-user activities into the organizational systems are realized.

In conclusion, this case illustrates that EUC problems identified in the 1980s have not changed. This leads to the conclusion that while it appears interest in EUC has waned (based on the author's perception from doing the background research for the chapter and serving as EUC track chair for the 2003

Information Resource Management Association conference), the need for continued research in EUC is still great.

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Chapter IX

Employee Perceptions of Outsourcing of Information Technology Operations: An Empirical Investigation

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Abstract

Little research exists that address employee perceptions of information technology (IT) outsourcing, and its effects on IT employees. This chapter examines a study that investigated perceptions of employees directly involved in IT outsourcing and correlated these perceptions with factors identified in earlier studies. The following human resource factors associated with outsourcing were evaluated: job security, benefits and compensation, morale, productivity, training and skills, and career opportunities. The study evaluated four hypotheses that contended transitioned employees benefited more from IT outsourcing. Results

substantiated those of two previous studies of employee perception of IT outsourcing. However, there was no statistical evidence to support the contention that transitioned professionals benefit more from outsourcing than retained professionals. To assist management with addressing these issues, a Modified Management Outsourcing Adoption Model, based on an earlier study, is presented as a tool for use in management action plans to incorporate employee perspectives into the outsourcing process and potentially lead to more successful outsourcing ventures.

Introduction

Loh and Venkatraman (1992) defined information systems (IS)/information technology (IT) outsourcing as the significant contribution external vendors provide in physical and human resources (HR) associated with the entire or specific components of the IT infrastructure. Hirschheim and Lacity (2000) said IT outsourcing involves transferring assets, leases, staff, and management responsibility for delivery of services from internal IT management to third-party vendors. Aside from the contracting of skills, assets, and resources, outsourcing also is contracting for results, where the *quality* of both the vendor and the company's respective skills and resources is highly important to the success or failure of the outsourcing initiative (Kakabadse & Kakabadse, 2000).

Researchers including Hurley and Schaumann (1997) and Kakabadse and Kakabadse (2000) state that IT outsourcing services include, but are not limited to:

- Data processing
- Business information accessing through external databases
- Systems integration
- Facilities management
- Contract programming
- Global networking
- Configuration management

- Desktop services
- Business intelligence gathering
- Turnkey projects implementation

Numerous researchers, including Antonucci and Tucker III (1998), Barrett (1996), Earl (1996), Graham and Scarborough (1997), Gurbaxani (1996), Hurley and Schaumann (1997), and McFarlan and Nolan (1995), have identified various reasons why companies are choosing to outsource their IT operations. These include, but are not limited to:

- Reducing or controlling operating costs
- Making capital funds available
- Creating cash infusion
- Augmenting for lack of internal resource availability
- Obtaining access to highly trained and skilled specialists
- Divesting functions that are difficult to manage or out of control
- Improving business or company focus
- Improving service quality
- Capitalizing on access to world-class capabilities
- Accelerating reengineering benefits
- Sharing or reducing risks and uncertainties
- Increasing competition
- Freeing resources for other purposes
- Focusing on core competencies

Quinn (1999) stated that outsourcing vendors are perceived to develop greater knowledge depth, invest more in software and training, be more efficient and innovative, offer higher wages and attract more highly trained people than can most companies who are choosing to develop and concentrate on core competencies. Quinn and Hilmer (1994) asserted that when properly developed, strategic outsourcing substantially lowers cost, risks, and fixed investments while expanding flexibility, innovation capabilities and opportunities and creating financial rewards for the outsourcing company.

Three major types of outsourcing are prevalent today: total outsourcing, selective outsourcing, and insourcing. Total outsourcing involves turning over all IT responsibilities to the third-party vendor (Lacity, Willcocks & Feeney, 1996). Insourcing involves retaining these responsibilities as in-house functions, usually after conducting an outsourcing evaluation to determine the most strategic approach to achieving the same objectives as outsourcing IT services (Benko, 1992; Hirschheim & Lacity, 2000). Selective outsourcing is where a company will choose to outsource only part of its IT functions, often to more than one vendor, and retain control of the rest (Garner, 1998a; Lacity, Willcocks & Feeney, 1996; Prager, 1998; Slaughter & Ang, 1996).

Currie and Willcocks (1998) assert that there are four types of IT sourcing decisions being made: total outsourcing, multiple-supplier sourcing, joint venture/strategic alliance sourcing, and insourcing. Again, their definition of total and insourcing does not differ from that offered above. The categorization of the other two types, multiple-supplier and joint venture/strategic alliance, is really a subset of selective outsourcing, but with different focuses on the contract and different expected outcomes for each company involved.

Outsourcing usually affects employees in one of three ways (Palvia & Parzinger, 1995). The outsourcing company can retain affected employees. Personnel can be transitioned to vendors' payrolls. Finally, employees may be released through attrition, layoffs or retirement incentives.

The outsourcing literature revealed that little emphasis is given to identifying and integrating non-upper level management employee concerns about outsourcing into the outsourcing process. Human resource issues are addressed from the perspective of upper-level management and from the perceived benefits of involved companies (Khosrowpour et al., 1995; Larabee & Michaels-Barr, 1994; Wray, 1996). This may produce a false sense of perceived outsourcing success from HR perspectives.

Literature Review

A search of several major online databases revealed a wealth of information on IT outsourcing in general. Results from ProQuest® are shown in Table 1.

Hirschheim and Lacity (2000) categorized the wealth of IT outsourcing research as:

- Descriptive case studies
- Surveys of current practices; surveys of practitioners' perceptions of risks/benefits
- Studies of outsourcing determinates and best practices that identify or distinguish successes versus failures

Table 1. Literature References on Outsourcing.

Publication Years	Keywords used	Total number of articles	Total number Peer Reviewed
1980-2003	Information Technology and Outsourcing	5109	258
	Information Systems and Outsourcing	1880	201
	Employee Perceptions and Outsourcing	3	1 ⁱ
	Employee Perspectives and Outsourcing	4	1 ⁱⁱ

ⁱ IS related

ⁱⁱ Non-IS related

As noted in Table 1, there is little published on employee perceptions of outsourcing, and even less related to IT outsourcing. This review offers a brief representation of literature addressing human resource issues relevant to the topic under discussion. First a discussion of general issues is presented, followed by the two studies noted in Table 1 that deal with employee perspectives of outsourcing.

Human Resource Issues in Outsourcing

Due' (1992) interviewed IS personnel involved in outsourcing and uncovered several serious concerns. The most significant were that the outsourcing process had negative effects on employee morale and that it presented uncertainty for employees' futures. These were fueled by rumors of lay-offs, benefits loss or reduction, transfers, and migrations to new or different technologies. When management did not address these rumors, low productivity and personnel exodus resulted.

Hurley and Schaumann (1997) stated that improved access to required skills is the number one objective for IT outsourcing. McLellan (1993) identified three core personnel issues that are both economic and strategic benefits to outsourcing: cost economies, enhanced career opportunities and reduced staff turnover, and removal of the salary sub-units. McLellan and Marcolin (1994) further discussed the research of McLellan. They termed their first listed risk of outsourcing as “technology skill stripping” (p. 99). They asserted that from the employee perspective an attractive benefit of outsourcing could be an enhanced career path outside of the employee’s existing company. This can lead to a drain of IT expertise from the employer as valuable employees move over to the vendor organization.

Lacity, Hirschheim and Willcocks (1994) studied why outsourcing deals often fail to produce the results anticipated. They noted that while many outsourcing deals list access to technical talent as a reason for outsourcing IT functions, this tactic often backfired when a company’s current perceived incompetent staff was transitioned to the vendor. They contended that the only way to ensure access to the technical skills desired was to build this requirement into the contract.

Khosrowpour et al. (1995) examined outsourcing problems from both an organizational and personnel perspective. They stated that personnel problems associated with outsourcing often are reflected in employee perceptions and actions. They contended it was important for managers to understand these perceptions so they could deal effectively with problems arising as outsourcing evaluation or transition progressed. They provided a list of seven personnel problems associated with outsourcing and presented eight potential remedies to the problems.

Barrett (1996) contended that ultimately outsourcing is concerned with people and jobs. He noted that in the deal between Hughes Aircraft and vendor Computer Science Corporation (CSC), 950 jobs were eliminated from Hughes but transitioned to CSC. Although Hughes made great efforts to ensure that the transitioned employees received similar benefits and pay packages with CSC, the results from this process were not without problems. Twenty-five percent of the Hughes IT staff quit prior to the transition, one-third of the staff embraced the move and one-third hated the change.

Cooper (1999) said that the 1990s saw a move away from emphasis on enterprise culture with its emphasis on strategic alliances and privatization to a short-term culture with outsourcing, flexible workforces, and long working hours. He reported on two *Quality of Working Life Surveys* conducted with

5000 junior managers through chief executive officers (CEOs). These studies revealed that where major corporate restructuring involved downsizing or outsourcing, there were adverse effects on employee loyalty, morale, motivation and perceived job security. However, there was a marked difference in perceived impact based on one's level in the managerial hierarchy. Chairpersons, CEOs, and managing directors perceived that the initiative increased their morale, motivation and loyalty. Senior, middle, and junior managers perceived these same factors more negatively. All levels perceived that their sense of job security decreased.

Elmuti and Kathawala (2000) performed an exploratory empirical study seeking to establish a positive relationship between global outsourcing programs and organizational effectiveness. Major factors associated with global outsourcing successes or failures were fear of change, access to adequate training and skills, choice of sourcing partners, and comprehensive plans detailing expectations. Fear of job loss, which negatively affected employee morale and job performance, was perceived as the most serious problem in global outsourcing.

Hancox and Hackney (2000) studied practices and perceptions of IT outsourcing in the United Kingdom. They reported that one population sector, non- and upper-level managers, often had significant misgivings about outsourcing, but for different reasons. Upper-managers usually were more concerned with the enterprise's economical welfare, whereas non-managers often felt excluded from managements' decisions that affected their employment and careers.

Kakabadse and Kakabadse (2000) discussed the downsizing effect of outsourcing that often leads to both positive and negative consequences. There was usually perceived improvement in organizational performances through introducing new skills and working practices, reducing staff numbers, and by modifying individual incentives, employment terms and attitudes in the workplace. These same incentives generated internal fears and employee resistance. Survivors of outsourcing, those who retain jobs with the company, suffered many negative effects as well. These included a loss in management credibility, decreased morale, increased absenteeism, and increased turnover. The authors asserted that the impact of outsourcing on all affected personnel depended on how well the initiative had been planned, how positively it had been communicated to employees and how effectively it had been implemented within the organization.

Employee Perceptions Studies

The research cited above deals with IT outsourcing in general. Human resource issues surfaced in these citations, and the researchers and authors offered a means of addressing these issues. However, these human resource issues were not researched from the employee perspective. By late 2003 only two studies dealing specifically with employee perceptions of outsourcing were published.

Khosrowpour et al. (1996) studied perceptions of IS professionals, how outsourcing affected them, and career and communications issues related to outsourcing. They asserted that successful outsourcing deals effectively with the following critical human factors: attracting/retaining talented IS professionals, employee resistance to outsourcing, job security, morale, productivity, training, and opportunities and career paths. This required management to understand what perceptions exist within employee ranks, and was best accomplished with communication and employee participation in the process. This would allow management to deal more effectively with problems as they arise during the outsourcing process.

Their research identified the following human factors as critical to this issue: attracting and retaining talented IS professionals, employee resistance to outsourcing, job security, morale, productivity, training, and opportunities and career paths. Thirty-five percent of the respondents agreed or strongly agreed that career opportunity was better with the outsource vendor. Fifty-three percent felt compensation was better, but only 33% felt job security was better with the outsource vendor. Low morale associated with outsourcing was attributed to the 81% of respondents with neutral or negative feelings about outsourcing and to the 78% of the respondents who disagreed that their welfare was considered in the outsourcing decision. They noted that IT employees did not perceive that their welfare was key to IT management as it made outsourcing decisions. Management routinely did not seek input from employees to assess the impact the impending deal had on employees.

They proposed a Management Action Plan (MAP) for addressing productivity and low morale issues, and a Management Outsourcing Adoption Model (MOAM) for managers' use to involve employees in the outsourcing process. The action plan posited a correlation between productivity levels when management implemented a plan to deal with employee perceptions and when they did not. It was based on management communication and employee participation, factors cited as most critical to addressing employee perspec-

tives. They suggested that should management implement a plan addressing employee concerns, the decrease in productivity during adjustment periods would be significantly less than without such a plan.

Kessler, Coyle-Shapiro and Purcell (1999) performed a case study of non-IS professionals involved in an outsourcing deal in London. They noted the lack of research of “insiders” (p. 6)—employees’—perspectives of outsourcing, and sought to identify potential impacts these perspectives had on outsourcing success. In examining employee responses to outsourcing, they suggested that three broad factors influence how employees react to outsourcing - specifically to a change in employer.

The first factor examined how employees felt their existing employer treated them. Influences in this area were the strategy and structure of the organization and people management as it related to human resource issues and policies.

The second factor, termed the *pull* from the new employer, examined how attractive employment with the new employer was viewed. Of importance to the process was:

- The employee perceptions associated with the identity of the potential new employer
- The way the information on the potential employer was presented, gathered and communicated
- The employee perspectives on the substance of what the new employer was offering to the employee, including benefits, staffing concerns, and workforce reduction concerns

Lastly, the factor termed *landing* examined the reality of employee experiences following the change in employer. This focused on how employees were treated after joining the new employer.

They measured work attitudes focusing on organizational commitment, job satisfaction, and HR practices including rewards, career development, training, communication and involvement. Their evaluation attempted to link consequences of outsourcing to change in employees’ assessment of HR practices, to whether initial employee expectations were met, and to the extent there was change to important attitudinal outcomes following outsourcing. Their research showed that while all four HR areas showed positive results, employees had a more positive view of career development (+1.22) with the new employer. The

least amount of change was in the perception of communication (+0.23). There were mixed results relating to expectations of the new employer versus fulfillment with the employer. Only two of the six factors, “work harder in the job (+0.28)” and “changes for the better (+0.16),” showed positive results. The least favorable factors were “anxious about the future (-0.90)” and “greater career opportunities (-0.53)”.

Employee Perceptions Study and Results

A study was conducted to investigate IT employees’ perceptions about outsourcing relative to various HR issues revealed in previous literature. This research focused on how outsourcing affected retained and transitioned IT employees directly involved in outsourcing in an attempt to identify a relationship between the employee perceptions and factors associated with outsourcing successes and failures. This study was intended to be an initial attempt to validate results from the two previous studies cited above, and specifically the Khosrowpour et al. (1996) study, against a more specific IT population: those employees who have been or are currently involved in an outsourcing initiative. One of its purposes was to determine whether these perceptions might affect outsourcing success. This perceived success was interpreted as a positive perception of outsourcing issues under study.

An empirical investigation was conducted to evaluate eight research questions and four hypotheses developed based on the body of HR literature. The survey instrument, a modified version of the Khosrowpour et al. (1996) instrument, had the same general format as the original. Section one consisted of 15 questions on demographics, and involvement in, and feelings about outsourcing. Feelings were ranked as positive or negative and addressed research questions one and two.

Section two consisted of 16 questions addressing research questions three through eight and the hypotheses. A Likert scale was used to elicit responses in this section: from 1 (*Strongly Disagree*) to 5 (*Strongly Agree*). Only those who had been involved in an outsourcing initiative were to complete this section. It was designed to elicit feedback on those HR issues identified in the literature based on the perceptions the employees have today about outsourcing.

These items were used as the primary dependent variables in this study. The Appendix summarizes responses for items from section two.

Finally, section three contained six opinion questions that were identical to those of the Khosrowpour et al. study. This section addressed communications issues associated with outsourcing. All respondents were asked to complete this section. However, only those meeting the requirements for inclusion in the study were included as part of the analysis of results needed to validate the hypotheses. The data from non-qualifying participants was used only to determine and develop further study implications.

The survey population included 1000 professionals of an international IS professional organization and a US business unit of a major IT corporation. Participants returned 201 valid surveys, yielding a 20.1% return rate. This exceeded the 14.6% rate reported by Khosrowpour et al. (1996), which they stated as consistent and expected for this type of research. Of the respondents, 150 (74.6%) had been involved in an outsourcing initiative: 13 displaced; 115 transitioned; 43 retained; 1 did not specify.

Since this study evaluated perceptions of those involved in outsourcing initiatives, and more specifically those retained or transitioned, major perceptions centered on two issues: (1) *feelings when going through outsourcing* and (2) *feelings today when the word “outsourcing” is mentioned*. Qualifying participants answered survey section two based on the response to issue 2.

Feelings About Outsourcing

An analysis of issue 2 versus issue 1 revealed an overall 10.5% increase in positive user feelings about outsourcing, an 8.4% increase of neutral feelings, and an 18.8% decrease in negative feelings. The 19.5% positive and 80.5% neutral/negative percentages for issue 1 tracked closely with those of Khosrowpour et al. (1996): 19.2% and 80.1% respectively.

On issue 2, 29.5% had positive and 70.5% negative/neutral feelings. Transitioned professionals had the largest change from negative to positive feelings: 25.0% decrease in negative; 12.9% increase in neutral; 12.1% increase in positive. For retained, the largest change was a 5.6% decrease of negative feelings.

The majority of respondents retained initial feelings toward outsourcing: 57.5% still negative, 51.3% still neutral, and 57.1% still positive. Half the transitioned employees with negative feelings at the outset had developed neutral (31.3%)

or positive (18.8%) feelings. Retained employees were 76.5% still negative, while 17.6% were now neutral and 5.9% positive. There was a comparable change between the two groups for employees who began with positive perceptions. For transitioned employees, 59.1% remained positive, while 40.9% now had neutral (36.4%) and negative (4.5%) feelings. Similarly with retained employees, 69.2% maintained positive feelings, whereas 30.8% now had neutral feelings. No retained employee with positive feelings during outsourcing indicated they had negative feelings today.

Research Questions

Eight research questions were formulated from the literature review. These addressed HR issues including job security, morale, productivity, training, skills, benefits, and career opportunity. They formed the foundation for the hypotheses presented for study. Research questions one and two were evaluated using issues 1 and 2 noted previously.

1. *What effect has outsourcing had on transitioned employees?* Transitioned respondents reported a 25% positive change from negative feelings to neutral or positive over time between the onset of outsourcing through the time of study.
2. *What effect has outsourcing had on retained employees?* These respondents reported less of a change in perception. Their change from negative feelings to neutral or positive was 5.6%.
3. *What are perceptions of the outsourcing process, either positive or negative (survey items 26, 27, and 28 in the Appendix)?* Both groups (transitioned 56.2% and retained 55.8%) disagreed that either the outsourcing or contracting company considered their welfare when making an outsourcing decision. In comparison, the Khosrowpour et al. (1996) study reported that 8.9% agreed, 13% were neutral, and 77.4% disagreed with the concept that IS professionals welfare was considered in the outsourcing decision. Conversely, both groups similarly agreed as to maintaining a positive attitude about the success of the outsourcing venture. On this issue, 62.3% of transitioned and 58.2% of the retained employees agreed with this perception.
4. *What are perceptions of whether venture enhanced or hindered IT career objectives (survey items 16 through 22, 26, 27, and 31)?*

Respondents reported a more positive (agree or strongly agree) perception of issues relative to their career except for job security. Both groups have basically the same feelings relative to IT companies offering better career opportunities. There was a slight difference between both groups on their perceptions of this issue: disagreeing (strongly disagree and disagree, 1.0%), agreeing (agree and strongly agree, 1.2%), and neutral (0.2%). These numbers marked the largest difference in opinions between this study and the Khosrowpour et al. (1996) study. For their study, 27.3% disagreed, 39.0% were neutral and only 24.6% agreed that career opportunities were better in IT companies. The Kessler et al. (1999) case study had a negative mean change in perception on this issue.

Retained employees had a more positive perception of compensation being better in IT companies than did transitioned employees (39.3% retained versus 36.9% transitioned). Transitioned employees were more neutral (34.2%) and negative (29.0%) than were the retained employees (32.6% neutral and 27.9% negative). Overall, respondents felt compensation was better in IT companies than in non-IT companies (37.5% positive, 34.2% neutral, and 28.2% negative). The Khosrowpour et al. (1996) study reported 36.3% positive, 42.5% neutral and 20.9% negative. The Kessler et al. (1999) case study had a positive mean change relative to compensation.

Transitioned employees view job security more favorably in IT companies than was reported by the retained employees. There was slightly more than a 50% difference in positive perception of this issue, 28.1% for transitioned employees versus 14.0% for retained employees. Even though there was this noticeable difference in positive perception of job security, the overall perception was negative (42.3% overall, 37.7% transitioned employees, and 48.9% retrained employees). Similarly, the Khosrowpour et al. (1996) study reported 22% positive, 33.6% neutral, and 43.8% negative. The Kessler et al. (1999) case study reported a negative mean change in this item.

Retained employees were nearly evenly split on their perception of job satisfaction being better in an IT company: 32.6% negative and neutral, and 34.9% positive. Transitioned employees had a slightly higher positive perspective (37.8% versus 34.9%). Transitioned employees (37.7%) were more neutral on this issue than was reported overall (34.9%) or by the retained employees. This item was reported in the Khosrowpour et al. (1996) study as an important variable in determining perceptions of

opportunities available with the outsourcing vendor (IT company), but they reported that “job satisfaction perceptions were not heavily weighted” (p. 91) to any preference in feeling for this item. The Kessler et al. (1999) case study reported a positive mean change relative to job satisfaction for its study participants.

The majority of both retained (45.2%) and transitioned (50.9%) employees had a positive perception that they possessed skills or knowledge that their employers would find difficult to replace. There was a 10.0% difference in negative perceptions between the two groups. Retained employees disagreed 38.1% while transitioned disagreed 28.1% on this issue. Likewise, the majority of both retained (58.2%) and transitioned (61.0%) had a positive perception that their employer still was committed to helping them improve or enhance those skills. However, on this issue nearly one-fourth (24.8%) of the transitioned employees had a negative perception, whereas 23.3% of the transitioned employees perceived this issue negatively.

Respondents who indicated that they had been retained by the company that outsourced its IT operations were more positive in their perception of the employer’s commitment to helping them identify and further their career objectives and that the outsourcing venture had proved positive for their IT career. Retained employees (60.5%) had a more positive perception than transitioned employees (52.7%) that their employer still was committed to helping them identify and further their IT career objectives. Likewise, transitioned employees were more negative (26.8%) on this issue than were retained employees (23.3%). Of the retained employees, 52.4% agreed that the outsourcing venture was more positive to advancing their IT career, whereas 46.5% of transitioned employees agreed. Again, transitioned employees (30.7%) disagreed more than retained employees (21.4%) with this issue. The Kessler et al. (1999) case study reported its largest positive mean change (+1.22) on the issue of career development with the outsourcing vendor.

5. *What are the perceived levels of change in commitment from either company towards furthering career objectives (survey items 21, 22, 26, and 27)?* Employee welfare being key to the outsourcing company or the contracting company was reported in results of research question 3. Perceptions related to employer commitment to skills and career objective were reported in research question 4.

6. *What effects do employees perceive their attitudes about outsourcing initiative will/will not impact success of overall outsourcing (survey items 24, 25, and 28)?* For each of these issues, transitioned employees agreed more than retained employees with the concepts promoted. The differences in perceptions of commitment to the customer and commitment to the employer was greater between the groups than was the difference between the perceptions for maintaining a positive attitude. Of transitioned employees, 74.5% agreed that they are committed to the success of their customer and 73.5% are committed to the success of their employer. Only 58.2% of retained employees view the contracting employee as committed to the success of their customer and 62.8% see them committed to the success of the vendor company.
7. *What is the perception that quality of service provided by outsourcer will be affected by employees' attitudes toward outsourcing (survey item 23)?* On this issue retained employees agreed and disagreed evenly (41.9%). More transitioned employees disagreed (53.5% disagreed, 33.6% agreed) that their attitude influences the level of service they provide. The implication here could be an implied notion that the transitioned IT professionals can separate their feelings about outsourcing from the level of service they provide. This could be inferred from the discussion under research question 6 and the transitioned employees' positive commitment to the success of both the customer and the employer. These results also imply that a higher negative response to this item is the more desirable reply to attribute to this outsourcing perception actually being interpreted as successful.
8. *What are the perceived effects of the outsourcing initiative as a result of communication by either company – was enough done up-front; had enough continued (survey items 29 and 30)?* No group agreed that enough communication was done during outsourcing to cause the employee to develop a positive attitude about outsourcing. Transitioned employees only agreed 27.2%, and retained employees only agreed 16.3%. Both groups had a high level of disagreement on this issue. Nearly half (49.1%) of the transitioned employees and 37.3% of the retained employees disagreed that enough communication was done on the front end of the contract.

There was a noticeable change in perception toward communication since the onset of the outsourcing contract that contributed to a positive attitude about the outsourcing venture. Of transitioned employees, 37.8% agreed

that communication had been adequate since onset, and of retained employees 34.9% (over a 50% increase) felt positive about the communication flow since onset. Both groups showed significant decreases for those who disagreed with communication flow during the initiative as noted above and communication flow since the onset of the contract: 32.8% of transitioned disagree (a decrease of 16.7%) and 25.6% of retained disagree (a decrease of 11.7%).

Analysis of Related Outsourcing Issues

The final section of the outsourcing survey retained 100% of the items from the Khosrowpour et al. (1996) study. This section of the survey examined several key factors associated with outsourcing. All respondents were asked to provide responses to these items. The last two items asked the respondent to write in his or her opinions of what both companies should do to make the outsourcing experience more positive.

Communication Flow

The majority of respondents, 53.2%, preferred to get these communications from their immediate supervisor. Khosrowpour et al. (1996) reported that those who responded to their survey preferred to get the information from their chief executive (32.2%). Immediate supervisors for their study only garnered a 22.6% response. The authors noted that the reputations of the individuals selected to deliver communications had a significant impact on how the message was received. Using this premise, it can be inferred that those who undergo outsourcing prefer to receive information from those closest to their level in the organization. This is evidenced by the fact that 53.3% of the respondents to this study who have been involved in an outsourcing initiative prefer communication come from the immediate supervisors. The next highest preference was the department head, at 24.0%.

Management Withholding Outsourcing Information

This issue determined whether or not the respondents felt it was appropriate for management to withhold information on an outsourcing deal until an agreement

had been reached. Of the 199 respondents who answered this, 69.3% answered no and 30.7% answered yes. These numbers track closely with those of the Khosrowpour et al. (1996) study: 67% no, 33% yes.

Time to Make Decision

Respondents were asked to indicate how much time they felt was needed to make a decision about accepting a job with an outsourcing vendor. Of the respondents to this item, 42.8% felt that they benefited from having one month to make such a decision. This represented 44.7% of those involved in an outsourcing initiative, 46.1% of those who have been transitioned to an outsourcing company, and 46.5% of those employees who were retained with the client company. One respondent indicated a six-month time frame to make the decision.

Reasons to Outsource

This issue examined what perceptions respondents had concerning the most compelling reason why a company would outsource its IT functions. While some respondents indicated both strategic and cost benefits, the overwhelming response was for cost benefits. Of the respondents, 63.5% felt cost savings was the primary reason why companies outsourced, while 31.5% felt it was for strategic reasons. While there was not a noticeable difference in perceptions between transitioned and retained employees on cost benefits, there was a larger difference relative to strategic benefits: 21.9% fewer transitioned respondents felt companies outsourced for strategic reasons whereas only 13.9% fewer transitioned employees felt their companies outsourced for strategic benefits.

Company Actions

The final two items on the survey asked the participants to verbalize their opinions of what the client company and the outsourcing vendor could do to make the outsourcing experience as positive as possible for affected IT professionals. Of the 201 respondents, 88.1% provided comments for the client company and 85.1% provided comments for the vendor company.

Seventy-two percent (72%) of the responses to both items centered on open, honest, and timely communication, along with openly sharing information. Fifty-two percent (52%) of the respondents voiced opinions concerning maintaining or increasing the current levels of benefits such as salary, medical, vacations, and 401K plans.

Respondents suggested that the client company should ensure that both stay and transition bonuses, applied equally to all employees, are offered. Four respondents voiced opinions that the client company should allow the affected employee to make the decision to transition or to stay instead of being forced into either option. Another key response was that the client company should educate its employees on why the outsourcing occurred, and establish a policy that would assure that transitioned employees were treated as partners. They felt this would lessen any animosity that retained employees might develop toward the outsourced employee once they show up on the job as employees of the outsourcing vendor.

Suggestions for the vendor company ran the same gamut as for the client company. Twenty percent suggested the vendor should ensure there was a smooth transition plan communicated and enforced. Key players should be retained on the account, both management and non-management. "Town hall" meetings with "swat teams" should be held before and after the contract is in effect. This allows the new employees to learn the culture of the new company, to establish expectations, and it allows the new employees to learn from the old. The vendor company's incoming management should avoid making immediate drastic changes. Instead they should learn the account and the culture that the transitioned employees bring with them and incorporate that into the account.

Hypotheses Analysis

In order to relate the results of the study to the hypotheses, independent sample *t*-tests were run on filtered responses. This was done to reduce the Type 1 error rate. Data were analyzed for transitioned and retained employees (independent variables). An *alpha* level of .05 was used for all statistical tests. The critical *t* value required to reject each null hypothesis shown below was 1.960, since each had *df* > 120. The critical *F* was 3.84.

H_{01} : *Outsourced IT professionals benefit the same in career opportunities as retained professionals* (all items section 2).

H_{02} : *Outsourced IT professionals have same positive view of outsourcing process as retained professionals (items 26, 27, 28).*

H_{03} : *Outsourced IT professionals' career objects are met the same as retained professionals (items 16-22, 26, 27, 31).*

H_{04} : *Outsourced IT professionals are equally satisfied with levels of communication involved with outsourcing as retained professionals (29, 30).*

Table 2 shows results of independent sample *t*-tests for each hypothesis. None was rejected, even though the calculated *F* for H_{01} and H_{04} exceeded the criterion *F*. Their associated *t* value was evaluated to determine if variance in means warranted rejecting the null hypotheses. Since both were less than criterion $t=1.960$, neither hypothesis was rejected.

A fifth issue, labeled *Attitude* in Table 2, was evaluated using the same technique employed for the hypotheses. This issue addressed whether IT professionals perceived that their attitudes affect the success of outsourcing relationship between companies and quality of service they provided. These issues addressed research questions 6 and 7. This researcher examined these collectively to determine if there was significant difference in means of perceptions between the two groups. Individually each item had more positive responses from transitioned respondents than retained respondents. Results showed that both groups perceived that their attitudes and quality of services provided positive impact.

Table 2. Hypothesis Statistics ($\alpha=.05$, critical $t=1.960$, critical $F=3.84$).

Hypothesis	Total Responses to items N	Levene's Test for Equality of Variance (<i>F</i>)	t-test for Equality of Means (<i>t</i>)	<i>df</i>	Reject Hypothesis
1	1644 Transitioned 462 Retained	9.527	1.875	2104	No
2	309 Transitioned 87 Retained	.099	.797	394	No
3	1027 Transitioned 288 Retained	.293	1.422	1313	No
4	206 Transitioned 58 Retained	17.465	-.095	523	No
Attitude	411 Transitioned 116 Retained	.075	1.580	525	Not applicable

For this study population, respondents disagreed with or were neutral on 62.5% of items, and agreed with remaining 37.5% of items. This closely correlated with, and thus validated, those published in Khosrowpour et al. (1996). When examining each item individually, *Agree* was the majority response (68.8%) and *Disagree* was a minority (31.2%). *Neutral* was never a majority response. This researcher concluded the issues under study are perceived as affecting success/failure of outsourcing initiatives.

Another issue under study was whether outsourced employees perceived they benefited more from outsourcing than retained employees. No null hypothesis was rejected, even though two showed significant variance in means between groups. Therefore there was no statistical evidence to support this contention for this study population.

Discussion

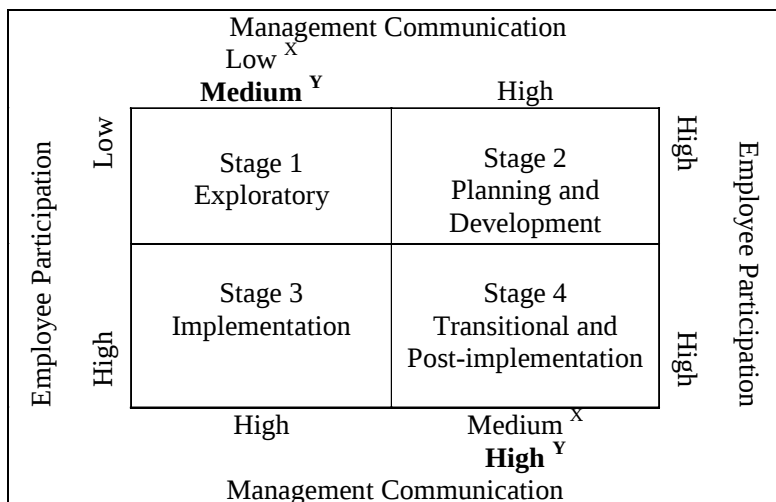
Results of this study revealed HR issues cited in earlier studies still present major concerns. Professionals undergoing IT outsourcing still have issues with job security, benefits, compensation, morale, productivity, training and skills, welfare, and career opportunities. While results did not support the idea that transitioned employees benefit more from outsourcing, there was evidence suggesting management must do more to ensure employee perceptions do not adversely affect the outsourcing. This researcher concurred that knowing how affected employees perceive outsourcing effects on their personal and professional lives would allow management to better construct agreements benefiting all parties. Knowing and addressing these issues from the onset of outsourcing should lead to more successful outsourcing agreements from the HR perspective.

Khosrowpour et al. (1996) reiterated that the most significant problem with outsourcing was the negative effect on morale that translated into low productivity. They attributed this loss to lack of communication, neutral or negative feelings about outsourcing, and the fact that 78% of their respondents disagreed that the welfare of employees was considered in outsourcing decisions. This study validated these perceptions related to: feelings when employee is going through outsourcing process (80.9% negative/neutral); lack of communication (74.5% neutral/disagree on level of effective communication); and welfare of employee being key to management (disagree/neutral: 73.1% outsourcing company, 71.1% contracting company).

Results also support the contention that absence of actions by management during outsourcing results in loss productivity (Khosrowpour et al., 1996). They incorporate perceived effect of factors from their MAP into the four stages of outsourcing. Their MOAM suggested employee participation should be low in stage 1 but high in remaining stages, and management communication about outsourcing should be low in stage 1, high during stage 2 and 3, and taper to medium during stage 4. Comments in this study, plus analysis of research questions, suggest a modification to the Khosrowpour et al. model. This researcher is proposing the Modified Management Outsourcing Adoption Model (MMOAM) shown in Figure 1.

This model reflects that respondents of this study wanted continued communication throughout the entire process. Comments from 72% of respondents that management should acknowledge the company is exploring outsourcing, communicate this early and honestly, and provide periodic updates on the process suggest stage 1 may require medium levels of communication instead of low levels. Not enough evidence existed to suggest employee involvement

Figure 1. Modified Management Outsourcing Adoption Model.



X = Khosrowpour et al. (1996) model

Y = this research model

during stage 1 warranted moving from low levels. Continued communication following the implementation was an issue for 78% of the respondents. Again this suggests instead of communication waning, it should continue at high levels during stage 4.

This researcher is proposing that a management action plan involves implementing the MMOAM. This study suggests this tool should more realistically allow for addressing reduced productivity levels by increasing employee involvement and bringing their concerns to management earlier in the process. Management should use this tool to definitively outline steps and actions required in each outsourcing stage for addressing specific employee concerns. These steps should be jointly constructed by both management and employee representatives.

Recommendations

Along with using the MMOAM, further study to determine if any one HR issue has a more positive or negative effect on outsourcing success, and what the linkages to these factors (i.e., more communication from company up front versus employee satisfaction) may be also is recommended. Comparative studies can be conducted on early outsourcing initiatives, when employees were totally omitted from the process or received minimal communication from management, to current initiatives where some attention may be given to employee perspectives. A case study of a company that integrates the MMOAM tool into its process could further validate results of the previous studies and this study. Another study worth considering is the effects outsourcing has on those employees who work on-site at their vendor location versus those who either telecommute or support the client remotely.

Additionally the results of this research support recommendations from Khosrowpour et al. (1996) and Kessler et al. (1999). Khosrowpour et al. suggested that their research, addressed from the perspective of a general IS population, could be extended by studying and comparing successful and unsuccessful outsourcing deals in relationship to the impact on people and organizations. Kessler et al., whose study was not focused specifically on the IT industry, recommended that their research be continued to academia, policymakers and practitioners. They suggested that their limited case study be expanded to establish whether or not their findings represented a general

response to outsourcing that might be replicated in other organizations or circumstances.

By identifying and addressing human resource issues from the employee perspective, management should be able to construct an outsourcing arrangement that will benefit the companies financially and the employees career-wise. With the use of the Modified Management Outsourcing Adoption Model as a tool, management should be better able to determine each employee's fit in the new environment, and offer better alternatives to meet the needs of the employee, while still meeting the company objective for outsourcing.

Conclusion

Results in this study validated those of the Khosrowpour et al. (1996) study and substantiated some of the findings in the case study by Kessler et al. (1999). Both of these researchers have concluded that management must understand what perceptions exist within the employee ranks and develop a plan to address these issues if they want the outsourcing to be successful in all realms, and not just financially. This study substantiated this claim. The researcher examined the human resource issues that previous research contended was most important to the employees involved in outsourcing. The difference in this study and the previous studies was that this one went to the source to substantiate these claims: those directly affected by outsourcing who primarily were not upper-level management. Knowing what these employees perceive about outsourcing will allow management to take some of the guesswork out of these human resource issues as they proceed with an outsourcing undertaking.

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Appendix

Table 3. Percent Summary of Survey Section 2.

Survey Item	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree
16. Career Opportunities for IS professionals better in IT companies.					
Transitioned	1.8	15.8	18.4	46.5	17.5
Retained	0	18.6	18.6	48.8	14.0
17. Compensation for IS professionals better in IT companies.					
Transitioned	8.8	20.2	34.2	31.6	5.3
Retained	2.3	25.6	32.6	30.2	9.3
18. Job security for IS professionals better in IT companies.					
Transitioned	9.6	28.1	34.2	26.3	1.8
Retained	7.0	41.9	37.2	14.0	0
19. Job satisfaction for IS professionals better in IT companies.					
Transitioned	2.6	21.9	37.7	32.5	5.3
Retained	0	32.6	32.6	32.6	2.3
20. Job function requires unique skills or knowledge that would be difficult to replace.					
Retained	4.8	33.3	16.7	38.1	7.1
21. Employer is as committed today to helping improve/enhance IS skills as at onset of outsourcing venture.					
Transitioned	8.0	16.8	14.2	51.3	9.7
Retained	4.7	18.6	18.6	51.2	7.0
22. Employer is as committed today to helping identify and further career objectives as at onset of outsourcing venture.					
Transitioned	8.0	18.8	20.5	42.9	9.8
Retained	9.3	14.0	16.3	53.5	7.0
23. Attitude about outsourcing influences level of service provided as IS professional.					
Transitioned	16.8	36.3	13.3	25.7	8.0
Retained	23.3	18.6	16.3	37.2	4.7
24. IS professionals providing contract services are committed to success of customers.					
Transitioned	0.9	7.9	16.7	52.6	21.9
Retained	0	18.6	23.3	41.9	16.3
25. IS professionals providing contract services are committed to success of employer.					
Transitioned	0.9	1.8	23.9	54.9	18.6
Retained	0	2.3	34.9	46.5	16.3
26. In considering outsourcing decision, welfare of IS professional is key factor in minds of outsourcing company's management.					
Transitioned	16.7	39.5	16.7	25.4	1.8
Retained	20.9	34.9	16.3	23.3	4.7
27. In considering outsourcing decision, welfare of IS professional is key factor in minds of contracting company's management.					
Transitioned	13.2	28.9	28.1	27.2	2.6
Retained	14.0	27.9	30.2	20.9	7.0
28. I have maintained positive attitude about success of outsourcing venture.					
Transitioned	0.9	15.8	21.1	43.9	18.4
Retained	0	16.3	25.6	41.9	16.3
29. Communication flow between companies during contract negotiations was adequate to develop positive attitude about outsourcing venture.					
Transitioned	12.3	36.8	23.7	26.3	0.9
Retained	2.4	34.9	46.5	16.3	0
30. Communication flow between companies since the onset of outsourcing has been adequate to keep positive attitude about outsourcing venture.					
Transitioned	7.0	25.4	29.8	32.5	5.3
Retained	2.3	23.3	39.5	34.9	0
31. Outsourcing venture has proved positive in advancing IS career.					
Transitioned	11.4	19.3	22.8	33.3	13.2
Retained	11.9	9.5	26.2	35.7	16.7

Section IV

Human and Organizational Issues Regarding IT Adoption and Use

Chapter X

Surfacing Occupational Threats to IT-Enabled Change: A Neglected Role for Organization Development?

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Abstract

While the business press is awash with claims that investing in information technology (IT) is the key to delivering superior economic performance, unfortunately, it appears that reaping the benefits of IT investments is fraught with difficulty. Indeed, the introduction of IT into work organisations is generally marred with persistent reports of underperformance and failure. This chapter critiques the nature of this dilemma and, in particular, explores the role of diverse occupational groups in its perpetuation over time. Executive management tend to view

the introduction of IT as an economic imperative while IT specialists tend to view it as a technical imperative. The coalescent nature of these two imperatives is such that the human and organisational aspects of IT related change are frequently marginalised and ignored. Achieving a more integrated approach to the introduction of IT is inordinately difficult since the narrow perspectives embraced by the executive and IT communities do not naturally attend to change in an integrated manner.

Introduction

Throughout much of the last four decades the introduction of new information technology (IT) based systems has posed formidable challenges for many organizations, both public and private sector alike (Clegg et al., 1996; Dearden, 1972). While each new decade has witnessed significant investment in both administrative and technological innovations, with the lure of achieving significant efficiency and economic gains, it remains that outcomes from such investment programmes have been continuously disappointing (McDonagh & Coghlan, 1999, 2000). Indeed, it appears that underperformance and failure are common experiences, with as little as 10% of IT-enabled change initiatives delivering promised business value (McDonagh, 1999).

Investments in e-government initiatives are prime examples of how administrative and technological innovations coalesce with the implicit promise of significant benefits for all stakeholders involved. Yet, it remains that e-government initiatives are fraught with difficulties (OECD, 2001; Performance and Innovation Unit, 2000). Furthermore, such difficulties evoke memories of ongoing pathologies that have routinely derailed the effective introduction of IT in work organizations over the years.

Drawing from both the information systems domain and its reference disciplines, this chapter presents a detailed critique of this enduring dilemma and in particular explores the role of occupational groups in its perpetuation through time. This chapter concludes by way of noting that effecting an integrated approach to the introduction of IT that accounts for economic, technical, human, and organisational facets of change is inordinately difficult since the requisite knowledge and expertise are widely dispersed among diverse occupational groups.

An Enduring Dilemma

Outcomes from IT investment initiatives all too frequently fail to deliver much promised business value. Indeed, many organisations appear to experience significant underperformance and failure with regard to their IT investments as opposed to the promise of superior performance so frequently claimed in the business press. Consider for a moment a number of high profile cases where the introduction of IT has been a fiasco.

- The California Department of Motor Vehicles embarked on a major project to revitalise its driver's licence and registration applications process. By 1993, after \$45 million dollars had been spent, the project was cancelled (Johnson, 1995).
- After a total of \$125 million dollars had been invested, Hilton Hotels Corporation, Marriott Corporation and Budget Rent-A-Car Corporation cancelled what had become a major IT failure (Oz, 1994).
- FoxMeyer Drug, a large Texas-based pharmaceutical company, filed for bankruptcy in August 1994 as a consequence of a \$65 million dollar IT investment that went devastatingly wrong (James, 1997).
- Having invested £600 million, the Child Support Agency in the United Kingdom admitted that its new system was a failure and was being abandoned (Jones, 1997).
- After seven years and about \$500 million dollars trying to implement the mainframe-based SAP R/2 enterprise software package, Dow Chemical scrapped the project and started from scratch with a client/server version instead (Cambridge Information Network, 1999).
- Having invested £878 million on a magnetic stripe card that never saw the light of day, the UK Government admitted that its PATHWAY initiative was a failure and was being cancelled (Ranger, 2000).

There is significant evidence to suggest that failures of the nature outlined above are a constant feature of the IT landscape (McDonagh, 2000; Ranger, 2000 Sabbagh, 1998). A recent analysis of 27 sources of evidence between 1979 and 1998 concludes that around 50% of IT initiatives fail or are completely abandoned, while another 40% are delivered late and over budget (McDonagh,

1999). Unfortunately, the percentage of initiatives that deliver business value is as low as 10% (Clegg et al., 1996; Johnson, 1995; Kearney, 1990; McDonagh, 1999).

Recent literature addressing the challenge of managing e-government initiatives echoes many of the sentiments expressed above, paying particular attention to the high probability of failure in IT-enabled change programmes in the public sector. Both the OECD and the Cabinet Office have clearly addressed the nature of this enduring dilemma (OECD, 2001; Performance and Innovation Unit, 2000).

Impaired Learning

Considering that such poor outcomes from IT investment initiatives have been a pervasive theme both in management literature and organisational practice throughout the last four decades, how can one readily account for such outcomes? To understand the persistent nature of this phenomenon one must understand the essential nature of the challenge involved in the introduction of IT into work organisations. That challenge necessitates fostering an integrated approach to the management of change, an approach that concurrently coordinates and integrates economic, technical, human and organisational facets of change. Recognising the systemic nature of this challenge, it is disappointing then to find that most IT-enabled change initiatives are dominated by economic and technical considerations to the relative exclusion of human and organisational considerations (Lunt & Barclay, 1988; More, 1990). The tangible nature of this dilemma readily manifests itself when one considers that extant empirical research supports the assertion that economic and technical considerations are unlikely to feature prominently when IT fails to deliver (Clegg et al., 1996).

What then are the consequences of failing to nurture a systemic approach to change that concurrently accounts for economic, technical, human, and organisational aspects of IT? Indeed, they appear rather grave since failing to attend to human and organisational facets of change are considered to be the root of much IT-related underperformance and failure (Benyon-Davies, 1997; Lucas, 1975). Lucas (1975) states that the difficulties with IT are primarily of a behavioural nature, a view well supported by Bariff and Ginzberg (1982).

Other writers have succinctly noted that 90% of the problems encountered in IT-enabled change are of a human and organisational nature (Clegg et al., 1996; Isaac-Henry, 1997; Long, 1987).

Recent studies by both the OECD and the Cabinet Office provide confirmatory evidence that failure to address the human and organizational aspects of change associated with e-government initiatives all too frequently contribute to rather poor outcomes in such investments (OECD, 2001; Performance and Innovation Unit, 2000).

Considering the wide array of evidence that suggests that human and organisational aspects of change are routinely marginalized and ignored in IT-enabled change initiatives, it is worth considering why this dilemma persists through time. Are organisational actors genuinely unaware of the human and organisational facets of change or in a more sinister sense do they willfully collude to marginalize and ignore these key dimensions of change? While the themes of both individual and collective learning are chic in the field of management and organisation studies, one could be excused for believing that organisations learn little, if anything, from their difficulties with IT-enabled change. Indeed, it has been well noted that we appear to learn relatively little from our mistakes (Andriole & Freeman, 1993).

A Social Phenomenon

Reflecting on such poor outcomes from IT investment initiatives, it is hardly surprising that the introduction of IT into work organisations offers a potent arena in which organisational actors are regularly drawn into a milieu of intense discord. Evidence of such discord abounds. Many IT specialists are considered lacking in the core skills required to integrate IT with the business (Martin et al., 1995). Company directors have little faith in the business judgement of their IT counterparts, even though IT is recognised as critical to corporate success (Stammers, 1997). Bosses tend to accuse IT colleagues of hiding behind techno-babble to cover their lack of business acumen (McGinn, 1997). IT people are often aloof and uncooperative, uncomfortable with teamwork and unable to listen effectively to users (Vora, 1997). Indeed, a recent survey of 340 CIOs (chief information officers) in the United States, the UK, Germany and France noted that CIOs show a lack of business acumen and shrewdness

and are generally perceived as geeks and not business professionals (Korn/Ferry International, 1998).

Conversely, a UK survey of 1,000 full-time IT professionals and 200 IT employers carried out by Harris Research revealed that 32% of IT professionals felt that senior management did not fully appreciate the role of IT in their business (Briggs, 1996). Similarly, a survey of the UK's top IT directors carried out by the Butler Group revealed that 73% did not think their business managers were IT focused (Briggs, 1997). IT specialists accuse management of profound ignorance when it comes to new technology (McGinn, 1997). Those who work in IT often complain that their non-IT colleagues do not really understand the true potential of technology. This is held to be especially true of directors, who can seem radically out of touch (Hallahan, 1998). Golden (1997) sums it up when he says that all too often there is a yawning gap of understanding between business management and IT professionals.

It is of interest to note from the above that much of the discord surrounding the introduction of IT in work organisations appears to manifest itself in the polarisation of diverse occupational groups, namely executive management and IT specialists. Davenport (1994) notes that IT appears to have a polarising effect on managers; it either bedazzles or frightens them. He suggests that those who are afraid of it shun it, while bedazzled IT departments frequently become prisoners of their own fascination, constructing elaborate technology architectures and enterprise information models. The level of intergroup dissent highlights the need for a deeper understanding of how such groups separately and collectively influence the process of introducing IT into work organisations.

On closer inquiry, it emerges that the plight with IT is of an enduring nature sustained by the behavioural patterns of polarised occupational groups who have vested, but divergent, interests in exploiting IT (McDonagh, 1999). Executive management view the introduction of IT as an economic imperative while IT specialists view it as a technical imperative. The coalescent nature of these two imperatives is such that human and organisational considerations are regularly marginalized and ignored during the process of introducing IT into work organisations (McDonagh, 1999; McDonagh & Coghlan, 2000).

Reflecting more closely on the manner in which the executive community shapes the introduction of IT in work organisations, it becomes increasingly apparent that this worldwide community of practitioners has a potent effect on IT-enabled change (McDonagh, 1999).

- Many senior executives see people as costly impersonal resources that generate problems rather than solutions.
- Many senior executives embrace a narrow economic focus on IT, believing that IT merely offers an opportunity for rationalisation and cost reduction.
- Many senior executives see IT as a cost-pit rather than a strategic capability.
- Many senior executives embrace a short-term focus on IT and exert inordinate pressure to achieve rapid payback and short-term gain.
- IT executives charged with delivering business value from IT are more often than not excluded from boards of management, executive management teams, and the corporate strategy process.
- Many senior executives fail to commit to the IT strategy process.
- The clear separation of managerial and technical work serves to reinforce and invigorate the divide between business and IT.

In a similar vein, IT specialists, as a worldwide community of practitioners, have a profound impact upon the introduction of IT in work organisations (McDonagh, 1999).

- Much of the community embraces a technical focus on IT, attending primarily to the task and technology components of work organisations into which IT is being introduced.
- The tools, techniques, and methods used by the community of practitioners sustain this narrow technocentric agenda.
- Much of the community is genuinely unaware of the human and organisational factors that account for the majority of IT-related under-performance and failure.
- There is no apparent incentive for the community of practitioners to embrace a more holistic perspective on IT-related change.

Conflict and discord between the executive and IT communities is undoubtedly a predictable outcome considering the manner in which each community shapes

IT-enabled change. Each community assumes a limited perspective on IT-enabled change, executives assuming an economic focus and IT specialists assuming a technical focus. Each community shares a predilection to design people out of rather than into systems. Similarly, each community shares a genuine lack of knowledge concerning the human and organisational aspects of IT-enabled change.

Fragmented Change

It remains unclear then as to whom is responsible for nurturing a more integrated approach to IT-enabled change that concurrently attends to economic, technical, human and organisational considerations. Clegg and Kemp (1986) and Clegg (1995) note that IT specialists see their job as being complete once the software application has been developed. Indeed, deeply held beliefs that IT can cause change lead both line managers and IT specialists to restrict their own efforts as change agents. With everyone assuming that change management is the job of someone else, there is often no one left to address change management tasks. Change then fails, and lack of learning about the root causes of failure promotes future failures (Markus & Benjamin, 1997).

Considering the power and influence that both the executive and IT communities exert on the process of introducing IT into work organisations, the challenge of embracing a more integrated approach seems daunting. In light of this, and without being prescriptive, how can organisations influence the process of introducing IT to ensure that human and organisational issues are given equal consideration with economic and technical issues? One distinct possibility is to consider the involvement of organisation development (OD) expertise since such expertise is generally well informed concerning the human and organisational factors that are generally ignored as part of the process of introducing IT (Burke, 1994).

Over the last two decades, various writers within the disciplines of OD and IT have advocated a potential role for such expertise. Notwithstanding such advocacy, the reality remains that the IT and OD communities are equally polarised with respect to their perspectives on change. IT specialists pursue a technocentric agenda, ignoring the human and organisational consequences of that agenda. Similarly, OD specialists pursue an explicitly humanistic agenda

and do not consider the IT domain as one to which they can naturally contribute (Burke, 1997; McDermott, 1984).

The potential role for a humanistic focus in the process of introducing IT is a central theme for neither the OD community nor the IT community. While some elements in both communities have pointed to the need for an integrated perspective on IT-related change, the reality remains that the IT community does not understand OD and the OD community does not understand IT (Markus & Benjamin, 1997a, 1997b). Considering the lack of understanding between these communities, should we be surprised to find that IT-related change remains, for the most part, technically driven?

Conclusion

While the process of introducing IT into work organisations warrants an integrated perspective on economic, technical, human and organisational aspects of IT, it appears that technical and economic considerations dominate the practitioner landscape. Paradoxically, when IT fails to deliver as it so often does, human and organisational considerations are the prime determinants of such underperformance and failure. This poses an intractable dilemma for many organisations.

The dilemma is of an enduring nature, sustained by the behavioural patterns of polarised occupational groups who have vested, but divergent, interests in exploiting IT. Executive management tends to view the introduction of IT as an economic imperative while IT specialists tend to view it as a technical imperative. The coalescent nature of these two imperatives is such that human and organisational considerations are regularly marginalized and ignored during the process of introducing IT into work organisations.

Implementing a more integrated approach to the introduction of IT that accounts for economic, technical, human, and organisational considerations is inherently difficult since the requisite knowledge and expertise are widely dispersed among diverse occupational groups (Andriole and Freeman, 1993; Clegg et al., 1996, 1997; McDonagh & Coghlan, 1999, 2000). This calls for expertise that cuts across the social, behavioural, computer, mathematical, engineering, management, and even physical sciences (Andriole & Freeman,

1993). Those who understand the technology tend not to appreciate the wider organisational issues, and those who have the knowledge of these are often technically naive. This places a very high premium on finding ways of integrating different forms of knowledge and expertise (Clegg et al., 1996).

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Chapter XI

Human Factors in the “System Selection” Stage of Library Automation

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Abstract

The aim of this study was to gain further insight into the suitability of a couple of different methods for investigating the possible human factors that have a significant bearing on the system selection of an automated library system. The two methods tested in this study included first a set of interviews whereby a number of people involved in library automation were asked to identify the factors that they perceived as having a significant bearing on the selection of an automated library system. The second interview method tested was the story telling approach, whereby a librarian was asked to tell her story of how and why the library that she worked for had chosen a particular library system. The results of this study showed that although both methods involved interviews, their outcomes varied somewhat where the story telling method highlighted the social interactions in a more noticeable way. A major point learned from this study was that particular attention should be paid to extracting information about more complex issues where the informants may not be able to easily identify or convey the required information.

Introduction

Since the introduction of automated library systems within libraries¹ a large amount of literature has been accumulating on various aspects of library automation². According to Storey (1992, p. 1), the two lines of approach excessively found in the library automation literature are the "machine side" and "what we did in our library to install a system". Like others (e.g., Fine, 1986, p. 84), Storey finds the amount of literature written on "human aspects" less frequent. However, today the fact that people have a pivotal role in organizations of libraries and in the process of automation is discussed and accepted widely (Clarke & Morris, 1998; Jordan & Jones, 1995; Farley, Broady-Preston et al., 1998; Olsgaard, 1989). For example, it is stated that more than half of libraries' budgets are spent on staff salaries (Jordan & Jones, 1995), large-scale changes that result from system migration will affect all levels of staff (Clarke & Morris, 1998), and based on indications from research, 90% of change initiatives fail due to human factors not being taken adequately into account (Goulding, 1996). Similarly, Olsgaard (1989) indicates that 85% of all failures in systems implementation could be attributed to people problems.

Despite the vast range of literature and guidelines available regarding library automation, costly mistakes are still made and problems are still recurring on a daily basis. Furthermore, research on the human factors that are of significance in the process of adoption and use of automated library systems are still minimal (e.g., see Clarke & Morris, 1998).

Based on this background, further research in this area seemed to be needed. In the present study, which was conducted in preparation of the design of the data collection instrument of a wider doctoral research, a pivotal point of interest centers on making sense of how and why library workers select their automated library systems.

The ever-changing Automated Library Systems³ (ALS) of today, even in their simplest forms, are very complex due to the enormity of the number of functions that they have to perform⁴. It would be very difficult (if not impossible) for a library to make a rational, fully informed decision about its choice of automated system based on a thorough examination of each detail of all of the potential systems, especially in the light of diminishing library resources, the changing marketplace (Mayo, 1995) and prevalent technologies. DiMaggio (1983) suggests that in situations of technical uncertainty, when rational evaluation of alternatives would be too costly, imitation (mimetic isomorphism) becomes a decision-making strategy. It has further been suggested that under circum-

stances of high uncertainty and unknown factors, managers' choices and actions will be bounded by the wider social conditions (see Alvarez, 1999). These give rise to many questions, such as: What decision-making strategies are used with respect to libraries' choices of ALS? What are the wider social conditions in which such decisions are made, and what would the effects of these social conditions be on the decisions made? What are the factors that affect the library workers in their pursuit of selecting a new system and what reactions are then formed as a response to these factors? What roles do these reactions play in making the choices? Does the structure of the library play a role in the library workers' automation activities? Based on what rules and resources do members perform these activities? Do these activities in turn affect the rules and resources?⁵ These are some of questions set to be answered by the aforementioned research project. Basically, what is of interest is to see what libraries' automation choices are based on and what factors (specifically human factors) play a role in the process of making these choices.

Although ALS, per se, have been in existence and in use for several decades, when a library is about to embark on the process of selection and subsequent purchase of a new system, that new system could be seen as an innovation for that library.

Rogers (1995, p. 11) defines innovation as "an idea, practice, or object that is perceived as new by an individual or other unit of adoption" (also see Zaltman, Duncan et al., 1973). Importance is placed here on the word "perceived". As Rogers (1995) explains,

It matters little, so far as human behavior is concerned, whether or not an idea is objectively new as measured by the lapse of time since its first use or discovery. The perceived newness of the idea for the individual determines his or her reaction to it. If the idea seems new to the individual, it is innovation.

As such, adoption of ALS by libraries could be looked at in the light of the theories that explain the adoption of information systems by organizations⁶. The research performed and the theories developed in the area of diffusion of innovation are very extensive⁷ and provide insightful explanations of the relationships between innovations and their acceptance or rejection by an individual or groups of people. Furthermore, similar to what is set to be achieved in the above mentioned research, among the vast number of studies completed in diffusion research, many seek to discover independent variables, or factors, that tend to influence the technology acceptance (Kwon & Zmud,

1987; Rogers, 1995). However, what differs between the mainstream diffusion research and this research is the focal point of the study. Diffusion studies have indeed been criticized for tending to side with the promoters of innovation rather than adopters (Rogers, 1995). In most diffusion research, the innovation is the center of the study with the aim to study how its adoption is spread. In this study the situation is rather reversed and importance is placed on the adopter rather than the actual innovation. The interest here is not to find out how a particular ALS is diffused among the library community, or which libraries are the early adopters of a particular system. Each library that embarks on the process of purchasing a new automated system is faced with a collection of potential systems. The center of interest in this study is placed on the libraries and library workers (the adopters) and how and why they choose a particular system among the many (often very similar) possible choices that may be available to them; a central question being the factors (especially the human factors) that play a significant role here. Regarding the individuals that come together in organizations, O'Donovan (1998) describes that the many different roles and lifestyles that make up an individual's self-concept are integrated into his or her life orientation or life plan that informs and orders the individual's activities. He then proceeds to indicate that between these individuals' own and the group's interests, there can, however, exist a tension. Due to their membership, the members accept some responsibilities while in turn they form expectations of the other members in their pursuit for finding a shared approach towards mutual goals. Hence, an individual's life is essentially social, as life orientations cannot be achieved without others.

Although the innovation theory has been praised for having made a considerable contribution toward understanding innovation diffusion, it does not fully explain the various influences that are in play in such complex situations as the selection of a complex, and to a great extent unknown, automated library system among several other similarly complex and unknown potential systems in the social organization settings of libraries. Even though the diffusion process is said to be a social process, taking place in a social setting, the diffusion theory has been criticized for not adequately dealing with the complexity that this entails (e.g., Alvarez 1999; O'Donovan, 1998) and thus, the social influences on the diffusion of information systems in organizations are being increasingly discussed and are receiving increased attention and acceptance (see O'Donovan, 1998).

Thus in forming a theoretical framework for studying the selection of ALS by library workers, not only theories that explore the implications of the social

context of such decisions need to be considered, but also several other relevant research fronts such as human behavior, decision making and organizational buyers become of interest and importance.

As such, the presentation of the theoretical framework for the wider research and relevant literature reviews and presentation of the lines of thought behind the planned study are beyond the bounds of this chapter. However, in preparation for that research a preliminary study was conducted and this chapter is dedicated to presenting it.

This chapter includes a presentation of some of the literature that is encountered in the field of library and information science (LIS), which addresses some of the related issues with regards to the selection of ALS.

Aim and Objectives

The aim of the present study is to add an extra dimension to the design of data collection instruments of a wider research by contacting people involved in the process of automation to see if their perception of the factors and events surrounding library automation could provide further insight into the design of the wider research.

In order to do so a couple of questions were formulated as follows:

- What do library system vendors and library decision-makers see as being the significant factors in the system selection phase of automation?
- What factors can be identified as being of significance by way of listening to the story of system selection as told by library workers?

Method

This study includes two sets of interviews:

- 1) The first set comprises four approximately 1-hour long semi-structured interviews with:

- A sales person (hereafter referred to as SP) who has been involved in more than 200 sales of ALS
- A system developer/vendor (hereafter referred to as SD) with the double role of being head librarian at an academic library
- A head librarian (hereafter referred to as HL) at an academic library, which now runs its third ALS
- A systems librarian (hereafter referred to as SL) who has been involved in a major purchase of an ALS for use by a consortium of five different academic libraries

These informants were asked to identify the factors, which, based on their experiences, could be seen as having a significant bearing on the process of selection of ALS. The interviews were generally divided into two sections. For the main part of the interviews no suggestions of possible factors were made to the informants and they were allowed to freely account for all the factors that they saw as important. Once they felt that they had come to the end of their list, the author solicited their views on a number of other potential factors mainly to see whether these factors had just been forgotten or whether these factors were not seen as important.

- 2) A different approach was used in an additional interview with a library worker at a public library, where the informant was asked to tell the story of how and why the staff at her library had chosen their particular ALS and to relate the experiences she had with the system selection process to any relevant past experience in her life as she would deem appropriate. Unlike the first approach, in this life-history-like interview, the emphasis was placed on the informant and her experiences and she was not directed to account for possible factors. The aim with the inclusion of this different approach was to see if the data gathered could be enriched and a new perspective added.

When analyzing the first set of interviews a comparative perspective was used, while for the latter interview a more hermeneutic approach was called for.

A Brief Review of Some Relevant Literature in the Field of LIS

In reviewing the literature in the field of LIS many issues that are related to selection of ALS are discussed by both practitioners and researchers. Although the research done in this and other related areas provide a basis for furthering the knowledge in this field, the many issues and concerns that are raised and discussed by practitioners (and indeed the reports of the situation in different libraries and the guidelines provided based on local experiences) are seen as valuable and relevant in this chapter.

To provide an overview of the topics taken up in this section and the connection between these, a summary follows.

Change within organizations is a complex phenomenon and as such has received much attention in the literature. Many have discussed the introduction of a new ALS or subsequent changeovers of such systems as a change agent within libraries affecting many aspects of the organizations of libraries. The importance of human issues has been highlighted and reactions to change have been examined. It has been indicated that attitudes and reaction to change can vary from person to person, and that in anticipation of change, people can behave in different ways, leading to different types of automation acquisition decisions. Some of the complex issues and factors that can come to have a bearing on the process of selection of ALS and which can be of significance in this process have been identified in the literature. These include factors external to ALS such as organizational (e.g., organizational structure and culture, etc.) and human factors (e.g., staff involvement and motivation, etc.), as well as factors more directly related to the automated systems.

Automated Library System as a Change Agent

Kinnersley (1996) suggests that change has become a constant in the lives of most librarians and reports that automation of the cataloging, circulation, and public access functions at a library cause changes to the tasks of virtually every employee at that library. Similarly, whether it is the first time around or a part of subsequent changeovers to newer systems, many have identified the introduction of ALS as a change agent. For example, Cartee (1990) examines the effects of introducing information technology on library managers, while

Shaughnessy (1982) discusses technology and its effects on organizational structure. The effects of large-scale adoption of IT on individual jobs and organizational structures are also claimed by Cross and Bawden (1987). Similarly, Drake (1993) speaks of technology as a factor that affects the organizational structure of libraries. Pungitore (1986) develops a scale designed to measure the extent to which automation is utilized in public and academic libraries in order to conduct comparative studies of the effects of technological change on traditional library organizational and staffing patterns. Moran (1989) names the adoption of new technologies as one of the driving forces behind the changes and claims that as much as technology has already changed libraries, these changes are likely to just be the beginning. New technology represents change, even according to Morris and Dyer (1998), who state that this would mean giving up familiar ways and facing the unknown. While highlighting the required effort and acceptance of new ideas and concepts, they also point out that it would disrupt well-established behavioral patterns, habits and securities. Crawford and Rice (1997) found that changes in the amount of library automation caused changes in several bases of power and that automation can be a change agent within organizations, causing changes in structure, bases of power, and in power itself. Fine (1982) claims that other than war and other calamities, few other changes in our social lives seem to produce a reaction with the same intensity as is aroused by the coming of technology. As a practitioner with a directory position at a library, Mason (1991) proposes that many of the innovations within libraries are technological and as such these offer the most obvious and dramatic opportunity for change. She further states that as technology does not exist in a vacuum, technological change would create and respond to other dimensions of change within an organization.

Importance of Human Issues with respect to the Introduction of IT and the Consequent Management of Change

Finer (1982) proposes that the introduction of technology affects people in a far more complex tangle of influences and effects than does a simple matter of changing the way they perform their work. While she presents an indication of a reasonable awareness among people about the "people problem" in using computers, she does not find this awareness or concern reflected in the literature and research of the time (p. 32).

This lack of attention to the human issues was further reported in the same year by Fine (1982), who claimed the human factor to be the most complicated aspect of any technological system, one which had received the least amount of attention, had been the least discussed, least researched and perhaps least understood. As such, several of Fine's further works attempt to address this problem. Since the early eighties the human factor, the effects of information technology on people, and the considerations that need to be addressed with regards to people and the introduction of information technology within organizations⁸ have gained momentum, and many interesting works have been produced. For example, Cross and Bawden (1987) present an overview of some of the literature on IT and human and organizational factors and report that the introduction and management of new information technologies are important topics for every organization. They further report that consideration of the human and organizational factors implicit in, and affected by, the introduction of new IT systems is clearly recognized as an absolutely crucial factor in success. Morris and Dyer (1998) state that staff would be most directly affected by a change of system, and in highlighting the importance of the human aspects of library automation they dedicate an entire book to numerous issues, offering guidelines as to how different aspects should be handled for successful management of the automation project. Clarke and Morris (1998) point out that it is fundamental to manage the change if librarians are to successfully respond to technological developments. Among other findings in their study they report that the nature of staff's reactions to change could be linked to staff's perception of whether the new system would be an improvement upon their older system. They also found support for the theoretical guideline that the involvement of staff in the process of automation is both important and beneficial. As such, they conclude their chapter by providing further recommendations for those libraries that face a challenge of system migration.

Reactions to Change

Attitudes towards change can vary from person to person, and according to Kinnersley (1996), those who want change embrace it and see it as an improvement and a good thing, while change makes others uncomfortable. She sees both change and resistance to it as inevitable. Similarly, Fine (1986) is of the view that human beings tend to resist change and its turmoil even when change represents growth and development or greater efficiency and produc-

tivity. However, in a study done by Clarke and Morris (1998), the general attitudes towards a new automated library system (change) were observed to be strongly positive.

Although the reactions to change might have been reported to vary in different studies, what seems to be of general agreement is that a strategy for managing change would lead toward a more successful end. In addition to these, it is change, the reactions to it, as well as its management that have been the center of much attention and discussion in the literature⁹.

Fine (1982) suggests that resistance is related to whether or not people are a part of the decision-making process in their organization and that resistance is a feeling, indicating that unless the fear and the feeling are addressed, the resistance is not likely to be reduced by argument and reasoning. Further, she (Fine, 1982, pp. 217-219) suggests that "responses to technology are a function of an individual's personality, attitudes and values, life experiences and technology-related experience, the environment in which the technology exists—and the attributes of the technology itself". However, as a result of a later series of studies based on public libraries and library schools, Fine (1986) suggests that resistance is not a function of personality or of demographics. Resistance is rather suggested to relate to the climate of the organization and an individual's beliefs, attitudes and values.

Morris and Dyer (1998) also examine the factors that can lead to resistance to change including various fears, such as fear of the unknown, obsolescence and failure, economic insecurity, changed relationships, changed working practices, and increased management surveillance. Others also highlight various types of fears as factors contributing to resistance such as Finer (1982), who also refers to the instances when the resistance to change is more likely. These include instances of unfamiliarity with the relevant facts by employees, when employees do not see the consequences as beneficial to them, when employees find it difficult to relate to the change agent and when the change is not initiated or sought by the employees.

A different perspective on this is proposed so that rather than looking at the human reactions to the introduction of technology directly, one could first try to identify various attributes of technology that lead to different reactions. According to Fine (1982), it would seem that technology has certain properties and characteristics that could become a unique and powerful stimulus and suggests that one way of looking at technology would be in terms of its attributes. She then proposes that human beings react to these attributes rather than technology itself. The attributes identified by Fine include speed, volume,

remoteness, rigidity, built-in obsolescence, foreignness, technology requiring specialized expertise and technology being its own reinforcer. She then suggests that although one may not be able to account for personal and historic bases of an individual's attitude formation, one could look at the kinds of perceptions and reactions that the attributes of technology tend to generate.

Decision-Making and System Selection

Selecting an ALS among a number of possibilities involves decision-making, which forms a central issue in the present study. Morris and Dyer state that a high level of intellectual skills is required in the tasks that involve decision-making. In these tasks people take on the role of an information processor with respect to which there are a number of limitations and characteristics that according to Morris and Dyer are not usually taken into account. These include the "primacy" effect, where too much emphasis is placed on the information that is collected early on in the process. Furthermore, people are conservative and their opinions do not tend to be revised based on new data, and people are also not always able to make full use of available information, and finally decision-makers often opt for the least effort and do not consider all courses of action (Morris & Dyer 1998, pp. 17-19).

Regarding selection of an automated system for the library, Rowley (1990) suggests that after having identified system requirements, it should be possible to identify a system that best meets the requirements for a given application. In this regard, Morris and Dyer (1998) propose that careful evaluation of all available options should be made before a system is chosen. Furthermore, with regards to system evaluations, they refer to the concepts of utility, usability and likeability (meaning that the system does the job you want, can be used by the staff and is enjoyable to use, respectively), which should be balanced against the cost and consequences in order to arrive at a decision on acceptability.

In addition to the vast amount of literature that offers guidelines as to how one should go about library automation¹⁰, there are an abundance of case studies that explain how various libraries have conducted such projects in their respective libraries, often highlighting the lessons learned and guidelines for other libraries that plan to embark on similar projects¹¹. Many of these case descriptions report group decision-making and more or less successful outcomes.

Factors that Could Directly or Indirectly Affect the Process of System Selection

The various factors that can be found in the literature in this area are extensive. According to Storey, particular physical constraints and emotional pressures are evident in the people that are involved in the process of library automation, both during and beyond the installation (1992). In introducing automation successfully into libraries, Storey (1992, p. 2) suggests that one of the important questions to ask is "what emotional pressures do they bring to bear on the process". He (Storey, 1992) then goes on to enumerate some emotional pressures, where among others, the negative ones include various fears and frustrations and the positive ones include personal development, anticipation of the new and exciting, and elation at a major or minor victory. Finer (1982) addresses similar issues in suggesting that the fact that a change will affect people is a cause for anxiety even if people have a thorough intellectual grasp of the reasons for change. She further suggests that there is likely to be a judgment of the change, not just after the event, but even beforehand, which means that preconceptions about the overall direction of the change can color the way one sees his or her involvement in it and indeed the way one acts.

In decision-making and selecting a system among several possible systems, human information processing will take part. Some of the factors affecting this human information processing such as attention, arousal, motivation, mental capacity, perception, memory, and learning were highlighted by Morris and Dyer (1998).

The complex array of feelings, attitudes, beliefs, actions, and reactions that come to play a role in the process of system selection form a complicated complex setting. While the price of potential systems could possibly directly effect the choice as a tangible factor, the exact role of some other factors such as motivation and the perceived future effects of a choice on one's job design are not so easy to trace and outline. The following is, therefore, just a selection of possible factors that are addressed in the literature as probable factors that somehow (directly or indirectly), to a lesser or greater extent could have bearing on the system selection process.

Staff Involvement

The importance of staff involvement is highlighted widely in the literature. Finer (1982) names staff involvement as one of the key issues in accommodating the human side of change. It is further said to help staff to feel less impotent and to mobilize constructive forces for problem solving and commitment to the implementation of decisions (Fine, 1986). Staff involvement in the process of automation can lead to a reduction in the resistance and level of the uncertainty felt (Butler & Davis, 1992). Cross and Bawden (1987) point out that by virtue of their knowledge, involving the staff in the process would allow for a unique contribution to the successful introduction of IT. Other studies show how the library workers themselves indicate that they would like to be involved (e.g., Shaw, 1986). Although the general agreement in the literature is that staff involvement in the process of decision making and automation is positive, some authors warn that involving staff on all levels in developing specifications and vendor response evaluation does not necessarily have to be beneficial, and instead suggest that the right level of the staff should be involved in the right ways (Clarke & Morris 1998).

Lack of System Thinking

In the trade-offs necessary in the choice of library systems, one would face a problem if various sections of the library could not see the good of the whole in preference to the best solution just for their part of the library. Shaughnessy (1996) identifies the lack of system thinking, which relates to developing a construct of the library as an interrelated whole—an organization that is more than the sum of its parts—as a major internal problem in large libraries.

First Time Around versus Second Time Around Automation

First time around automation and subsequent changeovers are differentiated in the literature (e.g., Clarke & Morris, 1998; Sykes 1991) mainly due to the fact that the automation experiences and efforts of the first time around automation seem to differ from those who have had previous experiences with the process of library automation. As such there are different issues involved in the choice of an automated library system depending on whether it is the first time that a library is buying a system or whether the library is replacing an existing

automated library system with a new one. For example, one of the issues touched on by Morris and Dyer (1998) involves the level of uncertainty or fear of the unknown, which seems to be a stronger influence against change for the people experiencing first time around automation rather than those going through subsequent changes.

Lack of Technical Knowledge

A major disabling factor in the choice of automated system is due to lack of technical know-how. In a study performed by Clarke and Morris (1998:), they found that the technological complexities of the technology used in a library automated system limited the extent to which some members of the staff felt meaningfully involved. The lack of technical expertise was reported to have prevented some staff from making worthwhile contributions and others from any involvement in the process.

Lack of technical know-how is of a particular importance at the managerial level, where organizational problems and authority and control issues could arise when managers with limited knowledge must make a timely and possibly costly decision or supervise workers with higher computing skills (Lamont, 1999).

Incentives, Job Changes, Job Designs and Motivation

Motivation, job designs, job satisfaction and incentives are very closely related areas. Various studies have been done to determine the factors affecting these and the effects on staff performance. In a case study by Farley, Broady-Preston et al. (1998), issues regarding motivation were examined and they found that motivation "came from internal factors to do with the work itself, such as having the ability and experience to solve problems and provide a good service" (p. 247). In other words motivation was derived from the confidence in one's own abilities and professionalism.

Jones and Jordan (1987) report that change at work could have an impact on staff job satisfaction and motivation. As library automated systems can affect job contents and job designs, they can therefore affect levels of motivation. Then in turn staff motivation can affect their behavior in dealing with automation in general and in system selection activities in particular.

In a study of a system migration done by Clarke and Morris (1998) it was suggested that staff reactions would be particularly positive if they saw that the new system offers improvements to both their job tasks and to the library service. It was reported that in that particular study, staff were not reluctant to give up their skills and knowledge of the old system and some saw the introduction of a new system as offering wider benefits, especially in terms of sharpening their skills and re-examining their working practices. Many also welcomed the opportunity to learn something new.

Farley, Broady-Preston et al. (1998) have also reported that staff job satisfaction, motivation, and response to change can be radically improved if attention is paid to job design following organizational and technological change. Furthermore, it is stated that a lack of consideration of this might lead to considerable resistance from the staff, whose motivation, commitment and job satisfaction would suffer much damage as a result. Furthermore, in that study they also identified responsibility, recognition and problem solving as factors contributing to job satisfaction, while an additional factor mentioned by all of their respondents was the importance of contact and interaction with library users.

Similarly, in a study done by Sykes (with the study population being non-professional staff), he has identified two main motivational factors (leading to job satisfaction). One is “the personal contact with the users of the library or other members of staff” and the other is “the feeling of doing a job well”. However in Sykes’ study very few were equally motivated by these two factors and the interviewees had stressed either one or the other of these factors as the most important (Sykes, 1991, p. 42).

Uncertainty

Fine (1986) refers to business-based research in suggesting that change in technology produces a break-up of established social routines for employees, leaving the individual uncertain about the courses of action that should be taken. Crawford and Rice (1997, p. 267) refer to a definition of uncertainty in which it is defined as “a lack of information about a future event, so that alternatives and their outcomes are unpredictable”. As such they suggest that coping with uncertainty refers to the extent of resources that are applied to reducing or responding to levels of uncertainty. Increased communication within organizations seems to be one way of reducing the uncertainty. Burkhardt and Brass

(1990) present previous research in this area and suggest that the increased communication will take place in order to interpret the change in the organizational technology and to reduce uncertainty. It does not seem surprising that many authors have highlighted communication as one of the keys in times of change and uncertainty (e.g., Finer, 1982).

Organizational Factors (Structure, Culture, Managerial Style, Environmental Pressures, Politics and Financial Resources)

As mentioned previously, the introduction of new library automation or subsequent changeovers can affect the structure of the organizations of libraries. On the other hand, the organizational structure of libraries is also suggested as an influential factor in the process of introduction and selection of ALS. Many case studies report an influence of the organizational structure on their automation project (e.g., Reeves, 1984). Indeed, one of the crucial factors identified by Farley, Broady-Preston et al. (1998) for the successful implementation of change is the structure and managerial framework of an organization. They find that organizational structures in academic libraries tend to be rigid, task-oriented and bureaucratic, further suggesting that the flexibility, which is essential in a period of uncertainty and change, is not allowed by bureaucratic structures.

Sykes (1991) discusses the supportive reasons for flexible and participatory style of management with respect to library automation, but also warns of the risks of automatically acting on recommendations to change to this style of management if one is not already currently doing so. He agrees that a participatory approach will yield the best results, but he also mentions that this will not invariably be the case.

Shaughnessy (1996) supports the idea that a reason behind not putting the best ideas and creative insights into practice is that they conflict with deeply held internal images of how the organization works, images that limit us to familiar ways of thinking and acting. He further promotes the view that in order to overcome this, the most important responsibility of leaders is to manipulate and transmit the organization's culture.

Paul (2000) suggests that the commitment and willingness to innovate among library staff is most likely to be fostered if library directors possess a number of managerial traits. Among others, these included the ability to be highly communicative and open to the participation of others in decision-making processes.

Paul (2000) highlights accelerated technological change (digitalization and networking), growing expectations of high-quality service, shrinking budgets, and dwindling resources as factors that are steadily increasing demands on libraries and creating enormous external pressure for innovation in the services that libraries are intended to provide.

As for politics, Butler and Davis (1992) suggest that it could play a macro role in the way automation is dealt with by the library workers. How the library is perceived by the parent organization and how this enables or limits the library's opportunities in gaining support or funds are central issues here.

Decreasing budgets are seen as a restrictive factor. Moran (1989) mentions the changes in library budget and budgeting for technology. As such it is highlighted that other resource demanding areas might reduce the libraries' ability in allocating adequate resources to libraries' technological needs. Budgetary reductions and rapidly rising costs are also included among the forces that are seen by Butler and Davis (1992) as pressing back the leaders of academic libraries in the 1990s.

Reasons for Purchasing a New Automated Library System

The decision to purchase a new automated library system can be made for a variety of reasons. Clarke (1995) suggests that people sometimes make changes simply to break up boredom and monotony. If such extreme unlikely reasons were to base an automation decision then one could imagine that a different process would probably take place than in cases when the reasons behind automation are of a more serious nature. Hence it would be of interest to look at the various reasons that are reported to give rise to automation decisions.

In a case study done by Reeves (1984), he mentions that the decision in that first time around automation was due to problems with slowness of manual operations leading to long queues at peak times, double work, and inadequate access to some information, which all led to levels of service that could be improved. In another case study by Khurshid (1996), it was found that processing of library materials involved slow, labor-intensive procedures involving duplication of effort in various departments of the library, and therefore automation was suggested as a means to improve library operations, management of collection and user services. A reason behind the decision to automate is given by Morris and Dyer (1998) to be the libraries' need to

improve efficiency because of an increased demand or reduced staffing levels. Storey (1992) suggests that the central argument for automation should be the advantages provided to users. Rowley (1990) highlights a couple of categories of objectives, the fulfillment of which (collectively or individually) are the common reason behind the installation of computer based systems. These include improvement of efficiency and the ability to offer a better or greater range of services.

System Related Factors

There are many introductory books and guiding literatures addressing issues that could be classified under this topic (e.g., Duval & Main, 1992; LITC, 1992a, 1992b, 1992c; Leeves, 1994; Tedd, 1993). Such a detailed overview of these will not be possible here; however, some of the most common general aspects, which are emphasized as needing particular attention, are system functionality, user friendliness, technological advancement, level and quality of support available and the vendor company's reliability and financial situation.

Results

As mentioned earlier, two sets of interviews were conducted. The informants were informed of the topic of the interview in advance in order to allow some time for reflection.

Interview Set One

In the first set of interviews, the emphasis was placed on the possible factors that had seemed of significance to the informants (SP, SD, HL, and SL).

In comparing the list of factors presented in the literature review, the system specific factors were given the highest priority by the three library workers (SD, HL and SL), who spent the main section of their responses discussing these. However, the other interviewee (SP) indicated that from the outset, it would seem that factors such as economy or system features would base libraries' decisions; however in reality the decisions are often based on irrelevant, irrational grounds. He likened the situation to buying a car, where one has really

formed a preference for a particular type and then would go around looking at other possibilities just to collect supporting arguments for his or her original choice. In SP's work with sales of many library systems he had come to feel that many libraries really know (consciously or unconsciously) from the beginning of the process which system they would like to buy.

In his view, one could often know which system a library is interested in just by looking at their system specification documents. They know the system they want and they write the system specification document in order to obtain¹² that particular system.

I can take one of these [system specification documents] and say oh, they want to buy that system. I can see it clearly; it's obvious, because they ask the questions that they know we'll say yes and no in the right places, ...

...It's pretty obvious sometimes it's ridiculously obvious.

SD also mentioned the fact that this can occur. Indeed, the other two informants (HL and SL) who had previously indicated that systems functionality was the most important factor in selecting a system also agreed that it would not be possible to test all of the systems in detail against the system specification document.

Regarding this, SL said:

I think that [testing all systems in detail] would require a lot of work and I don't think a library like this really has that kind of resources.

HL's response was that from the beginning they had the intention to have the potential systems in-house to test and compare; however, they had realized that this would have been very time consuming and impractical.

HL then went on to say that they were not so naive as to believe everything that vendors claim their systems can do. One experience that they had acquired from previous purchases was that although one thinks that one has written what one wants in the system specification document, in actual fact this is not quite so. Furthermore, vendors only answer to each sentence, interpreting it in the way they want. For example, if it was written that foreign currency should be exchanged into the local currency in the accounting section of acquisition, the vendors would answer positively to this demand, but in actual fact what they

mean is that it is possible to exchange the foreign currency into the local currency in the accounting section of acquisition, but you have to do it yourself.

According to all of the respondents in the first set of interviews, price and technical platform could be the deciding factors, but only in a fraction of the cases.

Except for one of the respondents (SP) who named staff's feelings, attitudes and irrelevant reasons as being the most significant factor in the choice of ALS, the human factors were not among the first factors named early on in the rest of interviews.

However at a later stage of the interview, SD referred to "old habits," by which he meant that upgrading the current system is often preferred to buying a new system. Later on in the interview he also referred to the staff's level of competence, past experiences, and staff involvement in the process of selection as significant. He also listed emotional bindings, anxiety and anguish in relation to decision-making, and a network of contacts as important.

HL only highlighted the first-time-around versus further system purchases and mentioned that staff experiences with past systems play a role. This was also a factor mentioned by SL. However, when at a later stage of the interviews other factors were mentioned to the informants, they went on to discuss the importance of a few additional issues. Among these were staff involvement, attachment to the older system, and influences of key personnel on others. With regards to the latter point, one of the informants (SP) explained that the final choice could depend on where in the library the decision is made, as to whether the decision is made by the top management or by the staff at lower levels. He added that of course it often seems to be the case that people involved in the process know what decision is expected from them by the top management without things being said. Such cases seem to be very common. Later on in the interview he said that in public libraries, the decisions seem to be often a team decision, but even then it would be hard to say; what could look like a team decision could actually be something else, because you have dominant people influencing the decision. He mentioned that the opinion of the head librarian is always very important. He had been involved in cases where a library had gone through a long process and had almost chosen a system, to then suddenly change the decision overnight only because the head librarian had changed. Indeed all of the informants were in agreement that the head and systems librarians' views can have a strong effect on the other library workers' views and thus on the choice of the system.

Factors such as a vendor company's reputation, location, language or system's innovativeness, openness, level of support offered, and other system related factors all were accepted as being important factors. However, the effects of these were said to differ from case to case, affecting the outcome differently in both directions (positively or negatively) depending on the libraries involved. For example, with regards to support it was said by one respondent that while some libraries look for full support and expect to do minimal administrative work in order to run their systems, others with local expertise prefer to be involved in the support and development of their systems to a much higher level. Another example given indicated that if a system was Swedish this would positively affect the choice in public libraries, while it would probably have the opposite effect in academic libraries.

With regards to sex and age, none of the informants had found these as influencing factors, at least not directly. One response was that these factors could only be of importance to the level that they affect the level of technical know-how and expertise.

Other factors that were seen as unimportant were: detailed features of the system, politics and time constraints according to SP; sales people, dominant personalities (not referring to the roles of head librarians or systems librarian, but rather personalities of other staff that attempt to get their own way), politics, interference from the parent organization and time constraints according to HL; and finally price, marketing, and time constraints according to SL.

In general all of the factors mentioned in the literature review were brought up except for job changes and job designs.

In response to the timing of the choice of system made by the respondents personally in comparison with the final official decision, both HL and SL indicated that their personal feelings about the choice of the system (which in both cases was the same as the final decision) had occurred at sometime prior to the final official choice. In the case of HL, this personal preference had probably taken form a couple of months prior to the final official choice, while in the case of SL, this personal choice had dated back to a time prior to the writing of the system specification document.

Interview Set Two

The final interviewee was asked to tell the story of the system selection at her library and explain as to how and why they had chosen this particular system.

No mention of the factors was made to her. If relevant, she was asked to relate her experience of their system selection process to any past experience or life event as she saw fit.

The response of this interviewee differed from the other interviews in that she started with her own educational background and how during a job at a bookseller she had started to experiment with building a small database just for fun. That playing around had led her to become efficient in the use of that DBMS, which consequently had led to improvements in that initially very simple and small register so that it had eventually become a reasonably advanced and useful system that had continued to grow and be used even after her departure from that job. This experience had eventually led her to her current position as the systems librarian at a small public library, although she had initially been employed on a temporary basis as the person in charge of general information technology, but not including the management of their automated library system of the time.

In this long interview about the very uncomplicated uninvolved selection of a new automated library system at a small library, many interwoven chains of events were described that showed how a simple playing around with a database program had led the informant to eventually land a systems librarian job and be given the joint responsibility of finding a new system for the library. The story then went on to explain how external regional politics and reorganizations had led to the possibility and initial decisions to change the system and how among other factors, the library's wish to mark this new identity had played a role in changing systems.

This was followed by how the general public library culture had led them to only consider the two Swedish library systems on the market; how the two involved persons had come to choose one of these systems above the other (probably mainly due to the reputation and accepted image of that system), only for the head librarian to then go ahead and buy the other option, the system which was not the choice of the staff. The reason for this was the price difference between the two.

Then in a retrospective reflection, the informant came to tell the story of the time when she as a student at the library school had spent the practice section of her education at a library. An important issue in this story was that the person who had been her supervisor at that library had later become a salesperson for the system, which was later bought at her current library.

She had come in contact with that salesperson again later on while working in her current position due to the personal contacts that her boss, the head

librarian, had with that salesman. In fact, this personal contact had led her boss to recommend her for project work at the salesman's company while the informant had been on leave. That short project work had been to test a new system that the salesman's company was developing at the time. That project work therefore had given her the rare opportunity of seeing and testing a new system that was being developed at that vendor company for future release. That experience, however, had not impressed her concerning the new system and if anything this had a negative effect on her view of the system. Therefore, when later on she had been involved in searching for a suitable system, she had been aware that both companies had plans to release new products, but she also knew that the system that she had tested was not very impressive.

Although the reason for the system choice had been the price difference, the informant could not exclude the friendship between the head librarian and the salesperson as a very influential factor.

Later on in the interview the informant mentioned that the head librarian had really decided about their choice of the system right from the beginning and that the rest of staff were aware of this without words being spoken. Through the process they had been aware that it would not be possible or easy to change the head librarian's view unless a very major convincing factor could be found. It was also explained that the staff had felt resentment towards the choice, not only because the staff preferred the system that was not chosen, but also because some of the staff had preferred their older system to the new choice. These resentments had led to lower inertia and a slow system implementation. It was mentioned that there is always a kind of slowness expected as a part of the change, and therefore the staff had moved forward with their work and the use of the new system in due course. It was said that the staff still prefer the system that was not chosen. It was also mentioned during the interview that the head librarian had long since moved to other managerial positions in larger libraries.

Discussion

Although, due to the scope of this chapter, no epistemological considerations and discussions are included, it should be noted that this study has had a qualitative nature, where the aim of the work completed has not been to produce results that could be generalized; the aim has rather been to form an

insight that would aid a better design of data collection instruments of a wider study. As such, a number of considerations were brought to mind as a result of this study.

The interviews gave rise to the thought that library workers' perception of what happens at the system selection can differ from what actually happens.

For example, system specifications and functional requirements were mentioned by a couple of informants to be the main basis for their decision. However, further discussions and deeper investigations indicated that detailed full examinations of the potential systems against these specifications were not seen as possible. This gave rise to considerations as to how to best design the data collection instruments to better capture the actuality of the situation. Another matter that became evident was that although the informants saw some factors as influential, they were prevented from further clarifications, perhaps due to the level of complexity involved. An example of this was the effects of organizational culture and structure on the choices made. In the first set of interviews, once this was put to them, the informants all agreed that organizational culture and structure could be important factors, but it could not be specified as to how. In the interview in the second set, in the story told, it was indicated that the public library culture had affected the choice of potential systems (only the Swedish ones) that were looked at. One could also sense that the choice made by the two persons assigned to this task could have been affected by the image of one of the systems considered. One could also easily observe a top steered decision making style in the organization. Another example was that, in the story told, the price of the new system was given as the deciding factor in choosing the library's current system. However in analyzing the story, other factors seem to be of importance also. This gave rise to the considerations that the data collection instruments should be designed in a way that would allow examining and puzzling out possible effects of such complex issues without placing unduly demands on the informants. Similar considerations would apply in deciphering the role and the extent of the influence of key people, previously formed personal preferences, social and professional networks and other social interactions and influences, which all need careful treatment.

Furthermore, when asked to list the factors that they had seen as influential in the selection process, several informants named issues that are of importance, but not directly influential in the decision process. Therefore, if such questions are to be repeated in the planned wider research, further clarifications would have to be provided; alternatively such information will have to be elicited differently.

As for the complexity of the interactions that can exist between various factors involved, although the first method used provided an extensive list of these, the first set of interviews did not portray a full picture of the social settings or social interactions surrounding the selection process; therefore the second method seemed to provide a richer level of information indicating that this would be a more appropriate method if a study of such interactions is of interest.

As the brief literature review above shows, many factors¹³ have been indicated as possible variables and influential factors in the selection of an automated library system. One could easily find examples of many of these in the interviews (e.g., opting for the least effort as mentioned by Morris and Dyer, or resisting the change when it is not initiated by staff as mentioned by Finer, or the importance of staff involvement as mentioned by Fine). However, there were issues that were brought up in the interviews that are more difficult to find in the literature, for example the case where the staff had actually been included in the process and had been assigned the task of choosing a system, only for their findings and recommendation to be ignored. Another example is the possibility that the selection of a system is made at an early stage of the process and that the process could only be a justifying exercise. The importance of the views of the head librarians and systems librarians were also emphasized by all of the respondents, indicating that it happens that the views of head librarians are known throughout the process by the staff, affecting their views and actions, without it being discussed. Furthermore, one of the informants named marking the new identity of the library as a reason for buying a new system, a reason that is not a recommended basis for such ventures. These give rise to a couple of considerations; firstly that reports of the worst case scenarios and irrational system selections are difficult to find in the literature; hence a question arises regarding the extent of such happenings in comparison with the “normal” cases. A second question that the literature review and the findings of this study bring to mind is with regard to the number and nature of factors that are feasible to be included in a wider study.

A previous reflection that was further heightened as a result of the preparation for this brief literature review was the enormity of the guidelines that are written with regards to library automation. This gave rise to a couple of questions; firstly to what level is this literature known and used by the library workers in their pursuits to purchase a new automated library system, and secondly the reliability of these guidelines. Not only would it be interesting to study library workers’ information behavior at the time of automation, it would also be interesting to test the available guidelines in order to examine the extent to which research can support their value.

Finally, when reviewing the literature that explains the process of automation, a more simplified view of the decision stage is often found. For example, as shown in the above literature review, it has been said that after identifying the system requirements *it should be possible to identify a system that would best meet the requirements*, or careful evaluation of *all available systems* should be made before a system is chosen. However, these interviews indicate a more complex situation where it does not seem possible to follow such guidelines in a straightforward manner, hence heightening the belief that further research in this area would be beneficial.

The results of these interviews, as hoped, and in accordance with the aim of this work, have led to several thought-provoking indications that require further consideration in designing the data gathering instruments of the wider research.

It is hoped that this presentation will be of help to other fellow research students in their preparatory work. Not only has the writer found the results of this study of much value in her own work, but it is hoped that a look at the considerations highlighted here might invoke valuable thoughts in others who plan to proceed towards similar ventures.

Endnotes

¹ For some historical accounts see Duval and Main (1992) or Tedd (1993).

² The terms technology, automation, and automated library systems are widely used, sometimes with divergent meanings attached. Although a discussion of these terms will not be entered into in this chapter, the reader should notice that the main focus of this chapter is placed on the selection of automated library systems, which are a more identifiable entity. Although, confusion can even arise in defining these. However, for the purposes of this chapter it might suffice to refer to Duval and Main (1992, p. 1) who define automated library systems as follows: "A library can be regarded as being made up of functions such as acquisitions, serials control, cataloging, circulation, and the online public (or patron) access catalog (OPAC). When a computer system is used to operate these functions, the term Automated Library System (ALS) is used."

Issues causing confusion and further clarifications and relevant discussions will be taken up more extensively in the doctoral thesis; however for now the reader should note that all of the referrals to technology and

automation in this chapter will be with regards to information technology and automated systems used within libraries.

3 Please see note 2.

4 Detailed description or even a listing of the functions that an Automated Library System could include is beyond the bounds of this document and the reader is referred to other literature, e.g., Leeves, J. (Ed.). (1994). *Library systems in Europe a directory & guide*. London: TFPL Publishing.

5 Please see structuration theory by Giddens (1984).

6 There is a vast range of research on diffusion of information systems in organizations, so much so that classification systems have been devised to categorize the studies in this field (e.g., Brabston, 1993; Kwon & Zmud, 1987; Swanson, 1994 in Prescott & Conger, 1995).

7 For some examples of these see Rogers (1995, pp. 88-95).

8 Including the organizations of libraries.

9 The amount of the literature on these topics is extensive, hence eliminating the possibility of providing an overview of these in the scope of this chapter. The reader is therefore referred to some examples of these, e.g., Atkinson, 1984; Baker, 1989; Bichteler, 1986, 1987; Branin, 1996; Bridges, 1991; Brook, 1978; Burkhardt & Brass, 1990; Clarke & Morris, 1998; Drucker, 1995; Edwards & Walton, 2000; Elliott, 1990; Farley, Broady-Preston et al., 1998; Goulding, 1996; Johnson, 1988, 1991; Kinnersley, 1996; Klobas, 1990; Penfold, 1999; Shapiro & Kirkman, 1999; Shaughnessy, 1996; Steffen, 1987; Taylor, 1999; Underwood, 1990.

10 E.g., Clayton & Batt, 1992; Cohn, Kelsey et al., 1998; Connor, 1992; Corbin, 1985; Döckel, 1992; Duval & Main, 1992; Epple, Gardner et al., 1992; James, 1987; LITC, 1992a, 1992b, 1992c; Leeves, 1994; Lovecy, 1984; Morris & Dyer, 1998; Muirhead, 1997; Tedd, 1993.

11 E.g., Clarke & Morris, 1998; Gratton, 1983; Farley, Broady-Preston et al., 1998; Khurshid, 1996; Kinnersley, 1996; Matthews, 1995; Pachent, 1996; Reeves, 1984; Shaw, 1986.

12 Based on Swedish law, public funds must be spent according to some certain rules in cases where the price of the system rises above a certain level. In such cases, if a system specification document is answered similarly by several vendors, the cheapest of these systems should be chosen.

- ¹³ E.g., first time around versus subsequent changeovers, level/extent of automation, library type, size, number of users, reason for automation, organizational structure and culture, managerial style, number of IT experts in the organization, level of staff involved in initiating the process and decision-making, mission and strategy for the decision, library's network of contacts, communication.

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Chapter XII

Stressing Office Technology's Non-Technical Side: Applying Concepts from Adaptive Structuration Theory

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Abstract

Office technology projects are not a “quick and easy fix”. They often fail to meet their objectives. This is probably due to a lack of attention for the non-technical element in office technology projects. To develop this non-technical side, in this chapter we introduce the concepts of spirit and appropriation, adopted from Adaptive Structuration Theory (AST). Spirit concerns the intention of a certain technology. Advanced information technology use must be considered as a matter of appropriation. In theory, office technology carries a certain spirit, which should guide users, but this spirit can only be materialized when users work with, or appropriate, the technology. A precondition is that users have to have a clear image of

this spirit. In this chapter, we report about the results of a study that show that if users of office technology find the spirit of the technology clear, they incorporate the technology better in their day-to-day tasks. Based upon these results we come up with a number of recommendations for office technology implementation and use.

Introduction

Projects aiming at implementing new IT systems in office environments (in short: office technology projects) are a very common phenomenon in organizations, but often fail or are abandoned (Doherty & King, 1998; Ewusi-Mensah & Przasnyski, 1994). For example, Ewusi-Mensah and Przasnyski¹ (1994) collected data on IT projects from IT senior executives and system managers in Fortune 500 companies. Their results showed that approximately one-third of the respondents indicated that five or more IT projects had been abandoned in their organizations within the period 1982-1986. This is supported by a classic Dutch study on automation projects carried out by Riesewijk and Warmerdam (1988). This showed that almost half of the projects (48.5%) ended “problematically” or unsuccessfully².

The figures as presented here suggest that IT projects in general are not a quick and easy fix. Although these figures come from somewhat old studies, there is no reason to believe that the situation has improved. One might argue that project management tools have improved and therefore IT projects in general are doing better nowadays. The other side of the coin is that IT has become more complex than it was five or 10 years ago, and that therefore it is likely that there is no improvement over five or 10 years ago. IT projects are shown to be, in a lot of cases, hard to manage. This prompts us to consider the reasons for the problems experienced in IT projects.

One reason for office technology project failure or abandonment is that in such a project different parties have to collaborate. This multi-party element of office technology projects complicates the project process, which is widely recognized in practice as well as in the literature (see for example Hirschheim, 1985; Lyytinen & Hirschheim, 1987). However, we believe this is only one part of the problem. The underlying problem is broader.

Ewusi-Mensah and Przasnyski (1994) identified the following project management issues that contribute to project abandonment or failure: staffing, mana-

gerial and communicational aspects of project management, and interaction between participants and their perception of work-related issues. In an earlier study, Ewusi-Mensah and Pzrasnyski (1991) found that organizational factors are an important cause of IT project abandonment (e.g., corporate management fails to deal with behavioral, political or organizational issues, or end users contribute to project abandonment). Vadapalli and Mone (2000) state that human and management issues play a critical role in the ability of an organization to lead a technology project to success. Hornsby et al. (1992) provide the following reasons for IT underperformance:

- lack of guiding organizational and business strategies;
- lack of end-user participation and end-user “ownership” of systems;
- lack of attention to education, training and awareness;
- lack of organizational resources and support (in terms of the “soft” infrastructure);
- lack of attention to organizational issues such as organization design, organizational culture, and management style; and
- lack of attention to psychological issues such as the design of jobs, the allocation of systems tasks, and the usability of the system.

Observing this, it seems clear that several authors provide reasons for project failure or abandonment that have to do with the fact that, in IT projects, management, users and IT professionals have to collaborate, and especially because they have different stakes in the process. But it is also clear that IT projects do not give adequate attention to organizational and human factors, which we consider to be a broader area than only the interaction between different parties. Organizational and human factors have to do with the organization of work and the probable changes that will occur as a result of the implementation of new IT, in our case particularly office technology.

Clegg et al. (1997) found that:

Regarding the impact of new information technology on the way in which work is organized and upon individual job design, the majority view (of the interviewees) was that this is hugely important but largely ignored in practice. Again this was seen as a topic that is significantly under-estimated. Where it is addressed this is because the job design implications of technical change are discovered, usually relatively late in the development process. These

findings demonstrate that IT projects remain technology-led. IT is not seen in an integrated way as raising sets of related business and organizational issues (p.859).

Overall, these observations establish a belief that the lack of attention to the *non-technical side* is a major cause of IT project failure or abandonment.

Our Starting Point

Office technology projects are not a quick and easy fix. They often fail to meet their objectives and, as we have noted, this is probably due to a lack of attention for the non-technical element in office technology projects. The question that emerges is: how can we contribute to improving this? In the literature several theories and approaches are available that claim to provide clear answers. However, new insights are frequently required in order to improve our understanding of the non-technical side of office technology projects. To develop this non-technical side, we introduce the concepts of *spirit* and *appropriation*. These concepts are adopted from Adaptive Structuration Theory (AST) as developed by DeSanctis and Poole (1994). AST starts from the assumption that the effects of advanced information technology are not a function of the technology itself, but of the way it is *used*. DeSanctis and Poole (1994) state that advanced information technology can be divided into a *spirit* and *structural features*. Spirit concerns the *intention* of a certain technology. The structural features concern the technical parts of an advanced information technology. Further, DeSanctis and Poole state that advanced information technology use must be considered as a matter of *appropriation*, in other words that technology is not an artifact from outside that determines user behavior, but that technology is realized by the actual behavior of users. In theory, office technology carries a certain spirit, which should guide users, but this spirit can only be materialized when users work with, or appropriate, the technology. A precondition is that users have to have a clear image of this spirit. Through being involved in the development and implementation process, it is possible for users to influence this spirit and to become aware of it.

The concepts of spirit and appropriation are especially adopted in this thesis to study office technology projects, as the concepts of spirit and appropriation in our view can provide a basis to understand the non-technical aspects of office technology. The concepts presented here will be elaborated upon in the second section.

Our Central Question

The concepts introduced, spirit of office technology and appropriation, are the essence of this chapter. These are considered as relevant in getting a better understanding of the non-technical side of office technology, and improving office technology development, implementation and use. Hence, our central research question becomes: How can office technology projects be improved by the use of the concepts of the spirit of office technology and office technology appropriation?

Following this first, introductory section the following section will develop the theoretical framework that will guide our study, resulting in a research model. The third section will elaborate on the research method used, which is basically of a quantitative nature. The fourth section reports about the results. We apply the theoretical framework with the help of our research method in order to answer the central research question. Conclusions and recommendations will be presented in the fifth section and lead to theoretical and practical recommendations.

Adaptive Structuration Theory's Concepts: Spirit of Technology and Appropriation

At the start of the 1990s, Orlikowski (1991) and Orlikowski and Robey (1991) reconceptualized the relationship between information technology and organizations based upon Giddens' structuration theory (1984). Orlikowski's approach pronounced that information technology in organizations should not be considered as a stable external agent that impacts on organizational forms, nor as a subject of interpretation only. Information technology itself is an agent of change depending on how it is used. The role of information technology is framed in terms of a mutual interaction between human agents and information technology. Information technology, in Orlikowski and Robey's view, provides certain structures that are brought into action by human agents. These structures can be altered by human agents during use.

Orlikowski's reconceptualization of the relationship between information technology and organizations is characteristic of an important line of thinking

during the 1990s. It attempts to give new input to the discussion on this topic, by withdrawing from the traditional deterministic and voluntaristic positions of the social sciences that had influenced the discussion to date (Orlikowski & Baroudi, 1991). Others that follow this approach include Poole and DeSanctis (1989, 1990), Walsham (1993) and DeSanctis and Poole (1994). The similarity between these authors' models is that the focus is on information technology *use*. Effects of information technology cannot be predicted beyond how it is used in a certain context. In other words, effects emerge as IT is used. It is especially the approach of DeSanctis and Poole (1994), adaptive structuration theory, which will be the main basis for our study presented in this chapter.

Adaptive Structuration Theory (AST)

In the former section we argued that the main reason for office technology project failure is the lack of attention paid to the non-technical side of office technology development, implementation and use. This suggested the need for a study on office technology that was centered on its non-technical aspects. Adaptive structuration theory (or AST) seems of use in carrying out such a study, as it starts from the basic assumption that the effects of technology are not a function of the technology itself, but of the way it is used. Furthermore, adaptive structuration theory provides promising concepts, which emphasize the non-technical side of office technology in organizations (Ruël, 2001, forthcoming). Hence, AST will be considered in more detail in this section.

With AST, DeSanctis and Poole try to develop a theory that holds the middle ground; inspired by the work of Anthony Giddens, they want to position themselves between technological determinism (or objectivism) and voluntarism (or subjectivism). In addition to Giddens, DeSanctis and Poole (1990) cite Heidegger and Ong as sources of inspiration, since they are representatives of an important school of thought that regards technologies as inherently social in nature. Social processes create the right conditions for the evolution of technology. Society is considered as a matrix in which technologies and their applications are embedded. Technologies sustain and change society, which is seen as mutual determinism. In this context, DeSanctis and Poole refer to Heim, who notes, "modern society and technologies are so bound together that it is impossible to sort out which causes which" (Poole & DeSanctis, 1990, p. 181).

Spirit of Technology

AST is based upon two main ideas: firstly, that advanced information technologies are social in nature. This is expressed by the concept of *spirit*. Secondly, that advanced information technologies are being realized by its use. This is expressed by the concept of *appropriation*.

DeSanctis and Poole (1994) define spirit as follows:

“Spirit is the general intent with regard to values and goals underlying a given set of structural features. The concept of spirit concerns the ‘official line’ which the technology presents to people regarding how to act when using the system, how to interpret its features, and how to fill in gaps in procedure which are not explicitly specified. The spirit of a technology provides what Giddens calls ‘legitimation’ to the technology by supplying a normative frame with regard to behaviors that are appropriate in the context of the technology” (Desanctis & Poole, 1994, p. 126).

The spirit can also give signification to users, as it helps them to understand and interpret the meaning of the IT. Finally, the spirit can be a means of domination, because it presents the type of influential moves to be used with the IT. Some users may be privileged by this and others constrained. Therefore, in terms of structuration theory, the concept of spirit concerns the total set of possible structures promoted that may be called upon by means of the structural features (later on in this section we will discuss how to define the structural features). The concept of spirit suits very well what Orlikowski (1991) calls the “interpretive flexibility” of information technology. The implication of this assumption is that the realization of any object may differ between situations, and that the object itself can change as people change their mode of using it.

If we project this onto the type of IT included in our study, that is, office technology, this can be clarified with the following example. A specific office technology may contain the spirit: *open organizational communication*. If we analyze this spirit, using the three types of structures (based upon Giddens, 1984), it is then possible to say that the spirit provides users with structures of signification that appeal to interpretive schemes about organizational communication, and allow the meaning to arise that the technology aims to support open organizational communication. The spirit also provides structures of domination that facilitate users to send electronic messages to people higher in the organization’s hierarchy (which might not have been allowed before the new

office technology was implemented). Finally, the spirit of the new office technology provides structures of legitimation with the norm that people who use indecent words in their electronic messages are excluded from the use of the new office technology.

Some information technologies present a clear consistent spirit, whereas others do not. If users apply information technology in contradictory ways, this might suggest that the technology does not present a coherent clear spirit. A clear coherent spirit would be expected to direct appropriation in more or less pre-defined ways, but an unclear, incoherent spirit would have a less directive impact on user behavior (DeSanctis & Poole, 1994). This is where the concept of spirit can help in understanding why office technology implementation can end in unanticipated consequences, and even in complete failure; the less clear the spirit, the less users are likely to use the office technology in accordance with its spirit (Ruël, 2001). This may result in unanticipated outcomes.

In conclusion, we define the concept of the spirit of information technology as the general intent with regard to values and goals underlying a given set of technical features. This differs a little from the definition of DeSanctis and Poole (1994), because in our view their distinction between the non-technical part and the technical part of technology is not sufficiently clear. A technology's spirit is the official line regarding how to act when using a technology. A spirit provides signification, legitimation, and can be a means of domination. Office technology (and thus its spirit) can only be realized in actual use, which is referred to as appropriation. If, in a certain context, users do not appropriate an office technology in accordance with its spirit, this may lead to unanticipated outcomes. In this way, it can be theoretically understood why similar office technologies, even in similar contexts, can lead to different outcomes. Related ways of referring to a technology's spirit in this thesis will be through the use of terms such as *underlying philosophy* or *intention* of an information technology.

Appropriation of Office Technology

AST considers information technology use as a matter of appropriation. For the roots of the concept of appropriation, Poole and DeSanctis (1989) go back to Hegel and Marx³. These 19th century philosophers were interested in how humanity progressively learned to control and shape the natural world and how this, in turn, influenced and changed human society. The nature of subject-

object relationships was of utmost relevance in understanding this progression. Marx stressed the productive and self-constructing nature of humanity. In his view the concept of appropriation was the key that unlocked the nature of subject-object relationships. By appropriating an object, Marx meant that it was used constructively, incorporated into one's life, for better or worse (Ollman, 1971). Men and women in nature make their worlds through appropriating objects, and advances in modes of appropriation are the basis for advances of human society in general.

Placing advanced (information) technology in Marx's perspective, every effect of a certain technology is dependent on the appropriation of the technology. Appropriation of an object implies that a user realizes that object (Ollman, 1971). What an object is depends on how it is used, on how it enters into human activity. The implication of this view is that the realization of any object may differ with situation, and that the object itself can change as people change their mode of using it.

Poole and DeSanctis (1989) note that Marx's conception of appropriation as a constructive use that shapes both user and object needs to be elaborated further to be useful in the study of GDSS and other new technologies. Things are no longer as straightforward as Marx suggested; he used the contrast between tools, which are controlled by the craftsperson, and machines, which control and appropriate the worker, to explain his worldview. One could also comment that Marx seemed to consider people as products of their historical period, and tended to stereotype appropriation modes by class. Marx distinguished only two classes: workers and capitalists. By doing so, he ignored differences in appropriation between individuals, groups, or organizations. Despite this weakness, Marx's basic conception of appropriation is a useful starting point for an analysis of human use of information technology.

In the relatively short history of AST, its developers have gone through some changes in the way they conceptualize appropriation. Initially, AST distinguished three dimensions of appropriation: *faithfulness of appropriation*, *attitudes towards appropriation*, and *the level of consensus on the appropriation*. However, after rethinking the theory of adaptive structuration, DeSanctis and Poole (1994) distinguish four dimensions of appropriation: *appropriation moves*, *faithfulness of appropriation*, *attitudes towards appropriation*, and *instrumental uses*. So, they added *appropriation moves* and *instrumental uses*, and removed *consensus on appropriation*. We believe that a combination of DeSanctis and Poole (1994) and Poole and

DeSanctis (1990) provides the most useful concept of appropriation. We therefore include all the dimensions in our concept of appropriation.

AST can be considered as a general framework from which more specific hypotheses can be drawn. It is especially the concepts of spirit and appropriation that we believe are promising (AST is a relatively young theory) and these have not been used before in studies on office technology projects. Nevertheless, good examples of applying AST in studying electronic group system use do exist and include Poole and DeSanctis (1992), Wheeler et al. (1993), Chin et al. (1997), Kahai et al. (1997), and Majchrzak et al. (2000). However, applying AST to office technology gives our study an interesting challenge

Developing a Research Model

Earlier in this section, we stated that some information technologies might present a clear consistent spirit, whereas others will not. A clear coherent spirit is expected to direct appropriation in more or less pre-defined ways, whereas an unclear incoherent spirit can be expected to have a less directive impact on user behavior. This is where we think that the concepts of spirit and appropriation can be used to improve office technology development, implementation and use. We think the best point to start from in order to improve office technology projects is the *clarity of the spirit* to users and their level of office technology appropriation. To determine whether the clarity of the spirit is a useful point of departure in guiding office technology projects we formulate two main hypotheses.

The first hypothesis to be tested is based upon DeSanctis and Poole's expectation that a clear spirit will direct users towards appropriation in a more pre-defined way. We translate this into the following hypothesis:

1. *The clarity of the spirit of office technology is positively related with the level of office technology appropriation.*

Thus, if users of an office technology experience the spirit to be clear, it can be expected that they will appropriate the office technology to a larger degree than if the users do not clearly experience the spirit.

This hypothesis forms the first part of our research model (the complete model is presented in Figure 1). In this figure, the box containing the clarity of the spirit

is surrounded by a dotted line representing the technical features of an office technology. Earlier in this section we explained that the technical features are the technical means through which users are expected to realize an office technology's spirit.

Our second hypothesis is concerned with the role of office technology appropriation. It is assumed that office technology is not implemented in organizations without reason. We suppose, if office technology is appropriated in accordance with its spirit, that the expected effects will arise. In general, the main reason for the implementation of office technology is to increase business performance (productivity, efficiency, quality of services). The relationship between new office technology implementation and business performance has been widely discussed in the literature, and still has not led to a clear answer (see for example: Hitt & Brynjolfsson, 1996; Pinsonneault & Rivard, 1998). We summarize the aspects mentioned as the effectiveness of the work processes. The problem with most of the studies that have been carried out on the topic of the influence of IT on effectiveness assume, implicitly or explicitly, that it is the IT itself that causes the expected effects. This is why these studies did not lead to clear and consistent answers. We assume it is the actual use of office technology, referred to as appropriation, which causes specific effects. Therefore, it is our expectation that a high level of office technology appropriation contributes to the effectiveness of work processes, as effectiveness in our opinion is: the extent to which work processes develop in a goal direction. In practice it is therefore the expectation that working with the new office technology will lead to an increase in work process effectiveness. We formulated this in the following way:

2. *The level of office technology appropriation is positively related with the level of effectiveness of the work processes.*

So far, in our elaboration, we have adopted from AST the two central concepts: the spirit of office technology and appropriation. These concepts are our main sources in developing a research model that suits our study on office technology. However, office technology development, implementation and use take place in a context, and so, in developing a research model, attention to this context is necessary.

With an eye on aiming to support the context of office technology use, we include the two sources of structure as proposed by AST: the internal

organizational environment and the characteristics of the user tasks. These two might influence the relationship between office technology appropriation and work process effectiveness.

Changes in the Internal Organizational Environment

Implementations of office technologies can accompany changes in the internal organizational environment, but the level of this change can differ extensively in each situation. In the first section, we referred to Hornsby et al. (1992), who discern six “problem-causing” issues regarding office technology projects. Two of these are related to the topic of organizational change. It is our basic belief that a change in an organization’s IT system implies a change in the organization of work also. With this point of view, a lack of attention to the internal organization when introducing IT projects will at least be problematic.

Users’ Work Autonomy

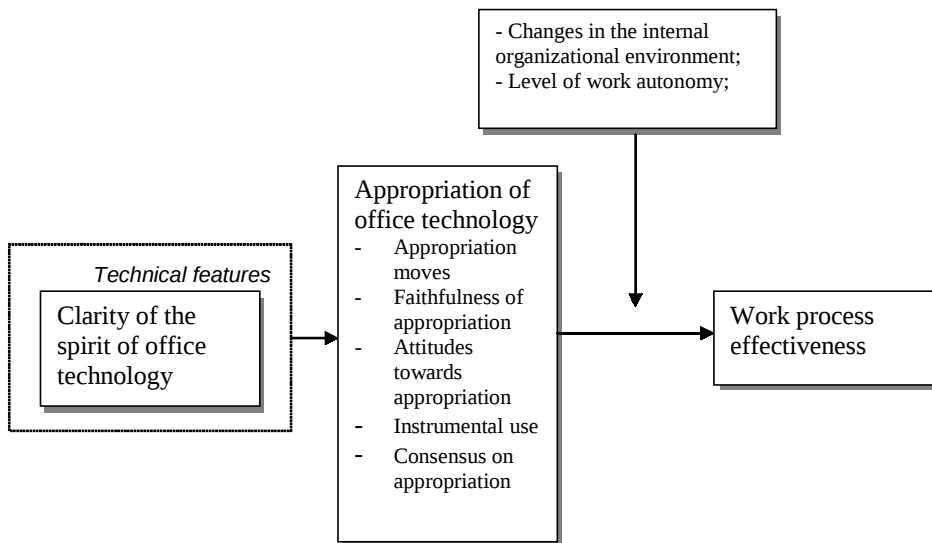
Office technology implementations can match differently to varying degrees the situations in hand. An important point to take into account is the level of work autonomy that users experience. It is our expectation that users with different levels of work autonomy will accept a newly implemented office technology differently. Users with little work autonomy might feel that they have no real alternative than to work with a given office technology, while users with much more work autonomy might feel that they can choose from a broader range of activities than only working with a given office technology. In other words, differences in the level of work autonomy suggest differences in office technology use

Taking into account these two contextual factors leads to the following variations on the second hypothesis:

The relationship between the level of appropriation and work process effectiveness is more positive among:

- 2a. *users who have experienced a high level of change in the internal organizational environment that accompanied new office technology implementation;*

Figure 1. The Complete Research Model.



2b. *users who experience a high level of work autonomy after new office technology implementation.*

The whole research model is assembled in Figure 1.

Having explained the theoretical framework, in the following section we will continue by discussing the research method used.

Research Method

The research model presented in the former section and the hypotheses drawn from it are intended to be tested by using results from the questionnaires. Chin et al. (1997) proposed developing scales for the central constructs of AST in order to measure them more easily. We follow this approach in our study. Constraints with available time, labor and budget were a factor in this decision. In addition, we believe that using scales for measuring AST concepts is innovative in the sense that for the concept of *clarity of spirit*, as far as we know, never before has a scale been developed and used. It is also the first time

that the complete concept of appropriation has been measured with the help of scales, and that AST has been applied for studying other technologies than group decision support systems. We will now elaborate on the scale development for each concept.

Clarity of the Spirit

For measuring the clarity of spirit, the five aspects of appropriation, experienced changes in the work situation, experienced work autonomy, and effectiveness of work processes, we to an extent developed scales ourselves and partly used existing scales. The scale for measuring the clarity of spirit was developed on the basis of our definition of spirit, as inspired by DeSanctis and Poole (1994) and Poole and DeSanctis (1990). We formulated five items, and tested them with colleague-researchers. The items for this scale were formulated as propositions about whether respondents are clear on the goals of the new system, whether the “thought behind” the new system is clear, and whether respondents know what effective use of the new system should lead to. An example of an item for this scale is: *I know what effective use of [name of the system] should result in.* The reliability of the scale was very satisfactory (Cronbach’s alpha is 0.87)

Appropriation

The concept of appropriation consists of five dimensions: *appropriation moves*, *faithfulness of appropriation*, *attitudes towards appropriation*, *instrumental uses*, *consensus on appropriation*.

DeSanctis and Poole (1994) define *appropriation moves* as the ways that users choose to appropriate the available technology structures. They propose four types of appropriation moves. In the context of our study we are especially interested in the level of appropriation moves, or in other words, how intensively do users appropriate office technology?

Faithfulness of appropriation is defined as the extent to which a certain office technology is appropriated consistent with its spirit.

By *attitudes towards appropriation* we mean the users’ assessments of the extent to which the structures within the system are useful and easy to use. Attitudes set the tone for system usage and can reinforce productive or

counterproductive trends in a group's experience with the system (Poole & DeSanctis, 1990).

Instrumental uses are another aspect of the concept of appropriation, referring to the reasons why systems are used. For example, users might only use a system for task completion, but they could also use it in an explorative way, or for individual personal purposes. In our study we intend to apply AST to office technology used by individuals in an organizational setting. Therefore we believe that only task-oriented use and exploration-oriented use are relevant. In line with the theoretical framework of AST, it is assumed that the clearer the spirit of a certain system is to users, the more task-oriented will be its use. When the spirit is not clear, users will more likely have a more explorative orientation.

Finally, the fifth aspect we distinguish on appropriation is *consensus towards appropriation*. The definition we apply is as follows: the extent to which users of office technology agree upon how the technology should be used. In order to achieve effective processes and desired outcomes, it is important that a specific office technology is used in a similar way by all users. Poole and DeSanctis (1989, 1990) assume that, especially with groups using group decision support systems, consensus on how to appropriate the system is important. If there is a lack of agreement, then appropriations may vary in terms of the nature and degree of conflict. We believe that a high level of consensus is necessary, not only for the use of GDSSs, but also for office technology use. For example, if in an insurance company, employees who work with a specific office technology do not use it in a similar way, this will probably lead to ineffective work processes. Therefore, whether users of office technology are linked with each other very closely or they work more as individuals, for the effectiveness of the work processes as a whole, it is important that there is consensus on *how* to use the technology.

The scales used for the aspects of appropriation were partly developed by us, and partly adopted from others. For measuring the first aspect of appropriation, appropriation moves, we used a single item. As we are interested in the level of appropriation in the context of this study, we modified the aspect of appropriation moves. In the questionnaire, we did not focus on the types of appropriation moves, but on the level of moves (for respondents, "moves" was replaced by "use"). This seems to be more in line with DeSanctis and Poole (1994), who hypothesized that it is the level of appropriation moves that is of importance with regard to the outcomes of ICT appropriation. When the

number of appropriation moves is high, the desired effects can be expected, naturally taking into account the levels for the other aspects of appropriation. To investigate this, the questionnaire contained the question: *To what extent do you use [the name of the system]?*

The scale for *faithfulness of appropriation* was based on Chin et al. (1997), but we added three extra items, in order to enhance the scale. Based on the results of a reliability test all of the eight items seemed valid. An example of an item for this scale is: *I use [name of the system] in a different way to the original goals*. The reliability of the scale was satisfactory (Cronbach's alpha is 0.77).

Attitudes towards the technology were measured by using two scales based on Davis (1989) and Sambamurthy and Chin (1994): a 5-item scale for measuring *perceived usefulness*, and a 5-item scale for measuring *perceived ease of use*. We changed some elements of the scales, such as formulations of items, as we believed that they could be improved. An example of an item from the "perceived usefulness" scale is: *The [name of the system] is useful for my work*. An example of the "perceived ease of use" scale is: *The screens of [the name of the system] are easy to understand*. The reliability of the scales was very satisfactory (Cronbach's alpha for the scale "perceived usefulness" is 0.85; for the scale "perceived ease of use" it is 0.82).

We measured two types of *instrumental use*: task-oriented use and explorative use. Each was measured with a self-constructed four-item scale. An example from the 'task oriented use' scale is: *If I use [the name of the system], then I know in advance for what task I want to use it*. An example of the 'explorative use' scale is: *During my work it takes me time to discover [the name of the system]*. The reliability of the scale "task oriented use" was moderately satisfactory (Cronbach's alpha 0.64), and for the scale "explorative use" the reliability was satisfactory (Cronbach's alpha 0.77).

Consensus on appropriation was measured with a self-constructed 6-item scale. An example from the "consensus" scale is: *There are implicit or explicit rules about how to work with [the name of the system]*. The reliability test of this scale gave a satisfactory result (Cronbach's alpha 0.70).

Effectiveness of Work Processes

Effectiveness of the work processes is defined as the extent to which work processes that are carried out with the office technology are achieving their

goals, are efficient, and occur with a low level of error. We measured effectiveness of work processes with a self-constructed 4-item scale. An example of an item on the scale used is: *Within the group of users of [the name of the system] the level of errors is low*. The result of the reliability test is satisfactory (Cronbach's alpha is 0.73).

All scales were measured with a 5-point response format ranging from 5 = "strongly agree" to 1 = "strongly disagree". The scales used can be found in Appendix 1. It was our intention to use the first case study to test the scale reliabilities, and then improve the scales. However, this did not seem necessary, as the scale reliabilities were adequate (the scales' internal consistencies were very satisfactory; Appendix 2 contains the relevant statistics).

One could counter that using scales simply presents a one-moment measurement and therefore is not a very information-rich look into the situation. We do not agree on this since we do not believe that respondents respond to statements based upon only their current situation, but, implicitly or explicitly, that they take into consideration a certain time span in making their judgements. Then one could argue that some respondents may have a bad day and so still give extremely low scores, which would give an incorrect picture of the situation. Our counter is that even if this did occur then it is equally possible that another respondent has an extremely good day and therefore responds over-positively. These two scores can then cancel out so that the mean score of the group of users as a whole will give a fair picture.

Selection of Respondents

The unit of analysis that is chosen for this study is users of office technology. Through the opinions of users of office technology, it is this study's goal to say something about office technology development, implementation and use; or in other words, office technology development, implementation and use make up our empirical domain. Therefore we consider it important to include a variety of office technology developments, implementations and uses in our study. We aimed to include different types of office technologies, so that a range of office technologies is represented in this study. In particular we included examples of what O'Brien (1995) calls electronic imaging/document management systems, and office management systems. These types of systems have the dearest impacts on users' work situation and are used in procedural offices (Panko, 1984).

We selected users of office technology of four different organisations in the Netherlands (three profit organizations and one non-profit organisation). In total 250 questionnaires were distributed, of which 112 were returned (response rate 44.8%). To ensure some possibility of comparability in the context of office technology use, all of them worked within service-oriented organizations.

Results

A major part of the study concerns the testing of the relationships between the variables in the research model. We formulated three main hypotheses and tested them in the four service-oriented organizations included in this study. In this section we present the results of testing these hypotheses. The results will provide us with an indication of whether they are correct or not.

Our first hypothesis was:

The clarity of the spirit of office technology is positively related with the level of office technology appropriation.

Table 1 summarizes the results.

Table 1. Correlations Between the Clarity of the Spirit and the Level of Appropriation.

Appropriation moves	-.11
Faithfulness of appropriation	.26**
Perceived usefulness	.39**
Perceived ease of use	.42**
Task-oriented use	.26**
Explorative use	-.04
Consensus on appropriation	.04

* = $p < 0.05$; ** = $p < 0.01$

From the results as presented in Table 1 we can observe that there is a weak (although non-significant!) negative relationship between the clarity of the spirit and the level of appropriation moves. In other words, the clarity of the spirit does not seem to be decisive in the extent to which users really work with the office technology. The main explanation is that other organizational factors, such as the nature of work, are more decisive. All our four organizations concerned office technology in procedural offices. The technology in general was an important tool for users in carrying out their tasks, and therefore in many cases there were no alternatives.

There is a moderate, but significant positive relationship between the clarity of the spirit and the level of faithful appropriation. More explicitly: if users experience the technology's spirit as clear, this contributes to the extent to which they work with the technology in line with its spirit.

The clarity of the spirit is moderately, significantly positive related to the perceived usefulness of the office technology. In other words, the extent to which the spirit of an office technology is clear to users influences their perception of a technology's usefulness in a positive way. This also applies to the perception of a technology's ease of use and to the level of task-oriented use.

Regarding the level of explorative use we found a weak negative correlation. This is in line with our theoretical expectations. The clearer the spirit to users, the less users need to explore the system. However, we expected a somewhat stronger negative correlation.

Finally, there is hardly a relationship between the clarity of the spirit and the level of consensus on appropriation. The results suggest that it cannot be said that the clearer users find the spirit of an office technology, the more there is unanimity among users on how to work with the technology.

Overall, however, we can conclude that our first hypothesis is confirmed for the majority of the dimensions of the concept of appropriation, namely for faithful appropriation, perceived usefulness, perceived ease of use and task-oriented use.

The final hypothesis that was tested is as follows:

The level of office technology appropriation is positively related to the level of work process effectiveness.

As with the previous hypothesis the results are summarized (Table 2).

Table 2. Correlations Between the Level of Appropriation and Work Process Effectiveness.

Appropriation moves	-.18
Faithfulness of appropriation	.13
Perceived usefulness	.36**
Perceived ease of use	.40**
Task-oriented use	-.01
Explorative use	-.04
Consensus on appropriation	.32**

* = $p < 0.05$; ** = $p < 0.01$

The results show that appropriation moves (“just pushing buttons”) does not make a significant difference in work process effectiveness.

The results suggest that using the technology in line with its goals and intention is poorly related to a higher level of work process effectiveness. Although theoretically unexpected, plausible explanations are expected to come from the contextual factors included in the research model, namely the level of internal organizational change as part of the project, and the level of users’ work autonomy. However, what can be learned from the current result is that the spirit of the office technologies in use does not represent what is considered as necessary by users in order to improve the work process effectiveness.

Further, the results show, in our view, that there are convincing indications that when users perceive an office technology to be useful, this contributes to the work process effectiveness. Also, for the extent to which users perceive the new system as easy to use counts that it is positively related to the level of work process effectiveness. That the relationship is in general somewhat weak indicates in our view that contextual factors (such as aspects of the organizational structure, and culture, or employee characteristics) are at least of equal importance in contributing to work process effectiveness.

Task-oriented use of the new system is hardly related to work process effectiveness. Theoretically this is very surprising. In our view, this result again emphasizes that contextual factors are very important regarding any improvement of work process effectiveness. It is clearly not only the new system that makes a difference in improving work process effectiveness.

Explorative use of a new system does not seem to be related with work process effectiveness. Theoretically, we expected that explorative use of an office technology would be negatively related with the effectiveness of the work processes. That this is not the case can be explained by the fact that it is surely not only the new system that has a role in terms of the level of work process effectiveness. Other, contextual factors intervene in the relationship between explorative use and work process effectiveness. We will carry this forward to the following part of this section.

Consensus on appropriation is significantly, positively related to work process effectiveness. In other words, the more users work in a similar way with a new system, the higher the effectiveness of the work processes.

Considering the overall results with regard to the second hypothesis we conclude that it is confirmed for three of the seven dimensions of appropriation, namely perceived usefulness, perceived ease of use and consensus on appropriation. The fact that with some dimensions the relationship is somewhat weak, or even not positive, must in our view be explained by the context in which the office technology is used (e.g., aspects of the organizational structure, culture, and employee characteristics). These factors are expected to play an intervening role. It is clearly not only appropriating an office technology that improves work process effectiveness.

We hypothesized on the role of two of these contextual factors on the relationship between the level of appropriation and work process effectiveness. These factors are the level of change in the internal organizational environment, and the level of work autonomy. The hypotheses are presented below:

The relationship between the level of appropriation and work process effectiveness is more positive among:

- 2a. users who experience a high level of change in the internal organizational environment that accompanied new office technology implementation;*
- 2b. users who experience a high level of work autonomy after new office technology implementation.*

We continue with testing the role of two of the contextual factors on the relationship between the level of appropriation and work process effectiveness. For testing these hypotheses we split the respondents into two groups:

Table 3. Correlation Between the Level of Appropriation and Work Process Effectiveness in Groups that Experienced High and Low Levels of Internal Organizational Change.

	mov	faith	usef	ease	task	expl	cons
“Low change” group of users (N=62)	-.22	.02	.39**	.53* *	.05	-.04	.29*
“High change” group of users (N=30)	-.16	.21	.37*	.35	-.17	-.20	.41*

* = $p < 0.05$; ** = $p > 0.01$

mov = appropriation moves; *faith* = faithful appropriation; *usef* = perceived usefulness; *ease* = perceived ease of use; *task* = task-oriented use; *expl* = explorative use; *cons* = consensus on appropriation

one group containing those with a high score on a contextual factor, and the other group those with a low score. Respondents who rated higher than 3.0 on the 5-point scale with which we measured the factor were placed in the “high” group, and respondents who rated 3.0 or lower were placed in the “low” group. First, hypothesis 2a, of which the results are shown in Table 3.

The results in Table 3 make clear that our hypothesis is only confirmed in terms of the level of consensus on appropriation. In other words, in the group of users who experienced a high level of change in the internal organization, the higher the consensus on appropriation, the higher the level of work process effectiveness. Otherwise, the level of organizational change only makes a real difference in the relationship between the perceived ease of use and work process effectiveness. Among users who experienced a low level of organizational change, the more the office technology is perceived as easy to use, and the higher the level of work process effectiveness. This is not in line with our expectations. Therefore, how can this be explained? The organizational changes in the organizations we covered were in general quite unanticipated. The appropriation of the new office technology might not contribute to work process effectiveness because of this high level of unanticipated organizational change.

The overall conclusion is that the level of internal organizational change does not make a real difference in the relationship between the level of appropriation and work process effectiveness.

Table 4 shows the results of testing hypothesis 2b.

Table 4. Correlation Between the Level of Appropriation and Work Process Effectiveness in Groups that Experienced High and Low Levels of Work Autonomy.

	mov	faith	usef	ease	task	expl	Cons
"Low work autonomy" group of users (N=47)	-.12	.13	.31*	.42**	.12	.13	.36*
"High work autonomy" group of users (N=60)	-.18	.12	.33**	.36**	-.09	-.13	.24

* = $p < 0.05$; ** = $p > 0.01$

mov = appropriation moves; *faith* = faithful appropriation; *usef* = perceived usefulness; *ease* = perceived ease of use; *task* = task-oriented use; *expl* = explorative use; *cons* = consensus on appropriation

Overall, the relationship between the level of appropriation and the level of work process effectiveness is most positive among users with a low level of work autonomy, although the difference between the two groups is not that large. Theoretically, we expected the opposite. Our explanation for this opposite result is that users who have low work autonomy are in general more "stuck" to the office technology for their daily work. The content of their job is limited and probably more focussed on working with the office technology than users with a high level of work autonomy. Users who have a high level of work autonomy will probably have the possibility to choose whether to work with the technology or to carry out other tasks. In their work they are unlikely to be as dependent upon the office technology as users with a low level of work autonomy. Thus, appropriating the office technology has a stronger impact on work process effectiveness among users with a low level of work autonomy.

It is noticeable that the relationship between the level of consensus on appropriation and work process effectiveness is more positive among users with a low level of work autonomy than among users with a high level of work autonomy. Understanding the situation in which our respondents operated provided an explanation. Users with a low level of work autonomy are in general more "mutually dependent" for their daily work. Each user carries out small, limited tasks. Being more dependent on the office technology means that the level of consensus on how to work with the office technology among users

with a low level of work autonomy impacts more strongly on the level of work process effectiveness. Overall, we conclude that hypothesis 2b is not confirmed.

Having tested all hypotheses, a summary of the findings will be given in the final section.

Conclusions and Recommendations

Overall, the clarity of the spirit is positively related to the level of appropriation. The clearer the spirit is to users, the more faithful they appropriate the office technology, the more they perceive the technology as useful and easy to use, and the more they use the technology in a task-oriented way.

Overall, only the level of perceived usefulness, perceived ease of use, and consensus on appropriation are significantly positively related to work process effectiveness. With the other aspects of appropriation this was not the case. Notably, contextual factors such as the level of organizational change and the level of work autonomy explain to a limited extent this limited relationship, but in the opposite way to that expected. Office technology appropriation contributes to work process effectiveness, especially among users who experience a low level of organizational change and a low level of work autonomy. This outcome can most reasonably be explained by the fact that most of the organizational changes in the organizations involved were unanticipated, and thus might have meant an extra stress factor for users. Furthermore, users with a high level of work autonomy probably had alternatives to working with the office technology, while users with low work autonomy probably had no choice but to use the office technology in order to carry out their tasks. Therefore, appropriation of an office technology has more influence on the level of work process effectiveness among this latter group of users. It is likely that contextual factors such as users' satisfaction with organizational support during appropriation and users' satisfaction with the implementation process also influence the relationship between office technology appropriation and work process effectiveness. These were not identified as such in the research model as presented in the second section.

Our initial research model, presented in the second section, was based upon adaptive structuration theory (AST). Inspired by AST, we proposed that the

effects of office technology are a result of office technology *use* rather than a result of its technical characteristics. Office technology is realized during use. Expected effects arise only if office technologies are used in accordance with the intents and goals underlying the technical features. These intents and goals, or in other words the non-technical side of office technology, are referred to as its *spirit*. The process of realization is referred to as office technology *appropriation*. In order to realize an office technology in line with its spirit, users must experience this spirit as clear. That was one of our basic hypotheses. That the right way to make this spirit clear to users is to involve them in the process of development and implementation was another of our hypotheses. Our second hypothesis was that the better users realize an office technology, the more this will contribute to work process effectiveness. We conclude that it is confirmed for three of the seven dimensions of appropriation, namely perceived usefulness, perceived ease of use and consensus on appropriation. Reflecting on our theoretical point of departure, in the light of the results of our study, leads us to conclude that the basic approach of the research model is valid. The first hypothesis was confirmed, the second partly, but it has become clear that certain contextual factors play a more dominant role than others, and some play a role in the opposite way to that expected.

In this study we concentrated on the non-technical side of office technologies, namely the intention underlying the technical features, which we labeled as the spirit of the office technologies. Only if office technologies are used in line with the underlying intention can the expected effects arise. Therefore, technically sound office technologies on their own are not sufficient to solve the identified problems; the underlying intention must also be sound. Hence, a major issue we want to address in this chapter is that *office technology projects should shift from being technology-driven events towards technology use-centered events*. In use, office technology is realized depending upon *how* it is used. If the spirit is clear to users, they can enable the expected effects to arise.

Shifting the focus from the office technology itself towards its use can contribute to the extensive discussion in the literature on the relationship between IT and business performance. The results of research on this topic are far from consistent (Hitt & Brynjolfsson, 1996; Pinsonneault & Rivard, 1998). A main cause of this inconsistency might be that much of the research assumes a direct causal relationship between IT and business performance. It ignores the process of IT use.

Managing the Clarity of Spirit

The results from testing our hypotheses indicate that the clarity of an office technology really does make a positive difference in terms of office technology appropriation. In other words, *the non-technical side of office technology is an essential factor and has to be reckoned with*. Since office technology is realized when it is used, it is critical that users experience the intents and goals of an office technology as clear. Even more strongly put, *these intents and goals should be their own*. Therefore developing the intents and goals should at least be a joint activity between users, IT experts and management. In practice, users are usually only involved after decisions about the initial intents and goals of new office technology have been made. It is not surprising then that users find different intents and goals while appropriating a new office technology. The initial intents and goals may well not be the same as theirs. *In our view, office technology projects would be improved if it is taken into consideration that developing and implementing new office technology means developing and implementing a joint belief in the intents and goals of the technical features, and in the way to achieve these intents and goals*.

The results of our study showed that appropriation of the office technology to a high extent alone is not sufficient to give a high level of work process effectiveness. This is an interesting result. In other words, if incorporating the new office technology into users' day-to-day activities did not make that much difference in work process effectiveness, what else would? In our view, the results make one thing clear. The internal organizational environment in which office technology is used is of major importance in terms of improving work process effectiveness using the newly implemented office technologies. Therefore, we would decrease the high expectations of office technology if improving the effectiveness of the work processes is all that is at stake. *Improving the effectiveness of the work processes is in the first place a matter of influencing human behavior and human interaction, reflected in the organizational structure, culture, and human resources. Office technology can only play a facilitating role*. In terms of managing office technology projects we believe that ignoring the internal organizational environment is like leaving the engine out of an automobile!

Last, but not least, new research should be carried out based upon the theory used in developing our research model, namely adaptive structuration theory. In this study we used concepts from this theory to test the relationships between

certain concepts. We studied whether the concept of spirit makes a difference in office technology appropriation, and to what extent. One of the consequences of our findings from our theoretical framework is that the concept of spirit may need refining. We propose that *the spirit of an office technology should be considered as flexibly interpretive*, to use Orlikowski's (1991) words. Users interpret the technical features in such a way that the features make at least some sense to them in any given situation, provided that they want to. Therefore, the spirit can change as the office technology is appropriated. This dynamic characteristic of the concept of spirit can explain why users in general at least attempt to use the technology, although in general they are poorly involved, the technical features can be highly restrictive and neither sophisticated nor comprehensive, and users in general are not fully satisfied with the implementation process itself.

New research should be of a more interpretive nature and start from the view that the concept of spirit is dynamic, or in other words, flexibly interpretable. We expect that conceiving the spirit in this way will provide a fruitful basis for a deeper understanding of the interaction between office technology and its users. Adaptive structuration theory offered a valuable basis for deepening our understanding, but humans will continue to develop new technologies. Therefore, new concepts will be needed to understand the reality we perceive.

Endnotes

- ¹ Ewusi-Mensah and Przasnyski sent out more than 1,400 questionnaires and received 82 completed usable responses (5.6%). Ewusi-Mensah and Przasnyski suggest that one reason for this very low response rate might be that discussing IT project abandonment has negative connotations, and therefore is not a favoured topic (besides this, it was also suggested that the length of the questionnaire (11 pages) played a role). The useful responses were analysed and showed that approximately one-third indicated that five or more IT projects had been abandoned in their organizations within the period 1982-1986.
- ² These are projects that were supported by external automation experts. The study of Riesewijk and Warmerdam (1988) concerned 274 companies. 233 of them had carried out an automation project in the last three

years. The figures on projects' success or failure were collected by a written questionnaire among automation experts and managers. These might have had a certain level of responsibility in the projects, and therefore be more positive than other people involved.

- 3 Poole and DeSanctis are not the only researchers who have adopted the concept of appropriation. Ciborra (1996) also does, but uses Heidegger's "Being and time" (New York: Harper and Row, 1962) and Dreyfus' "Being-in-the-world" (Cambridge, MA: MIT press, 1994). Ciborra considers appropriation as a form of taking care of an innovation "fallen" in its context of use (p. 11). This concept of appropriation is basically the same as Poole and DeSanctis'; information technology is a "trigger" for human behavior, but users of information technology are "active agents," and effects come from their interaction with the technology. In our study we use the concept of appropriation as Poole and DeSanctis (1989) and DeSanctis and Poole (1994) define it, as this fits into the broader context of AST.

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Appendix 1

Questionnaire

The questionnaire consisted mostly of propositions. Respondents were asked to express to what extent they agreed with a proposition. This could be done by rating a proposition using a 5-point response format:

The questionnaire is translated from Dutch; between the brackets the *name* of the system was placed:

- 1 Strongly disagree
- 2 Disagree
- 3 Partly agree, partly disagree
- 4 Agree
- 5 Strongly agree

- 9 *Not relevant*

If a respondent considered that none of the alternatives matched his or her opinion, the respondent was asked to choose the closest alternative. Only if propositions were really not relevant to a respondent's situation was the respondent then asked to choose the alternative response "9," which meant: not relevant to my situation.

1. Personal data

The following questions concern a number of general topics such as age, education etc. Please, place a circle around the most appropriate answer, place a cross in a box, or insert an answer on the dotted line.

A. Are you male or female? (please, place a cross in one of the boxes)

☐ male

☐ female

B. What is your age?.....

- C. How long have you been working for this company?.....
- D. What is your current job?.....
- E. How long have you been working in this department?.....
- F. What type of education did you follow and graduate from?
- 1 Lager Onderwijs/Lager Beroeps Onderwijs
- 2 MAVO, MULO, ULO
- 3 HAVO, HBS
- 4 VWO, Atheneum, Gymnasium (zoals LEAO, VBO)
- 5 Middelbaar Beroepsonderwijs (MTS/MEAO)
- 6 Hoger Beroepsonderwijs (HTS/HEAO)
- 7 Universiteit, TH

2. Use of “[name of office technology (OT)]”

1. I use the [OT]. (*place a circle around the relevant answer*)
yes no
2. To what extent do you use [OT]?
(hardly) 1 2 3 4 5 (very much)
- b. How long have you been working with [OT]?

1. Strongly disagree
2. Disagree
3. Partly agree, partly disagree
4. Agree
5. Strongly agree
9. *Not relevant*

Items 3 to 7 concern the scale “clarity of the spirit”

- | | | | | | | |
|----|---|---|---|---|---|---|
| 3. | The goals of [OT] are clear. | | | | | |
| | 1 | 2 | 3 | 4 | 5 | 9 |
| 4. | The “thought behind” [OT] is quite clear to me. | | | | | |
| | 1 | 2 | 3 | 4 | 5 | 9 |
| 5. | I know where effective use of [OT] should lead. | | | | | |
| | 1 | 2 | 3 | 4 | 5 | 9 |

6. I understand what designers of [OT] aimed for.
 1 2 3 4 5 9
7. I know in what way according to [OT] experts, for example system managers, the [OT] is used optimally.
 1 2 3 4 5 9

Items 8 to 12 concern the scale “perceived usefulness”. Items 13 to 17 concern the scale “perceived ease of use”.

Using [OT]:

8.I think is a good idea.
 1 2 3 4 5 9
9.contributes to my effectiveness.
 1 2 3 4 5 9
10.is not my preference, because there are better ways than using [OT].
 1 2 3 4 5 9
11.makes my work easier.
 1 2 3 4 5 9
12.is useful for my work.
 1 2 3 4 5 9
13. It is easy to learn to work with [OT].
 1 2 3 4 5 9
14. Most functionalities of [OT] are easy.
 1 2 3 4 5 9
15. The screens of [OT] are easy to understand.
 1 2 3 4 5 9
16. I find [OT] flexible in use.
 1 2 3 4 5 9
17. I think [OT] is easy to use.
 1 2 3 4 5 9

In the following propositions sometimes the term “[OT] experts” is used. This refers to people who are very acquainted with the [OT], such as system managers within your organization. Sometimes propositions are about how [OT] should be used. In these cases, start from what you

believe about how [OT] should be used, for instance as a result of what you heard in information meetings, training sessions, or what you read in manuals.

1. Strongly disagree
2. Disagree
3. Partly agree, partly disagree
4. Agree
5. Strongly agree
9. Not relevant

Items 18 to 25 concern the scale “faithfulness of appropriation”

18. I use [OT] in accordance with what manuals and/or documentation state it is intended.
1 2 3 4 5 9
19. “[OT] experts” will not agree with my way of using [OT].
1 2 3 4 5 9
20. I probably use [OT] in ways which are new, in comparison with the initial goals of [OT].
1 2 3 4 5 9
21. With certain functionalities of [OT] I probably work in an unusual way.
1 2 3 4 5 9
22. I use [OT] differently from the initial purposes.
1 2 3 4 5 9
23. “[OT] experts” will not consider the way in which I use [OT] as the most appropriate in order to use the system to its maximum.
1 2 3 4 5 9
24. I do not succeed in using [OT] as it is should be used.
1 2 3 4 5 9
25. I do not use [OT] in the optimum way.
1 2 3 4 5 9

The following propositions are about the way [OT] is used.

Items 26, 27, 28, 30, 31 concern the scale “task-oriented use”, items 29, 32, 33, 34 concern the scale “explorative use”.

26. In my work I use the possibilities of [OT] which are relevant to my work.

1 2 3 4 5 9

27. Tasks that can carry out with [OT], I really use [OT] for.

1 2 3 4 5 9

- | |
|---|
| 1. Strongly disagree
2. Disagree
3. Partly agree, partly disagree
4. Agree
5. Strongly agree

9. Not relevant |
|---|

28. I use [OT] much in my daily work.

1 2 3 4 5 9

29. I discuss with my colleagues about how [OT] works.

1 2 3 4 5 9

30. When I start to use [OT] I know in advance for which task I will use it.

1 2 3 4 5 9

31. I use [OT] to make progress in my work.

1 2 3 4 5 9

32. I use the manual of [OT] regularly.

1 2 3 4 5 9

33. During my work it takes time to ‘discover’ [OT].

1 2 3 4 5 9

34. By “trial and error” I still find out new aspects of [OT].

1 2 3 4 5 9

Below you are asked to make statements about the extent to which, in your view, users of [OT] in your organization agree upon how to use [OT].

1. Strongly disagree
2. Disagree
3. Partly agree, partly disagree
4. Agree
5. Strongly agree
9. Not relevant

Items 35 to 40 concern the scale “consensus on appropriation”

35. Within the group of users of [OT] there is consensus on how to use [OT].
 1 2 3 4 5 9
36. I use [OT] in a fairly identical way to my colleague-users.
 1 2 3 4 5 9
37. Within the group of users there are still considerable misunderstandings about [OT].
 1 2 3 4 5 9
38. There is no difference in opinion within the group of users of [OT] about what you can do with it.
 1 2 3 4 5 9
39. Within the group of users there is disagreement about how certain functionalities work.
 1 2 3 4 5 9
40. There are (written or tacit) rules about about how to work with [OT].
 1 2 3 4 5 9

1. Strongly disagree
2. Disagree
3. Partly agree, partly disagree
4. Agree
5. Strongly agree
9. Not relevant

3. Your work situation

The following propositions are about aspects of your own work situation.

Items 51 to 54 concern the scale “internal organizational change along with the office technology implementation”.

With the implementation of [OT]:

41.... changes have occurred in my tasks.

1 2 3 4 5 9

42.....changes occurred in my physical work environment.

1 2 3 4 5 9

43.....changes occurred in the composition of the employees in my department/unit.

1 2 3 4 5 9

44.....the performance criteria regarding my job changed.

1 2 3 4 5 9

The following propositions concern the way work processes which can be supported by the group of users of [OT] are going. It is, however, not necessary that you really use [OT] for these, but that you can use other means.

Items 55 to 58 concern the scale “work process effectiveness”.

Within the group of users of [OT]:

45.....work processes are progressing in an effective way.

1 2 3 4 5 9

46.....work processes are progressing rapidly.

1 2 3 4 5 9

47.....the level of mistakes is low.

1 2 3 4 5 9

48.....the amount of work that is being carried out is high.

1 2 3 4 5 9

Items 59 to 61 concern the scale “work autonomy”.

Finally, a few propositions about your work.

49. I can determine the sequence of tasks myself.

1 2 3 4 5 9

50. I can determine how fast I carry out my work.

1 2 3 4 5 9

THANK YOU FOR YOUR COOPERATION!

Chapter XIII

Expanding the Information Carrying Capacity of the New Media in the Context of Virtual Teams

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Abstract

This chapter considers the pivotal role of computer-mediated communication in supporting the work of virtual teams. The limited information carrying capacity of computer-mediated communication channels has been well documented and the subject of much research. Media richness theory is the context for a proposed technique aiming to increase the information carrying capacity of CMC in virtual teams. The

technique, based upon developing a shared social construction, is presented and suggestions on how it may be evaluated are proposed.

Introduction

With the growth of global organisations, virtual teams, and advances in networks and telecommunications, face-to-face meetings are no longer the sole communication medium used by organisations to facilitate collaborative work. Computer-mediated communication (CMC) systems that have emerged in recent years have revolutionised communication and made possible new and expanded forms of group work. These CMC systems have become an integral component of organisational communication as they are more convenient and less expensive than travelling to face-to-face meetings as well as being integrated into multi-media environments and digital networks (Baltes et al., 2002). CMC media include e-mail, voice-mail and video conferencing over digital networks. These media have come to be known as the *new media* as opposed to the *traditional* media of face-to-face meetings, telephone and text based documents. There has been much research exploring the use of the new media attempting to develop theoretical approaches for explaining media choice and usage in organisational contexts where available media for communication has now been complemented by the new media. However, there has been little work done to investigate how CMC systems can be used as effectively as conventional face-to-face meetings to enhance group performance. This issue must be addressed as CMC is emerging as the preferred medium to facilitate virtual workgroups.

The aim of this chapter is to address this gap by giving a synopsis of previous work and presenting a framework based upon a shared social construction in an attempt to advance our understanding regarding the effective use of CMC within organisations. The structure of the chapter is as follows: firstly an overview of the theoretical perspectives that have been developed is presented, emphasising the key issues of the effective use of CMC; secondly a dialogue technique framework proposed by Huang et al. (1998b) is presented, describing how dialogue technology may be adopted to help organisational members work effectively in mediated environments; thirdly, a model is presented that integrates the dialogue technique into a process of developing a shared social construction in collaborative work environments, which may

increase effectiveness. The chapter closes with a discussion of the implications of the model, and some final conclusions are drawn.

Background

CMC systems use computers to structure, manage and process information, images and electronic resources across telecommunications networks to facilitate their exchange. Characteristics of these systems that have implications for organisational communication include the following (adopted from Rice & Shook, 1988):

- 1) **Asynchronicity** – users do not have to be on the system simultaneously in order to send or receive messages. This removes the constraint of temporality inherent in face-to-face or telephone communication.
- 2) **Synchronicity** – video conferencing allows for the digital transmission of images, voice and the sharing of electronic resources managing data and documents in an integrated environment. This environment allows for the simulation of face-to-face meetings, removing the constraint of geographical proximity.
- 3) **Feedback** – users may interact as quickly as they wish to clarify points or requests for further information. This removes the time lags inherent in memos and letters.
- 4) **Electronic transmission and storage of information** – messages documents, images and other resources can be accessed wherever a user has access to a terminal. This removes the constraint of geographic proximity inherent in face-to-face communication, and the constraint of point-to-point communication inherent in letters and memos.
- 5) **Structuring of communication** – users may use the capabilities of a computer to structure their communication. For example, using pre-established distribution lists removes the constraint of having to send separate letters or make separate phone calls to transmit the same message to many people. Users also have greater abilities to index and retrieve messages, documents, images and other resources.
- 6) **Connectivity** – users typically can contact other users on the system without having to know them in advance, or, by using keywords for

interest areas or distribution lists, without knowing the person exists. This also increases the potential value of the interaction because users become sources of information value themselves, and the value of the communication component rises exponentially with the number of users.

- 7) **Integration** – users have access to multiple applications and technologies without learning multiple interfaces, and can transform information from one medium to another. This removes the constraint that multiple organisational media impose on the sequential transmission or formatting of communication.

Through these characteristics CMC systems have been shown to reduce delays in information exchange, improve maintenance of records and information received, increase coordination of geographic dispersed groups, and improve users' capabilities to process large amounts of information (Baltes et al., 2002; Kettinger & Grover, 1997; King & Xia, 1997). As these new media generally are asynchronous and involve text and audio modes, they tend to be characterised by a relatively lower information carrying capacity relative to face-to-face.

The effectiveness or suitability of these new media, as compared to traditional media, for various communication activities, is still debatable and yet to be resolved by research. It is still not well understood how these new media are integrated into users' communication behaviour or which traditional media are displaced by the new media within the users' task environments. To answer these questions there has been research in the many dimensions of CMC usage that emerge from the above characteristics. These dimensions include: changing perceptions of communication media (Schement & Stout, 1989); the technical and social characteristics of the new media (Huang & Wei, 2000); the human conceptualisation of the underlying properties, roles and functions of the new media (Katz & Rice, 2002); the perceived characteristics of the new media (Culnan & Markus, 1987; Short et al., 1976; Trevino et al., 1990)); the effect of context and social influence on the adoption and usage of the new media (Carlson & Zmud, 1999; Rice et al., 1998); and structuration examining the adoption and development of new organisational structures and technologies in the domain of communication technologies (Rice & Gattiker, 2001). An emerging dimension of research in CMC is the effectiveness of teams using CMC technologies as the medium for all communication and collaboration of virtual teams. A virtual team is a "group of people who collaborate closely even though they are separated by space, time, and organisational barriers" (Lipnacek & Stamps, 1997). Group members work on a specific high-level task or goal;

they may work at the same time but at different locations; or they may even work over different time zones and different locations due to geographic and time zone differences. CMC systems are used widely to facilitate virtual teams to communicate and exchange knowledge and information to achieve the team goal. The effectiveness of CMC in supporting the collaboration and successful outcomes of virtual teams is the focus of this chapter.

In addressing the seminal issue of the information carrying capacity of the new media, Daft and Lengel (1984) proposed Media Richness Theory (MRT), which hypothesises on the information carrying capacity of the new media. Richness is defined as the potential information carrying capacity of data. Daft and Lengel proposed that communication media vary in the richness of information processed. This is illustrated through a continuum of media and their level of richness illustrated below:

<u>Information Medium</u>	<u>Information Richness</u>
face-to-face	highest
telephone	high
written, personal (letters, memos)	moderate
written, formal (bulletins, documents)	low
numeric formal (computer format)	lowest

The explanation of this hierarchy of media richness lies in the manner in which media differs in its capability to:

- **Provide Feedback:** the capability of participants to ask questions, make corrections
- **Support Multiple Cues:** the capability for participants to add meaning to what is said by using multiple cues, that is, body language, voice, tones
- **Language Variety:** flexibility offered by a medium in using words to increase understanding

- **Personal Focus:** the extent to which participants can show their feelings.

Face-to-face is the richest form of information processing because it provides immediate feedback. With feedback, understanding can be checked and interpretations corrected as well as allowing simultaneous observation of multiple cues, including body language, facial expression and tone of voice, which convey information beyond the spoken message. The telephone medium is somewhat less rich than face-to-face. Feedback capability is fast, but visual cues are not available. Participants must rely on language content and audio cues to reach understanding. Written communication is less rich. Feedback is low. Only the information that is written down is conveyed so visual cues are limited to those that are on paper. Formal numeric documents are lowest in information richness. An example would be quantitative reports. Numbers do not have the information carrying capacity of natural language. Quantitative reports provide no opportunity for visual observation, feedback or personalisation.

The literature on media richness theory demonstrates that support for media richness propositions is often mixed at best, especially when new media such as voice and electronic mail are concerned. Part of these inconsistent results may be due to inherent problems with judges' ratings of task equivocality or user ratings of media's richness. Other reasons may be due to poor understanding of individual, positional and organisational differences in media choice.

These inconsistencies of research findings in the literature, however, have encouraged a reconsideration of the descriptive and predictive validity of MRT, especially for CMC systems. Some researchers (e.g., Fulk et al., 1990; Huang et al., 1996) contend that media richness is not a fixed feature of a medium, but could be changed by shared social constructions, which refers to an object that is, at least in part, socially constructed and subjectively generated, as defined by Huang et al. (1996). To choose and use CMC systems effectively for improving group performance, the key issue is thus how to develop a shared basis for communicators before they work together as a team to engage in task based activities and frequent communication. This proposition is supported by the findings of recent research into the use of CMC by computer-mediated groups. The effectiveness of computer-mediated teams has been found to improve where: the teams had a shared history (Alge et al., 2003); when training in developing media use and communication-related issues took place (Lurey & Raisinghani, 2001); teams had the ability to build

personal relationships in the mediated environment (Pauleen & Yoong, 2001); and the media allowed the team to adapt their behaviour to match the nature of the task and other constraints (Majchrzak et al., 2000; Manevski & Chudoba, 2000). The next section of the chapter proposes a technique for expanding the information carrying capacity for CMC media used by virtual teams.

Dialogue Technique

Based on the mental model discipline (Senge, 1992) and dialogue theory (Bohm, 1990), Huang et al (1998b) proposed a dialogue theory-based technique to help organisational groups build a shared basis for effective communication. The main premise of this technique is that through dialogue, group members could build a common mental model that facilitates shared understanding (Huang et al., 1998b). This model serves as a group norm to guide future interaction and activities of the group.

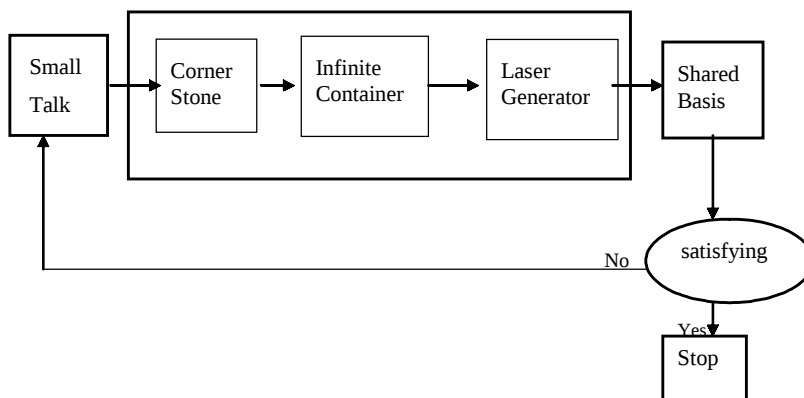
Effectiveness of group work depends on valid communication across group members (Schein, 1995). Mental models encompass the ingrained frames of reference, generalisations, and images that reflect human understanding of the world (Tan et al., 2000). Differences in mental models among group members can cause vastly different tacit decision rules, such as different perceptions of communication media, inability of group members to understand each other, disagreements during group work, and poor group work outcomes. If a group mental model can be established, shared understanding of group members is possible. The more a group has achieved this, the easier it is for the group to reach a collective decision, and the more likely the decision will be implemented in the way the group wants (Isaacs, 1993). Dialogue theory offers suggestions on how group mental models can be developed. Dialogue is a basic process for building common understanding and it is at the root of all effective group actions (Schein, 1995). Through dialogue, group members will be able to determine whether or not the communication is valid and will be able to build sufficient common ground and mutual trust for future effective interaction.

This proposed dialogue technique, illustrated in Figure 1, comprises five stages: small talk, corner_stone, infinite container, laser generation, and satisfying.

- **Small Talk:** At the small talk stage, group members introduce each other and conduct an informal conversation with the purpose of providing an open conversation environment for further communication.
- **Corner_Stone:** Members have a dialogue defining and generating shared goals for communication.
- **Infinite Container:** Members share their ideas about “effective communication practices” based on their past experience with their group members. They are allowed to clarify any questions raised. But criticisms and defensive behaviours are not permitted. Every member will contribute to this container regarding effective communication practices. As part of the infinite container process a dialogue facilitator may intervene, when necessary, to clarify or elucidate communication issues using concepts and examples illustrating communication issues.
- **Laser Generation:** At this stage, group members develop their group communication mental model by ranking the characteristics of effective communication practices, discussed earlier in the infinite container stage, that are most important to the attainment of shared goals.
- **Satisfying:** The validity of the extent to which the model reflects the values and perceptions of all the team members will be assessed by an evaluation instrument measuring the members’ satisfaction with the shared mental model. If members are not satisfied the dialogue process will be repeated until all members are satisfied.

This process should result in a shared mental model for the team’s communication behaviour, which will guide the team’s communication in the future.

Figure 1. Dialogue Framework.



We propose that the dialogue technique can be used to support teams using CMC to develop shared mental models which would map agreed, effective communication behaviour for the team in the mediated environment. The dialogue would also contribute to the team developing effective personal relationships, a past and future perspective.

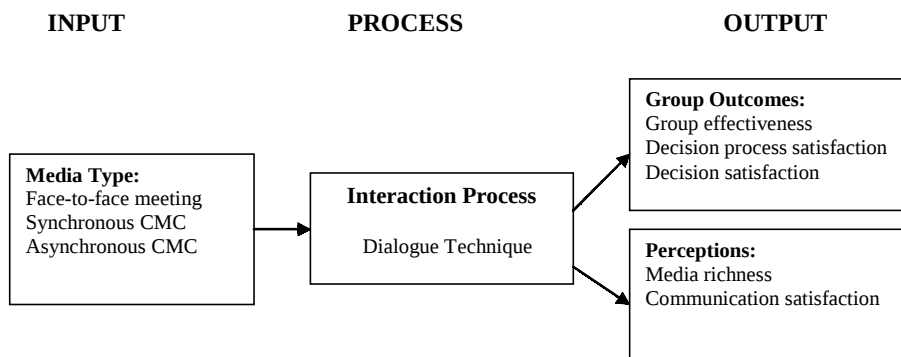
Clearly the process outlined above requires much investigation to determine if the proposed benefits from the dialogue process are in fact delivered. The next section outlines how such an evaluation may be conducted.

Evaluation of the Dialogue Approach

To examine the above approach, an input-process-output model of group interaction may be adopted. Figure 2 illustrates the relationships between the media, the dialogue process and the group outcomes.

- **Media Type:** The input variable. Media type maybe an asynchronous medium such as e-mail or a synchronous medium such as video conferencing.
- **Interaction Process:** Members of the team present to the dialogue process with past communication experience. This experience may be within the context of the medium to be used or it may not. Members will share their past experience and learn from the past experience of others. Through this process of sharing and learning the shared mental model of effective communication will be developed and accepted.

Figure 2. Group Interaction.



- **Output:** The effectiveness of the shared mental model can be assessed by measuring group members' perception of attributes of the media used and outcomes of the group's tasks. This can include group effectiveness, satisfaction with decision processes that may have been adopted and overall satisfaction with the decision. These dependent variables are believed to be critical for understanding and predicting the use and usefulness of CMC in organisational settings (Baltes et al., 2002).

Prior research has demonstrated that when communicators possess shared experiences or social constructions, a lean medium, such as synchronous CMC or asynchronous CMC, can be used as effectively as face-to-face meetings for rich information, which could enhance work performance for solving a complicated equivocal problem (Dennis & Kinney, 1998; Huang et al., 1998a). Huang et al. (1998b) propose explicitly the dimensions of teams and teamwork that can be enhanced by a shared basis. These dimensions include trust, cohesion, conflict, and decision process satisfaction, decision satisfaction and decision quality in a virtual environment. These dimensions can be used to direct the dialogue process (and training process), thereby facilitating communication behaviour that directly addresses the critical success factors of effective teamwork in virtual environments.

Future Trends

The adoption of CMC in the developed world has reached saturation. However, organisations adopting new CMC technologies have not given careful consideration to the effective use of these communication technologies (Baltes et al., 2002). Users will have increasing access to CMC, both asynchronous and synchronous. With this increase in access there must be support from within organisations for training users on the effects of the new media and how the new media can be used effectively. Training will have to be provided to develop an understanding of communication behaviour, communication tasks and the match between the medium and the communication task. Organisations must develop an understanding of the attributes of the new media and how these attributes may or may not "match" organisational needs and tasks. The dialogue process proposed here is one technique that may be used

for organisations to learn and understand communication behaviour and thereby use CMC more effectively.

Implications and Conclusion

In this chapter, we have recognised the need to fill the gap that exists in the theoretical approaches explaining media choice. We have proposed that as long as a shared social construction can be developed among group members, CMC systems may be used as effectively as the traditional face-to-face medium for virtual teams' interactions. We have applied the dialogue technique to develop our model, which can also be used to evaluate the use of CMC in organisational contexts. The dialogue technique can be adopted to assist group members to develop a shared group norm for further effective communication, which is the key for virtual teams to achieve their goals.

This chapter has described a mechanism through which CMC systems may be applied effectively within virtual teams that are task based and use CMC as the primary communication medium. One of the reasons why virtual teams have not been as productive as expected is that teams do not develop a shared basis for collaborative processes before they work together to perform various tasks. The model presented in this chapter provides some guidance for organisations regarding CMC adoption and diffusion, as well as group decision-making performance via CMC systems. It is widely recognised that CMC systems significantly alter communication processes and outcomes in organisations. The framework presented by this research can provide a better understanding of CMC systems on organisational communication processes and group outcomes in order to increase the benefits derived from their use.

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Chapter XIV

Change and Challenge: Managing the E-Business Organization

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Abstract

In addition to changing the ways organizations do business, the adoption of e-business forces significant changes to the organizations themselves—in culture, structure, and in what needs to be managed and how it is managed. This chapter describes characteristics of e-business that impact organizational management, focuses on four major ways in which organizational management is impacted, and offers some major guidelines for success in managing in an e-business environment. Understanding the challenges and adopting new management styles and techniques are critical success factors for the netcentric organization.

Introduction

E-business is a major disruptive force for organizations. In addition to changing the competitive landscape and introducing new ways of doing business, new products, and new ways to deliver them, the extensive and rapid deployment of e-business has caused significant changes to organizations. Net-centric organizations—those which conduct significant business on internal and external digital networks—are finding that business-to-consumer, business-to-business, and other applications and business models are converging to form the e-enterprise, in which the entire value chain, from procurement to customer service, is fully digitally integrated. Adoption of e-business thus forces many organizational changes that provide new and complex challenges for leaders and managers engaged in electronic business.

Technological, economic, and societal factors have contributed to create the modern netcentric organization. This type of organization is one that not only uses, but also clearly exploits, digitized data and the automated processes that use them effectively and efficiently. The netcentric organization uses networks to share content (data) and process within the organization and without—to customers, suppliers, and sometimes even competitors (such as with electronic markets).

The technical capabilities of the Internet, combined with intranets and extranets, enable new ways to communicate and exchange information at any time, in any place, in a variety of ways. The rapid and continuing decline in technology costs relative to productivity encourages the adoption of these technologies. Economic pressures that support the creation of network-based organizations include the development of the global economy, a competitive environment that demands better-faster-cheaper products and processes, business-to-business alliances, the fast pace of market change, and the increased power of consumers. Societal pressures include changes in the expectations of consumers and workers—for example, in the amount and types of information expected about commercial goods and commercial and government services. More and more, consumers expect 24-7 service levels accessible via the Internet. As the technology matures, mobile commerce will surely become an expectation as well.

The extent to which organizations are impacted by e-business is, of course, a function of how thoroughly and how rapidly they adopt netcentric business practices. A company that uses the Internet merely for posting an online catalog

(an early, first-stage implementation of e-commerce) is not as extensively impacted as the organization that participates in enterprise-wide inter-organizational e-business. Companies that are culturally open to change and that have leaders who understand the capabilities and benefits of digital, information-based processes will be affected most.

This chapter describes the general characteristics of e-business that force fundamental change to organizational management. It focuses on four significant dimensions of the impact of e-business on managing organizations: how organizations manage and control processes and projects; organizational design; technology transfer management; and changes to the nature of work—what workers do and how, where and when they work. It also offers some guidelines for successfully managing the e-business organization as a response to these forces.

Background

A definition of e-business, as used here, is necessary, particularly in regards to differentiation from e-commerce. There is certainly debate among information technologists and academics about the meaning and coverage of the terms *e-business* and *e-commerce*. Rayport and Jaworski (2000) argue that e-commerce encompasses the entire set of electronically based organizational activities, including the information systems infrastructure. Kalakota and Robinson (2001), on the other hand, use *e-business* as the more inclusive term, and posit e-commerce as a precursor, developmentally, in an organization's progression to e-business. Laudon and Traver (2001) suggest that e-commerce primarily involves transactions that cross firm boundaries, while e-business concerns use of digital technologies for processes within the firm—thus viewing the concepts as mostly exclusive with some overlap.

For this discussion a broad view of e-business is adopted, one that encompasses e-commerce and includes all digitally based transactions, processes, and communication, both internally and externally directed, that support the organization. Organizations that fully embrace e-business are netcentric. That is, they conduct significant business on intranets, extranets, the Internet, and other networks of various protocols and technologies. Under this definition, in addition to Internet protocol technologies and online commerce, e-business technologies include collaborative software, electronic data interchange (EDI),

enterprise-wide databases, real time information exchange, enterprise applications (such as supply chain management and customer relationship management), mobile commerce and more.

Historically, technology has been an enabler of business transformation, and e-business technologies are certainly no exception. The concept of information technology as a disruptive force within organizations is one that was developed at least a decade ago and incorporated into basic concepts of re-engineering (Champy, 2001).

As a set of technologies, e-business is arguably the most disruptive force in organizations in many decades. At the core of the impact of e-business is its capability to “collapse” time and space, allowing organizations to dissolve boundaries to better-faster-cheaper commerce (Ashkenas, Ulrich, Jick & Kerr, 1995). The Internet, for example, reduces or eliminates time boundaries by enabling fast (instantaneous or simultaneous) communication and sharing of information. E-business technologies lessen geographic boundaries that physically separate employees and organizations from one another and from their customers. Network based collaborative software, for example, allows for synchronous or asynchronous communication and effective team building across boundaries. For example, workers can use search engines and intelligent agents (“bots”) to scour global resources for the latest news, research, and other information to support organizational objectives. Another example is the use of streaming video, which has the capability of delivering complex, content-rich information in real time mode whenever the viewer is ready.

Operating within an e-business paradigm is also disruptive in regards to the balance of power between companies and their customers. Fingar, Kumar and Sharma (2000, p. 24) suggest that because of the access to information, the Internet “turns the producer-consumer relationship upside down, with the balance of power going to the customer”. This is very different from earlier business paradigms in which information is tightly controlled by companies.

Some primary characteristics of e-business that contribute to its being a disruptive force in the management of organizations include:

- Ubiquity. Traditional, non-electronic business is limited by place. The e-marketspace is available to consumers nearly everywhere at times and in locations convenient to them. Organizations must change structure and management approach to support this.

- **Reach.** Most traditional commerce is local or regional, concentrated in geographically accessible merchants. E-business encompasses potentially global reach and introduces management and control challenges that span geographic barriers.
- **Richness.** This refers to complexity and content of a message or product. In traditional commerce there is a tradeoff between richness and reach—in order to provide rich content a seller needed to be face-to-face with a customer. Through online business and mass customization of digital content, e-business can dispel that tradeoff.
- **Interactivity.** E-business technologies support easy, two-way synchronous or asynchronous communication among workers, between the organization and its customers and suppliers, and between organizations.
- **Information transparency.** This refers to the ease, efficiency and effectiveness of information collection, distribution, and exchange that surround the netcentric organization.

These disruptive forces fundamentally alter the competitive environment in which organizations operate and forces them to change in order to compete successfully and, in the long run, to survive.

Challenges in Managing for E-Business

Management: Structure, Control, and Planning

One major impact on the organization is on how they manage and control processes, relationships and projects. The fundamental challenge to management is the need to implement the processes and infrastructure that support *information* management, in addition to the traditional product management paradigm. The introduction of disruptive e-business technologies cannot help but significantly (and appropriately) impact the organization's management structure and management procedures, style, and techniques.

Through the deployment of networks, information quality and richness has improved, and its facile and rapid movement throughout the organization has been greatly enhanced. Information transparency can provide lower-level

workers the information they need to make decisions with less direction and screening from upper management. Thus managers and workers who previously merely served as conduits of information can be bypassed, and eventually eliminated. This facility of knowledge transfer tends toward less structural formality, decentralization of decision authority and a greater reliance on skills (Wang, 1997). It therefore promotes a flatter managerial hierarchy because employees have greater independence and managers can effectively have a wider span of control.

Although managers have always worked on good relationship management, automated enterprise systems such as customer relationship management (CRM) and supply chain management (SCM) significantly change the way in which relationships with customers and suppliers must be managed. Because these systems can deliver significant value to the organization, they demand significant attention and management resources. Inter-organizational relationships are a significant aspect of e-business, but managing interfaces in these systems and networks is particularly challenging. Businesses are extending their internal processes and strategies into inter-organizational space in order to gain benefits, such as cost reduction, and there is a growing reliance on inter-organizational learning to improve performance (Scott, 2000). These extensions introduce an additional level of complexity. SCM systems, for example, contribute value through the sharing of data and processes, but require a high level of trust among participants (Hoffman, Novak & Peralta, 1999).

Project management is also more complex in a highly competitive netcentric e-commerce environment that demands better-faster-cheaper products and processes developed and implemented via lightning-quick schedules. Yourdon (2000) suggests that newer flexible, rapid development approaches to project management are necessary for e-business projects. In this kind of emergent, unformed, somewhat chaotic environment, a traditional approach to using an optimal methodology, one that is predictable, tested, and proven, has no application, and managers need to adapt accordingly.

In planning for e-business, organizations need to carefully evaluate their own current capabilities and identify new capabilities needed. In the rapidly changing digital environment, traditional top-down planning is often viewed as too cumbersome and inflexible (Kalakota, 2001). Because of this, the insights of front-line employees have increased in significance and tend to support a more bottom-up strategy (Wang, 1997). Unfortunately, the “just do it” approach, which de-emphasizes planning and delivers products more quickly, also has a

high level of risk. Arguably, dissatisfaction with early implementations of e-commerce applications was a result, to a significant extent, of poor planning and design.

Managing the Transition: Technology Transfer

A second major impact for organizational management caused by the adoption of e-business is in technology transfer management. Although organizations have always been concerned about change management, the introduction of e-business significantly affects the breadth, depth, and pace of change. In order to be successful, organizations that choose to participate fully in e-business must undertake major changes that include adopting new technologies, changing existing business processes, and transitioning workers to new roles and skills. A major concern of corporate leaders and managers is how to effectively, efficiently, and quickly transform an organization from an older business design and model to one that is competitive and fully operational in the digital business world. These leaders and managers must function as fully informed change agents, anticipating the need for transformation and carefully guiding the organization through planning and implementation of all the facets of new business paradigms. The transformation may be gradual or quick, narrowly or widely focused, involve only internal components or extensively involve customers, suppliers and other external entities. Major characteristics and processes for successfully managing the transition include vision, process re-engineering, and architecture redesign knowledge and skills.

Technological innovations by themselves introduce new learning challenges for managers. Organizational leaders need to understand new ways to compete effectively (Porter, 2001). E-business infrastructure is complex, requires high levels of consistency and reliability, and often is globally implemented. For example, technical managers must acquire new skill sets for rapid development and implementation. They need to understand the capabilities and limitations of new technologies and develop strategies for integration into existing processes and systems. Managers in netcentric organizations are often faced with new transnational legal, cultural, and social issues due to the implementation of new technologies and processes globally.

Organizational Re-Design

A third major way that management is impacted is in organizational design. Information technology (IT), in general, has long been a source of consideration regarding its impact on organizational design (see, for example, Malone & Rockart, 1993). Lau et al. (2001) argue that design and culture are the two most significant ways in which IT impacts the organization. Lucas and Baroudi (1994) provide a strong view of e-business technologies as agents for organizational change, particularly for new organizational forms such as virtual organizations, negotiated organizations, and vertically integrated conglomerates.

Organizational design is directly impacted by the ubiquity and transparency of information in the netcentric organization. As noted previously, these forces tend toward supporting a flatter organization. Another force for organizations redesigning themselves is alliance building for e-commerce, something even small companies can use effectively. Because of the facility of communication and the lowering of coordination costs, companies can more easily exchange information as a resource and as a commodity. The result is increased value-added partnering, such as for SCM systems (Hitt & Brynjolfsson, 1997). The fully developed e-enterprise includes organizations in the same and other industries that work together through complex processes that bring together customers, suppliers, distributors, and others. This leads to an interesting phenomenon and management challenge—the cooperation of competitors, for example in establishing industry exchanges that facilitate purchasing.

Still another significant way organizations change their structure for e-business is via globalization, which is enabled by telecommunications networks and is a feature of advanced e-business adaptation. At the simplest level of implementation, companies can adopt e-business with little change to structure. However, as organizations begin to fully exploit the e-business capabilities that reduce or eliminate space and time barriers to commerce, they need to adopt structures that support a global IT infrastructure. Consultant Robert Heller (2001) argues that no matter how well a CIO wires a global enterprise, a top-down inflexible management structure will keep it slow and inefficient.

The ease and low cost of communication via the Internet has also facilitated further growth in outsourcing (Wang, 1997). The virtual organization extends the outsourcing facility to its maximum capability (Donlon, 1997). As an example, application service providers sell access to Internet based software

applications. Organizations that contract for these services can reduce costs and eliminate the difficulties of developing and maintaining complex systems, particularly those systems that are fundamentally operational and do not deliver competitive advantage. Organizations that adopt significant levels of outsourcing require different organizational structure than those that do not (Lucas & Baroudi, 1994).

Organizational Impact: Work and Workers

A fourth significant way in which the management of organizations is impacted by e-business adoption is in the change in the way people work. Efficient and effective communications, access to a wealth of various types of information, and the automation of processes inevitably lead to work redesign and an increase in “virtual” (i.e., netcentric, paperless) work. In fact, to fully exploit the capabilities of these technologies and processes, an organization must redesign what tasks workers perform, where and when they perform them, who does the work, and what kinds of skills are needed.

Some tasks are best done by people, but many others within the e-commerce realm can be effectively done by computers. As more and more organizations adopt e-commerce and its functionality expands, more and more processes will be automated. Disintermediation efforts that eliminate the “middle man” and allow customers direct access to information (for example, the replacement of telephone order clerks with Web-based ordering) replace workers who once performed basic sales and customer service tasks with higher-level knowledge workers who need to be capable of collecting, analyzing, and integrating information (Kalakota & Robinsin, 2001). They handle the more complex transactions and queries that require integrated skills and that cannot be easily automated.

Where and when people work is also changing. Network based work is information and knowledge intensive and is less tied to restrictive time and place parameters (Hitt & Brynolfsson, 1997). Although the wireless data communication industry has had a rocky start (Dunne, 2001), mobile e-business retains the potential to deliver real time information to remote locations and to enable many types of commercial transactions that can be executed outside the traditional work environment and work hours, thus supporting a more mobile work force. Web-enabled personal devices will greatly extend functionality and mobility and virtual private networks will provide the flexibility and security

workers need. Organizations will more frequently face the challenges of managing, evaluating, and rewarding virtual workers who are globally dispersed.

As noted earlier, the changing communication patterns of workers lead to a flatter organizational structure. They can also lead to more collaborative work (Rudnick, 1996). Cross-functional integration, inter-organizational and intra-organizational structures are common components of e-commerce that are facilitated by collaborative technologies. Task oriented work teams are not limited by geographic proximity. Virtual communities, uniting managers, workers and professionals within and across organizations, and even across industries, can be more easily developed and maintained for supporting knowledge sharing and learning (Lau, 2001).

From the worker's point of view, there are several major negatives for workers. One is the worker stress that is an inevitable result of extending the work into leisure time and into homes and cars and other traditionally non-work spaces. The fast pace of change, the need to adopt new skills quickly, and independence in knowledge work are also stress factors. Another concern to workers is the ease with which processes can be outsourced. Once an infrastructure for virtual work is established, work can be accomplished abroad as easily as it can be done domestically. While easier access to less costly human resources is a financial benefit to companies, "electronic immigration" can result in job losses.

Changes in what people do, the kinds of skills needed, where and when they work, outsourcing, and the increased stress of omni-present work all present special challenges to managers.

Managing E-Business: A "Systems" Approach

Because of its potential extensive impact on the core parameters for managing an organization, leaders and managers should approach e-business from a "systems" perspective. E-business is not just about changing business processes and the way products are developed, marketed and distributed. A systems perspective will approach the adoption of e-business as a systemic change, affecting multiple aspects of an organization's components and con-

stituents. It is too easy a mistake for managers to see e-business as an “external” objective entity that is about what to manage, instead of one that directly affects *how* to manage. Managers who recognize the significant expected impact will be better prepared for changing the way that people are managed, changing the structures that support management, supporting employees as they change how, when, and where they work, and enabling an organizational culture that will support effective and successful e-business.

To manage the e-business organization successfully, managers need to do the following:

- Understand the impact of adopting netcentric processes on all aspects of the organization, including structure, culture, workers, relationships, processes, technology, and information collection and dissemination.
- Redesign the organization to successfully exploit e-business capabilities and information value. Allow for more independent workers, collaborative work, and work across traditional time and space barriers.
- Adopt flexible planning and project management techniques that are responsive to the needs and fast pace of change in the competitive digital economy.
- Adopt change management procedures that keep all constituents informed as new processes are developed and implemented.
- Learn to manage geographically distributed customers, suppliers, and knowledge workers.

Conclusion

In a survey of 33,000 organizations, IBM found that 80% were at some stage of e-business adoption (Perna, 2003). Of these, 28% were at a second stage—conducting business transactions for employees, customers and suppliers. As more and more organizations face the challenges of doing e-business at a transactional level, managers will need to understand the extensive impact on many of the systems, components and constituents that comprise the modern enterprise and change how they manage organizations. Understanding the challenges and adopting new management styles and techniques are critical success factors for the netcentric organization in the coming decade.

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Section V

Case Studies of Human and Organizational Issues Regarding IT Adoption and Use

Chapter XV

Data Quality and Work Alignment: Do IT Professionals Think Differently?

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Abstract

Organisational decision-makers have experienced the adverse effects of decisions based on information of inferior quality. Millions of dollars have been spent on information systems to improve data quality (DQ)¹ as well as the skills and capacity of IT professionals. It is an important issue that the IT professionals align their work within the expectation of the organisation's vision. This chapter provides some theoretical background to DQ and establishes a link between DQ, performance-importance analysis and work alignment. Four case studies are presented to support the theory developed in this chapter and to answer the question as to whether the IT professionals consider DQ issues differently from other information users.

Introduction

There is one thing we can all agree on when it comes to discussing the recent advances in information technology (IT). IT has dramatically changed the way in which business operates. The Internet, for instance, brings with it ubiquitous connectivity, real-time access to information and allows the organisation to communicate instantly with customers, suppliers and partners (El Sawy, 2001). More and more electronically captured information needs to be processed, stored, and distributed through IT-based business systems. Information is shared amongst various decision makers within organisations and between supply chain partners not only to benchmark, amend or formulate competitive strategies but also to control day-to-day operations and to solve problems on a real-time basis (Al-Hakim, 2003a).

On the other hand, IT advances can create problems rather than benefiting the organisation, if data quality (DQ) issues have not been properly addressed. Although software bugs and facility catastrophe are likely to be widely reported, by far the most common source of business failure is data quality (Laudon & Laudon, 2002). Firms become so critically dependent on information that DQ problems must be identified and treated as urgently as possible.

There is strong evidence to suggest that DQ has become a critical concern of organisations (Lee et al., 2002; Redman, 1998; Wand & Wang, 1996). The growth of data warehouses, communication and information technologies have increased the need for, and awareness of, high DQ in organisations (Lee et al., 2002). DQ has been rated as a top concern to data consumers (Wang, 1996) and reported as one of six categories commonly employed in management information systems research (Delone & McLean, 1992).

Zero defects in information systems of any complexity cannot be achieved and there are technological barriers to perfect information systems. According to Huang et al. (1999) most chief executive officers (CEOs) have experienced the adverse effects of decisions based on information of inferior quality. At the same time, most chief information officers have experienced the discomfort of explaining why, in light of the costly investment made by the company in information technology, these data are of inferior quality.

Many firms strive to satisfy the organisational need for DQ. "All too often, however, DQ is not delivered or is not accessible to the user. *This does not have to be so*" (Huang et al., 1999, p. 9).

Strong et al. (1997) identify three roles for people working within information systems:

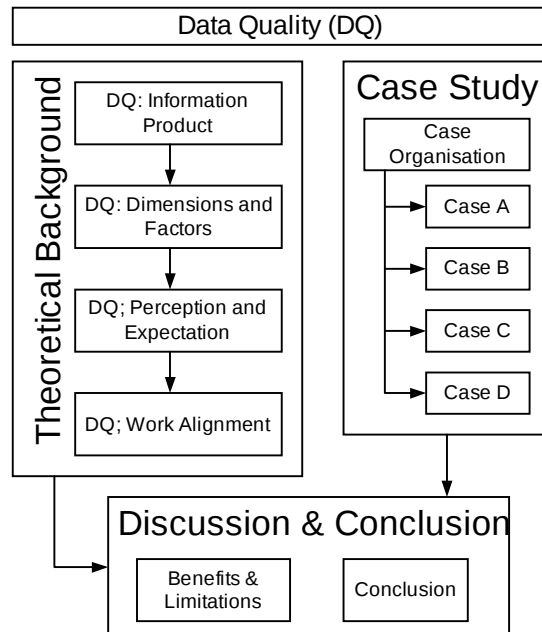
1. *Information producers* are those who create or collect data;
2. *Information custodians* are those who design, develop and maintain the data and information systems; and
3. *Information consumers* are those who use the information.

Wang (1998) finds an analogy between quality issues in product manufacturing and those in information manufacturing and asserts that information manufacturing can be viewed as a processing system acting on raw data to produce information products. Based on the work of Wang (1998), Huang et al. (1999) add another role for the people working within information systems, that is, information product managers. Information product managers are those who are responsible for managing the entire information product processes. Information custodians and information product managers could be seen as “IT professionals”.

IT professionals, information producers and information consumers are all data users but with different degrees of complexity and scope. The people working within the information system in an organisation can be seen as a customer-supplier information network in which every employee has internal customers who receive information from suppliers within the organisation. The IT professionals may be considered as information suppliers to the information consumers, who are the ultimate users of information. The question raised by this research is whether the IT professionals think differently from others, that is, from the information consumers. A gap in the thinking could disclose an important dimension affecting DQ in organisations.

This chapter is organised into two parts. The first part provides some theoretical background to DQ and its relation to work alignment. This first part comprises four sections. The first section emphasises the correlation between DQ and quality management for products and considers information as an intangible product. The second section explores the dimensions of DQ and factors affecting DQ. The third section investigates the relationship between the information user's expectation from each factor and the user's perception of the factor's performance. The fourth section establishes a link between performance-importance analysis and work alignment, and constructs several formulas for determining DQ alignment.

Figure 1. Outline Structure of the Chapter.



The second part of this chapter presents four case studies. The theory of DQ alignment developed in the first part is used to show whether IT professionals think differently from other information users. The last section of this chapter discusses the limitations and benefits of this study and draws conclusions from the case studies. Figure 1 illustrates the structure of the chapter.

Part 1: Theoretical Background

DQ: Information Product

Forza (1995a) suggests that new production models (world-class manufacturing and lean manufacturing, etc.) have not clarified the role of information systems in quality management. Forza (1995b) concludes that links between suppliers and customers in term of quality practices and information flows strongly influence achievement of quality performance. Wang (1998) takes a

step beyond the work of Forza and finds an analogy between quality issues in product manufacturing and those in information manufacturing and asserts that information manufacturing can be viewed as a processing system acting on raw data to produce information products. He urges organisations to manage information as they manage products if they want to increase productivity. Meade and Sarkis (1999) emphasise that, in an agile environment, skills, knowledge and information are no longer enough for achieving or enhancing competitiveness without the ability to convert the knowledge, skill and information into products. “Ability to convert” is what companies are really relying on to achieve customer satisfaction (Al-Hakim, 2003a). Clearly, there are also some differences between product manufacturing and information manufacturing. For instance, the raw materials used in information manufacturing are data, which can be consumed by more than one consumer without depletion, not like raw materials in product manufacturing that can only be used for single physical products. However, such difference will not affect the analogy proposed by Wang (1998).

The analogy between products and information (Wang, 1998, 1999) and the strong relation between information flows, quality practices and quality performance (Forza, 1995a, 1995b) establish a strong correlation between DQ and quality management for physical product and service. An information product has quality dimensions that can be measured, analysed and improved. However, DQ is different from the quality management of a manufacturing system since the users of the end product are undefined in the former, whereas they are clearly defined in the latter (Sen, 2001).

Information quality or DQ can be viewed by information consumers from various perspectives; as “fitness for intended use,” “conformance to specifications” or as “meeting or exceeding customer expectations”. Sen (2001) emphasises the importance of applying total quality management (TQM) to the production of information. Sen argues that the zero defects goal of TQM becomes particularly relevant to data and information producing entities to avoid undesired consequences. Based on the principles of TQM, Wang (1998) and Huang et al. (1999) address total data management quality (TDQM). Further, Wang et al. (2003) emphasise the criticality of having tools and techniques to manage the life cycle of the information product and stress the importance of developing a mechanism for producing the *Information Product Map* (IPMap), just like a blueprint for an assembly line that produces a physical product. Further, Lee et al. (2002) develop a methodology for DQ assessment and benchmarking considering DQ dimensions that covers aspects of DQ that are important to information consumers.

The explosion of the Internet offers new challenges for marketing. Since the birth of World Wide Web (WWW) in 1993, companies are rushing to the Web to enhance their competitiveness. Web-based customer service provides a close connection between customers and companies, between companies, and among the customers themselves (Kiani, 1998; Li et al., 2003). The traditional emphasis on the physical facilities, equipment, personnel appearance, and other tangibles does not seem important due to the absence of physical and face-to-face interaction (Rohan, 1998). DQ, on the other hand, plays an important role in the evaluation of Web-based service quality (Li et al., 2003).

One can conjuncture from the above discussion that factors influencing DQ are the same as those affecting quality management of physical products. However, the strength or influence of each factor may not be same and it is immature to conclude existing similarity in degree of criticality of these factors on DQ and quality management of physical products.

DQ: Dimensions and Factors

Just like quality management of physical products, DQ has multiple dimensions. People view quality in relation to differing criteria based on their individual roles in the production-marketing chain (Evans & Lindsay, 2002). Thus, it is important to understand the various perspectives from which quality is viewed. DQ dimensions refer to issues that are important to information consumers. Strong et al. (1997) group the DQ dimensions into four categories. These categories are contextual DQ, intrinsic DQ, accessibility DQ and representation DQ (Table 1). These categories are widely acceptable in the literature (Lee et al., 2002). However, there are no uniform lists for the DQ dimensions as illustrated in Table 1. The choice of these dimensions is primarily based on intuitive understanding, industrial experience, or literature review (Huang et al., 1999) and depends on the actual use of information. Thus, good information for a specific user in one case may not be sufficient in another case.

The dimensions of DQ are useful in ensuring coverage of the concept of DQ but are not as useful for deciding what to do to improve DQ (Lee et al., 2002). In other words, improving the quality of information comprises factors other than DQ dimensions. DQ has, accordingly, two sets of elements. These are DQ dimensions and DQ factors. To determine factors affecting DQ we need to understand the concept of critical success factors (CSF).

Table 1. Dimensions of DQ.

Category of DQ*#	Implication / Definition*	Selected Literature			
		Delone and McLean (1992)*	Goodhue (1995)	Wang and Strong (1996)*	Strong et al. (1997)#
Intrinsic	Information has quality in its own right.	Accuracy, precision, reliability, freedom from bias.	Accuracy, reliability.	Accuracy, believability, reputation, objectivity.	Believability, accuracy, credibility, consistency, completeness.
Contextual	DQ must be considered within the context of the task.	Importance, relevance, usefulness, content, completeness, currency, sufficiency.	Currency, level of detail.	Value-added, relevance, completeness, timeliness, appropriate amount.	Relevance, value added, timeliness, completeness, and amount of data.
Accessibility	Information is interpretable, easy to understand and manipulate.	Useableness, quantitativity, convenience of access.	Accessibility, assistance, ease of use, location.	Accessibility, ease of operations, security.	Accessibility, system availability, transaction availability, privileges.
Representation	Information is represented concisely and consistently.	Understandability, readability, clarity, format, appearance, conciseness, uniqueness, comparability.	Compatibility, meaning, presentation, lack of confusion	Understandability, interpretability, concise representation, arrangement, readable, reasonable.	Interpretability, syntax, version control, semantics, aliases, origin.

* Adopted from Lee et al. (2002)

Adopted from Turban and Aronson (2001).

The concept of critical success factors (CSF) was first defined by Rochart (1997) as the limited number of identified operational goals shaped by the industry, the firm, the manager, and the broader environment that are believed if they are satisfactory, will ensure successful competitive advantage perfor-

Table 2. Factors Affecting Data Quality.

Factor	Birkett (1986)	Nichols (1987)	Saraph (1989)	Bowen (1993)	Zhu (1995)	Wang (1998)	English (1999)	Laudon (2002)	Kirsh (2002)	Li et al. (2003)	Xu* (2003)
Role of top management			✓		✓	✓	✓				✓
(Data) quality policies & standards						✓					✓
Role of DQ & DQ manager			✓		✓	✓	✓				✓
Training			✓		✓	✓	✓				✓
Organisational structure							✓				✓
Nature of the system			✓								✓
Control & improvement			✓			✓	✓				✓
Employee/ personnel relations			✓		✓						✓
Supplier quality management			✓		✓	✓					✓
Performance evaluation and rewards	✓					✓	✓				✓
Manage change							✓				✓
External factors	✓							✓			✓
Cost/benefit tradeoffs					✓						✓
Internal control (systems, process)		✓							✓		✓
Input control				✓				✓			✓
Self-control/Informal control									✓		
Customer focus						✓					✓
Continuous improvement							✓				✓
DQ audit and reviews								✓			✓
Middle management											✓
Teamwork/clan control									✓		✓
Risk management											✓
Personnel competency											✓
Physical environment											✓
Web designers										✓	
Information service providers										✓	

* See also Xu et al. (2002).

mance for the organisation (Laudon & Laudon, 2002). The CSF approach has become an accepted top-down methodology for corporate strategic planning (Chen, 1999). It can highlight the key requirements of top management (Byers & Blume, 1994). One can conclude from the literature that identifying CSF forms the first step for developing a roadmap for improving performance and hence competitive advantage (Laudon & Laudon, 2002).

There have been many studies of critical success factors in quality management of manufacturing systems such as total quality management (TQM) and just-in-time (JIT). Some of the data quality literature has addressed the critical points and factors for data quality. Table 2 indicates the summary of the literature review identifying factors influencing data quality.

DQ: Perception and Expectation

There have been different conceptual approaches to quality. We do not attempt to debate the relative merits of each approach. Rather, the “customer-driven quality” approach (Evans & Lindsay, 2002) is chosen and used to develop a framework that allows us to analyse DQ from the viewpoint of the customer, making quality a subjective assessment dependent on the satisfaction of information users.

As early as 1973, Power and Dickson (1973) concluded that customer satisfaction is the most critical criterion in measuring computer system success or failure. Bailey and Pearson (1983) argued that user satisfaction is correlated to information system utilisation and system success and pointed out the need for an accepted measure of satisfaction. Bailey and Pearson define user satisfaction as the sum of the user’s weighted reaction to a set of factors as shown in Figure 2.

Figure 2. Customer Satisfaction (Bailey & Pearson, 1983).

$$S_i = \sum R_{ij} W_{ij}$$

Where:

S_i is the satisfaction of individual i ,

R_{ij} is the reaction to factor j of individual i ; and

W_{ij} is the weight of factor j by individual i .

The formula of Bailey and Pearson suggests that satisfaction is the sum of one's positive and negative reaction to a set of weighted factors. Bailey and Pearson suggested a complicated rating method in that the individual's feeling must be placed somewhere between a "most negative" reaction and "most positive" reaction.

Maister (1985) identifies two important elements that constitute customer satisfaction. These are customer expectation and customer perception (Barlow, 2002; Maister, 1985). Maister emphasises that if a customer receives a better service than his or her expectation, he or she will leave happy and satisfied. Maister translated this assertion into a simple formula as shown in Figure 3. Other researchers also support the notion of satisfaction in relation to service quality of information systems as the discrepancy between customers' perceptions and expectations (Parasuraman et al., 1985; Pitt et al., 1995; Watson & Pitt, 1998).

Figure 3. Relationship Between Customer's Satisfaction and His/Her Perception and Expectation (Barlow, 2000; Maister, 1985).

$$\text{Customer's Satisfaction} = \text{Customer's Perception} - \text{Customer's Expectation} \quad (1)$$

From the viewpoint of Evans and Lindsay (2002) a reference to customer needs and expectations is a reflection of the customer's expected quality. Customer-driven quality is about translating expected quality into output during the design, production and delivery processes. Perceived quality, on the other hand, is the customer's perception of the overall quality or superiority of a product or service and, accordingly, drives consumer behaviour (Evans & Lindsay, 2002). Evans and Lindsay emphasise that perceived quality is the area where producers should really centre their concerns. They derived formula 2 of Figure 4 for the actual product quality.

Figure 4. Relationships Between Various Aspects of Quality (Formula 2 was adapted from Evans & Lindsay, 2002).

$$\text{Product Quality} = \text{Perceived Quality} - \text{Expected Quality} \quad (2)$$

$$\text{Data Quality (DQ)} = \text{Perceived DQ} - \text{Expected DQ} \quad (3)$$

Any differences between the perceived quality and expected quality can cause either satisfaction (perceived quality is higher than or equal to expected quality) or dissatisfaction (perceived quality is less than the expected quality).

Considering the analogy between DQ and product quality, formula 2 in Figure 4 is applicable also to information, whether from the satisfaction viewpoint or from DQ perception (formula 3 - Figure 4).

Performance standards for information are difficult to measure, primarily because information manufacturing systems deliver intangible products. Intangible products must be performed at the convenience of the users and managing intangible quality characteristics depends on users' performance and behaviour and is more difficult (Evans & Lindsay, 2002).

Each information user may have different perceptions about an organisation's vision and then about various factors affecting DQ. The expectation from each factor affecting DQ may depend on the user's performance and behaviour. In other words, the organisation's vision may be interpreted by various information users differently. Various interpretation of an organisation's vision represents a potential problem in information flow and then a problem in DQ. Organisations should find a platform that helps various information users to align their interpretation of the organisation's vision with the actual interpretation as perceived by the organisation's executive or CEO. The next section attempts to link DQ and work alignment.

DQ: Work Alignment

It should be noted that the CSF method is clearly biased toward top management because they are the ones (generally the only ones) interviewed in relation to identification of CSFs (Laudon & Laudon, 2002). The question may be

asked as to whether the traditional methodology of barely determining CSF will benefit the organisation.

Kraines (2001) argues that engagement and competence of employees in an organisation may not benefit the organisation without their work alignment. Kraines (2001) states:

“People can be engaged in their work with every fibre of their being, but unless they are aligned, their work will not do the organisation much good. Employees are aligned when they understand the relationship between their activities and goals and those of their organisation, managers, and co-workers — and then act on that.”

Management leadership should develop a clear understanding of the passion and competencies of every individual in their work group and then strive to align that passion and those competencies with the work group contributions (Roepke et al., 2000).

How can work alignment be measured? Indeed, it is difficult to measure the actual performance of the organisation’s stakeholders. The research considers the executives’ interpretation or perception as a scale to measure the work alignment. Our methodology is supported by the new research authored by Kathleen et al. (2003) and published in *Harvard Business Review*. Kathleen et al. ask which of the competing views—information accuracy or information interpretation—is the right one. They state that “in the complex world in which most business leaders operate, information about the [work] environment, though abundant, is seldom obvious in its implications. Executives therefore have no choice but to interpret and intuit the data they receive” (Kathleen, Sutcliffe & Weber, 2003). They conclude that the way senior executives interpret their business environment is more important for performance than how accurately they know their environment.

There are several factors affecting DQ as demonstrated in Table 2. Executives as strategic planners and decision makers have certain expectations of each factor that should be achieved and can assess the relative importance of factors in respect to the organisation’s vision. They can also perceive or interpret the performance of the factor in their organisation. The expectation from a factor is referred to as “expected importance” and the interpretation of performance forms the “perceived performance” of a factor. A grid similar to the one shown

Figure 5. Importance-Performance Comparison (source: Evans & Lindsay, 2002).

		PERFORMANCE	
		LOW	HIGH
IMPORTANCE	LOW	Who Cares?	Overkill
	HIGH	Vulnerable	Strength

in Figure 5 can be used to evaluate and analyse the importance-performance data (Evans & Lindsay, 2002; Keyt et al., 1994). An organisation should make a great effort to achieve high performance on factors of high importance and not to waste effort on factors of low importance.

Importance-performance analysis was first introduced by Martilla and James (1977). A gap between the perceived performance and the expected importance of a factor may provide some indication as to whether executives were successful in translating their vision to their employees, and hence such perception may give an indication regarding the degree of employees' alignment with the organisation's vision. Importance-performance analysis can be incorporated with formulas 1 and 2 in Figures 3 and 4, respectively, to measure the alignment of a factor or characteristic from the viewpoint of the organisation's executive as illustrated by formula 4 in Figure 6. If a factor affecting information quality is critical and has a negative value of factor alignment (perceived

Figure 6. Factor Alignment (Adapted from Al-Hakim, 2003b).

$$\text{Factor's Alignment} = \text{Perceived Performance} - \text{Expected Importance} \quad (4)$$

$$\text{Factor's Alignment} = \text{Employee's Expected Importance} - \text{Executive's Expected Importance} \quad (5)$$

performance is less than the expectation), then the organisation may have a potential problem with DQ. Information on factor alignment allows executives to develop a strategy process to balance the challenges associated with the gaps between importance and performance for CSF affecting DQ.

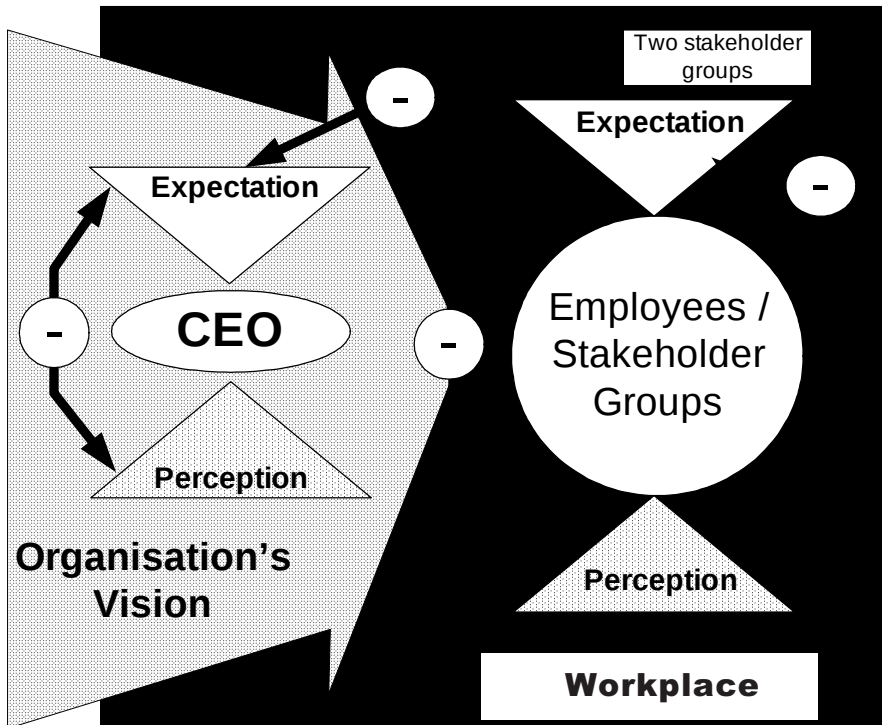
Information users from various managerial levels of an organisation may have certain expectations as to what each factor should achieve. They can also predict the relative importance of factors based on their interpretation of the organisation's vision and perception of their duties and responsibilities. The determination of an organisation's executive or CEO of the expected importance of a factor is a reflection of the executive's vision, or more precisely, the organisation's vision and strategic plan. The perception of other employees on the expected importance of the factor is the reflection of how the organisation's mission was interpreted by them. The gap between the expected performance of factors as interpreted or perceived by executives and the other employees—formula 5 of Figure 6—forms another practical measure of factor alignment (Al-Hakim, 2003b).

If a factor affecting information quality is critical and has a negative value of factor alignment (employee's expectation is less than the executive expectation), then we have a potential problem in information flow, information interpretation and then with DQ. A positive value (employee's expectation is higher than executive's expectation) indicates an overestimation, which may result in wasting effort to increase performance in less critical factors.

Ittner and Larcker (2003) find that, in far too many cases, management simply relied on its perception about performance of their employees and what was important to them, rather than verifying whether those assumptions had any basis in fact. Formulas 4 and 5 provide a good indicator for top management to examine their expectation relative to employees' interpretation of factors' importance—the DQ alignment. It also allows executives to implement a corrective action, say training, to orient their employees. Based on formulas 4 and 5, one can configure four ways of determining the DQ alignment, as illustrated in Figure 7.

Taking an advantage from Bailey and Person's (1983) customer's satisfaction definition, DQ alignment can be determined as the sum of individuals' reaction to the set of factors affecting DQ. The relations of DQ alignment illustrated in Figure 7 can be expressed in four formulas as shown in Figure 8. Formula 6 is a general expression of DQ alignment in which it defines the gap between perception and expectation for all individuals in the organisations. Formula 7

Figure 7. Ways of Determining DQ Alignment.



considers the gap between DQ expectation and DQ perception from the viewpoint of the organisation's executive. Formula 8 determines the gap between the executive expectation and the expectation of other employees. Formula 9 considers the gap between DQ expectations of two different stakeholder groups. DQ alignment shown in formulas 6 and 8 can be used to determine the DQ alignment for a certain group of stakeholders with the interpretation of organisation executive, while formula 9 reflects the interpretation of factors' importance perceived by two different stakeholder groups. For this study we concentrate on formula 9 to demonstrate whether IT professionals think differently from others.

Figure 8. DQ Alignment (Adapted from Al-Hakim, 2003b).

$$DQ_A = (\sum \sum P_{ij} - \sum \sum E_{ij}) / (n * f) \quad (6)$$

$$DQ_A = (\sum P_i - \sum E_i) / f \quad (7)$$

$$DQ_A = (\sum \sum E_{ij} / n - \sum E_i) / f \quad (8)$$

$$DQ_A = (\sum \sum \hat{E}_{ij} / n_J - \sum \sum \ddot{E}_{ih} / n_H) / f \quad (9)$$

Where:

DQ_A = DQ alignment.

P_i = Perceived performance of factor i by the organization executive.

P_{ij} = Perceived performance for factor i by individual j.

E_{ij} = Expected importance of factor i by individual j other than the CEO or the organization CEO or executive.

E_i = Expected importance of factor i by the organization's CEO or executive.

$\hat{E}_{ij}, \ddot{E}_{ih}$ = These mathematical expressions represent the expected importance for factor i perceived by individuals from two different stakeholder groups. Individual j is from a stakeholder group J and Individual h is from a stakeholder group H.

n = Number of individuals.

n_J = Number of individuals in group J.

f = Number of factors.

Part 2: Case Study

Case Organisations

We considered four Australian case organisations. The cases are a commonwealth agency, a federal government department, a government-funded institution that has many divisions across Australia, and a public utility. Table 3 provides an overview of the four case organisations. It includes the number of employees, the annual revenue, and the total assets. The cases have been adapted from Xu (2003) and Xu and Al-Hakim (2003).

The Interviews

Representatives from various stakeholder groups were also interviewed. They are divided for the purpose of this research into two categories: IT professionals and management professionals. Table 4 summarises the case study respondents who were the different stakeholder groups interviewed in the four cases. The table gives details of participants and their positions/work roles in their organisations. It shows also the number of officers interviewed. Interviewees from case organisations 1 and 4 were requested to rate factors' importance and factors' perceived performance using a scale of 10, 10 being the highest. For

Table 3. Overview of Case Organisations.

Description		Number of employees	Annual revenue (\$'000)	Total assets (\$'000)
A	Public utility	400	57,000	23,000
B	Federal Government department	2,500	16,000	300,000
C	Government funded institution	6,400	800,000	1,300,000
D	Commonwealth agency	1,200	98,000	139,000

Table 4. Summary of Case Organisations Interviews.

Profession	Case Organisations			
	A	B	C	D
IT Professionals	IT Manager	IT Manager, Data Manager and Data Administrator	IT Manager and Database Administrator	IT Manager and Database Administrator
Management Professionals	Chief Finance Officer (CFO), Regional Administrator	Senior Manager, Financial Manager, and Internal Auditor	Senior Manager, Accountant and Internal Auditor	Senior Manager, Director of Finance, and Internal Auditor

the purpose of this research, we adopt formula 9 of Figure 8. The DQ alignment equates the ratings of IT professionals minus the ratings of management professionals. DQ for specific factors is aligned between IT professionals and management professionals, where the value of DQ alignment equal zero. Otherwise, there is a problem in DQ alignment for that factor.

Case A

Case organisation A operates SAP R/3 on a minicomputer, using an Oracle database for financial and human resource management. Access to the Internet and e-mail are provided through stand-alone computers. Table 5 shows the ratings of each factor's importance given by the interviewees.

Both IT and management professionals considered the input control as the most critical DQ factor, (overall mean or $\sum E_{ij}/n = 9$). The organisation CFO provided an example in relation to the introduction of "Good and Service Tax (GST)" system. The CFO noted:

When we introduced GST, we trained everyone. We told everyone that this is a field they have to fill in called 'the tax code'. And we made that field mandatory, and then by having drop down fields. But the problem is they've still got to choose the right one.

The IT and management professionals agreed that the nature of the IS system and training factors are also very important factors for DQ, ($\sum E_{ij}/n > 8.60$).

Table 5. Stakeholders' Rating of the Importance of DQ Factors (Case A) (Adapted from Xu, 2003).

Factors	Management Professionals			IT Professional	Overall Mean	DQ _A *
	Chief Fin. Officer	Regional Manager	Mean	IT Manager		
Nature of the IS	10	8		8	8.67	-1
DQ policies & standards	7	8		8	7.67	0.5
DQ controls & approaches	7	8		5	6.67	-2.5
DQ vision	5	8		5	6	-1.5
Internal control	9	10		7	8.67	-2.5
Input control	9	8		10	9	0.5
Understanding of the systems and DQ	10	9		7	8.67	-2.5
Continuous improvement	8.5	8		7	7.83	-1.25
Top management's commitment	7	7		6	6.67	-1
Middle management commitment				(10)**		
DQ manager	10	9.5		4	7.83	-4.75
User focus	8	8		4	6.67	-4
Employee relations	6	9		7	7.33	-0.5
Information supplier quality management	2	8		3	4.33	-2
Audit and reviews	8	8		8	8	0
Personnel competency		**				
Training	9	9		8	8.67	-1
Org structure	6	8		3	5.67	-4
Org culture	7	9		7	7.67	-1
Performance evaluation & rewards	6	5		6	5.67	0.5
Manage change	8	9		7	8	-1.5
Evaluate cost/benefit tradeoffs	3	9		2	4.67	-4
Teamwork (communication)	8	10		7	8.33	-2
Physical environment		(10)***				
Risk management	(8.5)***					
External factors	4	8		5	5.67	-1
Overall Rating	7.16	8.34		6.09	7.20	-1.66

* DQ_A is the expectation of the factor I by the IT professional minus the average expectations of the management professionals: $DQ_A = (\sum \sum \hat{E}_{ij} / n_j - \sum \sum \hat{E}_{ih} / n_h) / f$

** The shaded cells in the table represent factors identified by the interviewees.

*** Numbers between brackets are not considered for calculating the overall rating.

However, the commitment of top management had not been seen by the professionals to perform a critical role in ensuring data quality. Instead, the organisation's IT manager (IT professional) highlighted the key role of the middle management in ensuring the DQ and stated:

Obviously, [top management] need to promote, and expect high data accuracy. But that's about all....You can get to the senior managers, who've just seen in front of them information. They assume that what they have is accurate. So, it is important to get that information right, and it's the person in the middle who does that.

The internal control and understanding of the system factors were considered extremely important factors by the management professionals, ($\sum E_{ij}/n = 9.5$). The organisation CFO, (information custodian) emphasised that:

Well, in theory, it should be written down, but in practice, it's the combination of your system knowledge and your organisation knowledge.

The CFO linked human aspect and internal control and stated:

I've been the auditor. I used to audit against all these controls, and after many many years, I realised that the most important [internal] control is trust..., the control systems, although fantastic, if you don't have good people who you trust

In contrast, the IT professional looked at both factors "internal control" and "understanding the system" as much less important, $DQ_A = -2.5$.

The largest gap in DQ alignment is in the expectation from the DQ manager role. While the management professional considered the role of DQ manager extremely important, the IT professional considered such role as unimportant, $DQ_A = -4.75$. This is the case for the "user focus" factor, $DQ_A = -4$. The analysis shows that IT professionals were also less interested in evaluating cost/benefit tradeoffs, $DQ_A = -4$.

The role of DQ control was rated less important in comparison with the rating of management professionals, $DQ_A = -2.5$. The interviews' results show also that IT professionals rated the role "teamwork" in DQ as "ordinary" in

comparison to management professionals, who highlighted the role of teamwork as very important, $DQ_A = -2.5$.

The overall DQ alignment for this case is equal to -1.66, which represents an overall tendency of IT professionals to rate DQ factors with less importance than the ratings of management professionals.

Case B

Both IT and business professionals consider the commitment of top management extremely important, while the nature of the system is considered an unimportant factor for the data quality. However, it was found that IT professionals were more concerned about systems and technical issues. They seemed to have confidence about the newer technology, and have greater trust in the systems' abilities to produce high-quality information. Even when they were considering organisational issues, they still related those issues to the systems. IT professionals seemed to be more systems-orientated.

On the other hand, management professionals were more concerned about the human related factors' impact on information quality, such as communications and staff turnover. Even when they were talking about systems issues, their focus was still from the human perspective, rather than the technological perspective. They believed that people's understanding of systems would impact on the quality of the information that systems produced.

IT professionals believe that the usage and the usefulness of the information have an impact on the information quality. The IT manager noted:

One of the problems is it isn't fully used, and hopefully it should improve the quality of your data after you re-use its code. But on the other hand, you have a system that is being used by a lot of people, and therefore, all the bugs should have been found in it.

The IT manager emphasised that *human errors* had much more impact on accounting information quality than *system failure*:

From one area, a lot of data quality is affected by how accurately the information is entered into the system by business users of system. Well, the systems get more complex. However, a well designed system, old or new, should be able to accommodate.

Communication within the organisation was perceived by business professionals to be an issue that might cause data quality problems. The Senior Manager of the organisation stated:

I think when you find things aren't going well in an organisation; it always comes back to the same problem. It is communication. Everybody complains of not knowing what is going on, not being told the right things.

However, it appears that this may be due to the nature of some people, as they were reluctant to disclose information that they had. As the information producer stated:

Well, that is the case. If you know something that someone else doesn't, then you are in a stronger position.

Case C

IT people thought systems controls were more important than did the management professionals. Management professionals tended to believe that human process controls were more important than system controls. They believed that human related factors had much more influence on accounting information quality. They argued that although IT people could build many controls into systems, at the end of the day it still relied on people to enforce those rules and controls. Furthermore, there were some human related factors that the computer could not control.

From the viewpoint of business professionals, Case C had issues of under-reasoning for education and training because, as stated by the System Accountant Manager, "it is not just how to use the system, but you need to incorporate policies and procedures and best practices".

However, the IT manager believed that organisations have to implement new systems because technology had changed and so had business needs. He stated:

At the moment we are actually doing a review, talking to all of our finance people in our divisions. It is a business needs review to see if the system we have now is meeting our requirements. So we will either decide whether to stay with it or to change to something else.

The answer of Case C Internal Editor was that:

If there is change, I guess everyone has to be on board with the change, or at least know what their responsibilities are and what they need to do. So things need to be well-planned and well-documented, so that if we just suddenly change everything and there hasn't been enough thought about what procedures need to change, it will cause serious problems.

Case D

The analysis of Case D reveals that there is consistency in the overall expectations of both IT professionals and management professionals with $DQ_A = -0.04$ only (Table 6). Training was regarded as one of the most important critical factors for DQ by both IT and business professionals, with mean equals 9.3 and DQ_A equals only -0.33. IT managers tended to have the same viewpoints of the business professionals in regard to the “internal control” and “DQ policies and standard” factors, with rating equal 9. This was not the case with the DBA. DBA rated the “internal control” and “DQ policies and standard” factors with 3 and 2, respectively. Input control, continuous improvement, change management and teamwork factors were considered very important by both IT and management professionals, with DQ_A equals 0.33, 0.67, 0.33, and 0.67, respectively, as shown in Table 6.

Discussion and Conclusion

Benefits and Limitations

Meeting and exceeding DQ expectations requires looking at the factors affecting DQ through the information user's eyes, not only the executive's. As far as this research is concerned, the methodology used was to interview various stakeholders in organisations with the aim to determine their assessment on critical factors affecting DQ and also to answer the question as to whether various groups of IT professionals perceive the importance and performance of various factors affecting data quality differently from other system users.

*Table 6. Stakeholders' Rating of the Importance of the Factors (Case D)
(Adapted from Xu, 2003).*

Factors	Management Professionals			IT Professionals		Overall Mean	DQ _A *
	Director Finance	Senior Manager	Auditor	IT Manager	DBA		
Nature of the AIS	7	5	5	9	7	6.6	2.33
DQ policies & standards	9	9.5	8	9	2	7.5	-3.33
DQ controls & approaches	7	8	8	9	9	8.2	1.33
DQ vision	10	5	6	8	6	7	0
Internal control	9	10	9	10	3	8.2	-2.83
Input control	9	9	8	9	9	8.8	0.33
Understanding of the systems and DQ	8	9	8	9	9	8.6	0.67
Continuous improvement	6	9	7	9	7	7.6	0.67
Top management's commitment	8	9	9	9	8	8.6	-0.17
DQ manager	3	?	?	?	7		
User focus	7	8	1	8.5	8	6.5	2.93
Employee relations	7	9	7	10	8	8.2	1.33
Information supplier quality management	10	9.5	5	7	8	7.9	-0.67
Audit and reviews	6	9	6	9.5	3	6.7	-0.85
Training	9	9.5	9	10	9	9.3	-0.33
Org structure	5	8	6	7	4	6	-0.83
Org culture					8	8	
Performance evaluation & rewards	10	8	5	7	5	7	-1.67
Manage change	10	9	7	10	8	8.8	0.33
Evaluate cost/benefit tradeoffs	10	9	6	6	7	7.6	-1.83
Teamwork (communication)	10	9	6	10	8	8.6	0.67
External factors	8	5	5	5	3	5.2	
Overall Rating	8	8.33	6.55	8.55	6.63		-0.04

* DQ_A is the expectation of the factor I by the IT professional minus the average expectations of the management professionals.

? The interviewee was not sure/clear about the factor.

The study has two main limitations. First, the actual performance of factors is not measured and the link between the expectation and actual performance was not examined.

Empirical research considering individual evaluations has been strongly criticised as lacking strong theoretical support (Melone, 1990). There are compelling arguments that individuals may comment retrospectively about their own usage behaviour and evaluate the performance of a factor according to their subjective understanding. However, objective measures for information system success are difficult to achieve and many researchers have relied on individuals' evaluations (Goodhue, 1995). Possible reasons may include restrictions imposed by the study site, the lack of system monitoring, and the potential influence of direct measurement of usage behaviour, and so forth (Melone, 1990). Goodhue noticed also that there are so many different underlying constructs and argued that "it is probably difficult to develop a single theoretical basis for user evaluation. Rather, what is needed is the identification of some theoretical perspective that can usefully link underlying systems to their relevant impacts."

The study focuses on the interpretation of the organisation's vision. It is emphasised by Kathleen et al. (2003) that the way senior executives interpret their business environment is more important for performance than how accurately they know their environment. The executive's interpretation or perception cannot be separated from the organisation's vision. The employee's perception, on the other hand, provides an indication of the interpretation of, and the alignment with, the organisation's vision. Such subjective measures are highly needed for orientating individuals to correct their perception and improve their performance based on the actual interpretation of the organisation's vision as perceived by the top management (Al-Hakim, 2003b).

Another supportive argument was provided by Roepke et al. (2000). Roepke et al. argue that "the greatest impediments to success are often related to people rather than to information, technology, and systems. What is not quite clear to IT leaders, however, is exactly how to develop and leverage this human capital in support of business needs." Indeed, individual perception plays a major role in determining a methodology to develop and leverage human capital.

According to self-perception theory (Bem, 1976) people form their attitudes by watching and learning from their own and other people's behaviour (Melone, 1990). Within the context of this theory, employees form their own "vision" in relation to the workplace. They can form their own opinions about the relative importance of DQ factors and they form certain perceptions about

DQ factors' performance. Modern organisations are searching and investigating the "inner voice" in business and are helping employees to examine their own personal visions and align them with the organisation's vision (Cacloppe, 2000). The formulas stated in Figure 6 are very helpful in this regard.

Conclusion

The results of the case studies reveal some conclusions regarding the IT professional perceptions, including:

1. IT professionals were more concerned about systems and technical issues. They seemed to have confidence about the newer technology, and have greater trust in the systems' abilities to produce high-quality information. Even when they were considering organisational issues, they still related those issues to the systems. IT professionals seemed to be more systems-orientated.
2. There is a great emphasis on the "input control" and the "nature of the IS" by the IT professional. IT professionals' perception about the importance of "internal control" is relatively low. Other professionals tended to believe that human related factors have much more influence on the quality of IS.
3. Similar to other professionals, IT professionals consider training and continuous improvement as critical factors for DQ.
4. In three out of four case studies, the commitment of top management had been seen as a very important factor for DQ. In one case, the IT professional highlights the critical role of middle management.

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Endnote

- ¹ The term data and information are often used synonymously — for instance, see Huang et al. (1999). Some literatures differentiate information from data. They consider data as a collection of facts, measurements and statistics, i.e., raw data. Information is defined as organised or processed data that are timely (Turban and Aronson, 2001). This chapter uses “information” interchangeably with “data”. Data quality, in this chapter, is a reference to information quality.

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Chapter XVI

Human Issues and Computer Interaction: A Study of a U.K. Police Call Centre

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Abstract

The Barfordshire Police Call Centre project began as an attempt to find a more efficient way of dealing with the public. Arguably, what this study has demonstrated is that often, in the quest for technical efficiency, effectiveness, which requires attention to both technical and human issues, is compromised. By taking a more human centred approach, focusing on the whole information system rather than just the information technology, those factors left unsolved by the new technology have been addressed, and a way has been found to improve both the efficiency and effectiveness of this project.

Introduction

The subject of this study is the implementation of a new call centre in Barfordshire (a pseudonym). Our involvement began after this centre had already been in operation for a year, and was experiencing serious problems indicated by negative client reaction. The approach taken to dealing with the outstanding issues, and the results of the intervention, are reported below. First, we have outlined the issues and problems that preceded the call centre implementation. Following this, the background to the intervention is outlined, and the consultancy itself detailed in the form of an action research project. Finally, the learning from the work undertaken is reported in the form of findings and conclusions.

Barfordshire Police: Issues and Problems

There are 43 police forces in England and Wales, all of which operate as independent organisations under National Government control and report to the Home Office. Within each force, smaller groups known as divisions may contain up to 250 officers. Each division manages a few police stations, each of which has up to 50 officers working in it. Although all police forces are governed by the same statutory regulations, each has a great deal of autonomy as to policing operations and internal management. One such police force, Barfordshire (a pseudonym), is medium-sized, with around 1,200 police officers.

A key issue for police forces is the management of information as it is received from the public and acted upon. In the United Kingdom, such information is divided into emergency (999, or 911 in US terms) and non-emergency.

Prior to April 2000, Barfordshire Police operated a Force Information Room (FIR), which received and allocated all emergency (999) calls, managed the radio channels for all divisions in Barfordshire, and dispatched resources to incidents. The FIR did not deal with non-emergency calls. In April 2000, a new state-of-the-art Information and Call Centre was opened at the Headquarters building. The key change as a result of this was the routing of almost all

emergency and non-emergency telephone calls to the Call Centre, rather than to individual divisional police stations.

Seen as an information system, the original combination of a centralised (emergency) system and a distributed (non-emergency) one was replaced with a single centralised system. In order for this to operate *effectively* it was essential that the acquisition, storage and transmission of information was restructured in line with the new organisation.

The Call Centre appeared to operate efficiently, with advice of call handling ergonomists and the outcomes of a simulation exercise being taken into account in enhancing operational procedures during the first year of operation. However, there were still concerns regarding its overall effectiveness, based, for example, on feedback from the public subsequent to the changeover. A key aim of this consultancy was to address this overall effectiveness, and make recommendations as to how to proceed. The objective of the study was to review the IS issues of the call centre, with particular reference to cultural, systems, and management issues, and prepare a report suggesting actions for improvement and proposing a schedule for progressing the issues.

The key issue to surface very early in the discussions was that the call centre had been implemented as a technological solution. But it was not the information technology that was giving rise to current problems, but rather the functioning of the whole system of technology, people and organisation, as an information system (see Clarke, Coakes et al., 2002; Hirschheim & Klein, 1989; Hirschheim, Klein et al., 1991; Lehaney, Clarke et al., 2002 for further examples and background to this).

Background to the Study: Prior Documentation

The study began with a documentation review: there was a significant history in relation to the call centre development, and this had to be understood in order to proceed with the current activity. The key documentation reviewed was a call handling strategy document, a call handling centre implementation project document, and a selection of other documentation. This appears initially to have been driven by technological considerations in many cases, though, from the call handling strategy document, it appears that at a strategic level the

objectives display a wider IS remit than at the operational or implementation level. For example:

1. Reduction of lost calls to a measurable minimum.
2. Increase in public satisfaction with the resolution of calls.
3. Increase the number of calls resolved at first and second point of contact.
4. Faster call answering times.
5. Improved effectiveness and efficiency in handling messages for staff.
6. Reduced direct revenue budget year on year costs of call handling process.

These objectives demonstrate, implicitly if not explicitly, a commitment to issues that include substantial non-technological factors (for example items 2 and 5 above). It is precisely in respect of these non-technological factors that concerns arose that gave rise to this consultancy. Importantly, while faster call answering times might be *technologically* achievable at present, the *quality* of call answering is seen as a potential area for improvement. Put another way: while the *technology* was functioning to specification; the *system* was failing (for further examples, see Clarke & Lehaney, 1999; Mallalieu & Clarke, 2000).

Activities listed in the call handling centre implementation project document included:

1. Conduct research into call handling activity within Barfordshire Police, using simulation techniques to enable the implementation to be based on a staffing model in line with the structural model.
2. Verify that job analysis and training needs analysis are undertaken and assessment criteria are developed to ensure correct staffing capability is provided.
3. Ensure that the people elements of the project are managed with sensitivity, professionalism and within legal constraints.
4. Evaluate all activities and processes to be conducted within the call centre and formulate activity flows, policies and user system design requirements.

5. Examine and monitor all elements of the material means provision, to ensure that the correct facilities are available to the call handling process prior to implementation date.
6. Ensure that the necessary capability exists to continue those activities that will not be conducted within the new call centre.

Of these activities, those that did not rely wholly on effective implementation of technology seemed to be giving rise to the greatest problems. Generally, the other documentation relating to the project was very inwardly focused, and concentrated on call handling functionality, rather than the *needs* that the call centre has to address, the latter being taken as effectively agreed. However, this conflicted with the evidence “on the ground,” which had the primary task of satisfying public demand for services. The problem that gave rise to the project — the perceived poor quality of public service and the opportunity to improve this by a more centralised system — seemed to have been lost in a drive for a technological solution. The overall impression was of documentation that focuses predominantly on technology, and this set the scene for the action research stage of the consultancy.

The Study: Action Research

Following the review of documentation, action research was conducted (Clarke & Lehaney, 1997), consisting of: shadowing call centre and divisional operations; participative sessions with call centre staff; and a visit to another police force. Once a picture of the implementation had been gained from the documentation, the next stage was to carry out primary research into call centre activity through those participating in that activity. Initially, to gain an improved understanding of the call centre, a decision was made to shadow all of the operations within it. Shadowing encompassed management and operations for: switchboard, call handling, dispatch, and radio support. Generally, the impression was of a professional, well managed operation, but there were nevertheless management and operational issues that, if addressed, would improve overall effectiveness.

Once again, and following on from the documentation review, the action research took a total system focus, seeing the IS as a combination of

organisational processes, people, and technology, rather than simply focusing on technology as had previously been the case.

At the time of our visit, the switchboard was very busy, and was a bottleneck, causing delays in routing calls to call handlers. Given its critical nature in addressing client perceptions, it was necessary to ensure:

- The switchboard was being adequately manned at all times. There were times, for instance, when the switchboard was not manned, all calls going to call handling direct, and if the lines were busy, the caller heard a recorded “in queue” message.
- Other staff in the centre were available for switchboard duty when the latter was overloaded.

Part of the call handling function, usually consisting of two call handlers, was dedicated to answering emergency (999) calls, giving rise to some “idle time”. However, dispatchers and supervisors were able to pick up 999 calls through the telephone system, and on the shifts that we observed, doing so enabled the number of call handlers dedicated to 999 calls to be reduced to one. In practice, the extent to which this was done seemed to vary from shift to shift. At the time of our visit, most 999 calls that were not picked up by the dedicated call handling agents seemed to be taken by the duty inspector. The implication here was that, with closer attention to call volumes versus staffing, efficiency could be improved.

Radio dispatch received calls through the IT system, with each dispatcher managing an ongoing list of open incidents. Where there were issues that were seen to go beyond “normal” radio dispatch activities, calls were passed to radio support. This activity, being the primary point of communication between the call centre and the divisional resource, seemed to be where the greatest benefit was to be derived in terms of improved call centre effectiveness. For example:

- The caller may have been promised something which cannot be delivered.
- Allocation of resource is constrained by availability.
- The radio system is not always reliable.
- While jobs are allocated from the call centre, some tasks that used to be based at the division have not been taken over by the centre (e.g., keyholder and alarm files); so they are falling into a “black hole”.

- Open incident logs seem to stay open for too long, leaving important issues not fully resolved and adding to ongoing workloads and lack of public satisfaction.

Demand was very unpredictable, but work rotas seemed to lack the flexibility to address this adequately. Partly, this might be seen as a multi-skilling issue, but also the possibility of not all staff having fixed hours, with some degree of on-call work, might be considered. Interestingly, there seemed to be no insurmountable issues related to unions or the customs and practices adopted that would prevent more flexible working arrangements.

The call handling design document made reference to multi-skilling only of call handling agents, so that in practice most tasks were performed by specialists concentrating on a given function, and this exacerbated the bottlenecks caused by fluctuating demand. The reason for functions other than call handling agents being excluded from multi-skilling was not clear; for example, the switchboard was arguably the one area that would most benefit from such an arrangement. Prior to the introduction of the call centre, the system was that:

- The force information room (FIR) at Barford (the county town, and one of the largest police divisions in Barfordshire) controlled all radio channels.
- FIR at Barford controlled all 999 calls.
- FIR at Barford dispatched resources.
- Non-emergency calls went to divisions.

Under the call centre arrangements, non-emergency calls were received centrally, and resources dispatched accordingly. Notwithstanding this change, the division remained as the “public face” of the police in a given area, but much of the ability to deal with public demand rested with the call centre and its associated organisational procedures. This gave rise to a number of perceived issues to be addressed, examples of which are:

1. Public frustration: the caller wants a timely response, both on the telephone and in terms of police action.
2. Divisions have lost staff and resource to the centre, but are still left with part of the problem.

3. While there is no argument in principle with a centralised call handling system, the loss of *information* at divisions is problematic.
4. Divisions still “own” the job, but have no *divisional* location for taking and managing calls.
5. Some calls taken at the call centre, either due to error or incorrect information, are incorrectly allocated.

While the previous were examples of perceived problems, the key issue here was not *what* these perceived problems were, but that there were issues still unresolved. It was an important outcome of this report that investigation of these issues was clearly necessary. This work built on the understanding gained in the documentation review, and cemented the view that much was to be gained by a deeper investigation of call handling through those most closely involved with it. In IT/IS terms, the solution seemed to lie in understanding the whole of the IS through the eyes of its participants. As a result, a number of participative sessions were undertaken, of which the brainstorming event detailed below is an example.

Call Handling Centre (CHC) Participative Session

This took the form of a brainstorming session with call centre staff. There were 11 attendees. A chair and note taker were elected from the attendees. The problem to be addressed, as determined and agreed by participants, was stated as:

The issues to be considered for effective co-ordination of control activities

The central issue to be addressed, as determined and agreed by participants was:

How can management of responses be better facilitated by the command and control system?

One of the aims of the session (de Bono, 1977) was to produce three lists of potential actions:

- Ideas of immediate usefulness.
- Areas for further exploration.
- Any new approaches to the problem.

These lists would be evaluated later by the group, and other groups within the force. For space reasons, only a summary of the immediately useful list is reproduced in the following:

- **Participation:** Continuous improvement through involvement — user groups set up to discuss and resolve issues of concern. Allow for more participation in change decisions.
- **Communications:** Address the “black hole” that exists in communication between the call centre and divisions.
The information passed between all groups needs to be investigated and improved.
- **HRM:** Address “them and us” issues between divisions and call centre.
- **Resources:** Officer numbers on divisions and at call centre, available for tasks, and also their timely updating of availability.
- **Training of CHC staff:** Training generally considered as poor.
- **Management and leadership issues in CHC:** Allow for more participation in change decisions.
Evaluation of the processes by which incidents are managed.

Finally, to further verify the outcomes of the study, it was decided to visit another force facing similar issues.

Comparative Study: Visit to West Midlands Police

The purpose of this visit was to begin the process of understanding how other police forces have addressed the problem of call handling. West Midlands Police were seen to have some similarities with Barfordshire, since they are in

the process of reorganising both emergency and non-emergency call handling. The West Midlands 999 Centre handles an average of 1,600 emergency calls per day, and has the task of answering the calls, and passing the tasks to Operational Control Units (OCUs). There are 21 OCUs, each of which has four to six sector stations within its control, and which in total have 7,500 officers. All resourcing and management of incidents is carried out by OCUs. Prior to the November 2000 changes, all non-emergency calls went to divisions, from where they were allocated to OCUs, which were then sub-divisional level. Emergency calls (999) were dealt with by a central control room (the “Force Control Room”). These calls were logged and passed to division, who controlled the incident from that point on. Under the new system, central call handling was introduced whereby 999 calls are logged and passed to operational control units (OCUs) via the IT system, from where the resources are allocated: In other words, similar to Barfordshire, divisions were being marginalised in the new process. There was, under this system, the growing conviction that incidents were not managed effectively, with OCUs seen to be taking calls and “dumping” them on officers.

This new system is giving rise to a number of issues currently under review, including:

- Poor local knowledge of the call takers.
- Inadequate call distribution: call takers seem to prioritise getting rid of the calls.
- Callers complaining that they cannot get through on the phone.
- The resource problem appears to be still evident.
- A quality “first line” response, both from the call centre and on the ground is needed, together with the flexibility to deal with ongoing unpredictability of demand: The call centre approach is failing to deliver this.

The outcomes from the West Midlands investigation were then combined with outcomes from the Barfordshire study to produce an overall picture of the issues to be addressed in Barfordshire.

Barfordshire Findings and Recommendations

In the original call handling strategy document it is possible to find the traces of the new call centre being considered as a combined organisational, technical and human system. But this was largely lost in the implementation of the call handling project, which placed increasing emphasis on technical factors, privileging an information technology ahead of an information systems perspective. The evidence of this study strongly suggested that the wider IS issues should be revisited. Specific areas identified as needing attention are detailed in the following:

- There were bottlenecks in the call centre (the switchboard seemed frequently to fall into this category). Largely this seems attributable to unpredictable demand, which called for a flexibility in work patterns beyond that which was practised. Some degree of multi-skilling was indicated in early specification documents, but its implementation was not widely apparent.
- There was a view that the technology and structure of the call centre could be improved.
- Training was seen to be an area of weakness. A review of training needs and assessment of training programmes was indicated.
- The link from dispatch/radio support to divisions was not always reliable — examples of problem issues are given below.
 - Communications and operations between call centre and divisions needed to be reappraised. There was a perception of a black hole into which were falling the tasks that used to be carried out by division, but that were seen to be call handling operations. All of these had not been picked up by the call centre, and perhaps did not even belong there.
 - There was an overall impression of a “them and us” culture, with call centre and division passing blame whilst tasks were left undone.
 - A lack of ownership of incidents. Divisions seemed the logical place for this, and they appeared willing to take on the task, but saw themselves as lacking the necessary information to do so.

- Public frustration was evident in the complaints received, and in feedback from the visits made. A similar problem existed at West Midlands, and was proving equally difficult to resolve.
- Divisions had no location from which to manage incidents.
- Participation:

Operational staff felt that they had information to offer that would improve the situation, but that this was not taken into account. Their desire to enhance the performance of call handling was clearly evident, and more use should have been made of this.
- Resources:

Allocation to incidents was resource constrained, both at the call centre and “on the ground”. The monitoring of effectiveness versus resources at the call centre and divisional levels was an ongoing requirement.
- Management:
 - It seemed no longer clear what the management process was or, perhaps even worse, should be.
 - Within this process, whilst the current *technical* operation of call handling was accepted as “here to stay,” there was a clear need to give more control to divisions.
- Public perceptions:
 - Call handling needed to address public expectations.
 - Local knowledge had been lost in the move to centralised call handling.

These findings were used to provide an action plan for the call centre, which is currently being implemented.

Conclusion

At the time of our engagement, the Barfordshire Call Centre had been in operation for a year, and had been extensively reviewed from a technological and ergonomic perspective. Nevertheless, it was still giving rise to concerns as to its efficiency and effectiveness, as indicated by client responses.

A review of the background to its implementation pointed to a need for a less technological (IT) and more human-centred (IS) approach, with the use of participative rather than technological approaches to the study. By involving a wide range of those affected by the system of concern in the exercise, through the use of participative methods such as brainstorming, metaphor and interactive planning, a richer view of the problem domain as an IS was formed.

The outcome was a series of actions to be undertaken within the call centre, the value of which were clearly demonstrated by the study.

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Chapter XVII

The Role of Group Learning in Implementation of a Personnel Management System in a Hospital

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Abstract

A new HR system was introduced in a Dutch hospital. The system implied collaborative work among its users. The project planning seemed to be reasonably straightforward: the system's introduction was intended to take place gradually, including pilots in different departments and appropriate feedback. After some time, the system was successfully adopted by one group of users, but failed with another. We conceptualize the implementation process of groupware as group learning to frame the adoption of the system, and analyze the qualitative data collected during the longitudinal case study. We found that in the user group with strong

group learning, adoption of the system occurred effectively and on time. In another user group with rather weak group learning, the use of the system was blocked after a short time. The results provided a first confirmation of our assumption about the importance of group learning processes in the implementation of groupware.

Introduction

It is broadly recognized that the IT use often develops differently from the expected plans, and that the degree to which use of technology corresponds to the anticipated rules and norms can vary a lot, depending on an organizational context, type of IT, end-users' awareness of the system, and so forth (Bardram, 1998; DeSanctis & Poole, 1994; Orlikowski, 1996).

Different research perspectives have developed their views on this issue in parallel. Orlikowski (2000) gives the following examples. Social constructivists refer to the IT "inscription," analysing further the role of debates, social interests, and conflicts in achieving a consensus in IT functioning (Akrich, 1992). Structurational traditions examine how technologies develop through the interplay between "embodied" and "embedded" structures (Orlikowski, 1992). Similarly, adaptive structuration theory focuses on the differences between "faithful" appropriation (use in line with IT intention) and "unfaithful" appropriation (actual use) (DeSanctis & Poole, 1994). Developing the structurational concepts, Orlikowski (1996) talks about "institutional" (prescribed) and "on-going," "enacted," or "situated" use of technology. All these views start with characteristics of technology, and analyze how those are used, appropriated, accepted, or adapted by the targeted employees.

Rather than starting with technology and examining how people appropriate, adapt, or accept it, we shall start with the employees and explore how they develop their work with the system. Whether through mistakes, or purposefully, users often ignore, alter or play around the "anticipated," "inscribed," and "institutionalised" technological characteristics. Even if technology is given and its use is mandatory, employees will influence their recurrent work with it through developing certain interpretive schemes like making preferences, new rules of the work being automated, new tasks facilities, norms (e.g., traffic regulation), interpersonal interaction via IT, modification of technological

properties, choosing or ignoring optional properties, inventing new ones, and so forth (Orlikowski, 2000).

Various studies have applied this to introduction of collaborative technologies, also known as groupware, which are intended to support interdependent tasks (e.g., Bikson & Eveland, 1996; Orlikowski, 1996). Engagement of different employees in a common task through the system in fact decreases technological malleability. Anticipating any technological changes involves negotiations of all users if their interdependence is based on the functionality of IT. In other words, employees probably will look for a community consensus in order to develop interpretive schemes to work with the technology together, within given or created interdependent tasks. As a result, implementation of groupware may have “drifted” (Ciborra, 1996) from its intended use because of those negotiation processes that result in new collaborative interpretive schemes.

The question arises as to how group interactional processes are related to the adoption of groupware. Some interactional processes that influence IT adoption are emphasized in the literature: reflective group processes (Hettinga, 2002; Tucker et al., 2001); sharing understanding (Mulder et al., 2002); and collaborative knowledge building (Stahl, 2000).

We propose to look closer at groupware implementation from a learning-oriented approach, which focuses on the group interactional process as the core factor in adopting a new system.

Why would we want to consider a collaborative technology implementation process as a learning-oriented process?

- User groups adapt a novel way of working when a new technology is introduced. Not all groups do this in the same manner, and this adoption process, called appropriation (DeSanctis & Poole, 1994; Ruel, 2001), depends on the group processes. The terms in which one describes the appropriation process — sharing understanding, mutual adjustment — are closely related to learning theory.
- Changes in technology do not only allow more effective ways of doing the same work, but in addition, lead to changes in various aspects of professional competency such as knowledge, skills, and attitudes. That, in turn, could influence ongoing use of technology. Hence, in theory, there is an ongoing evolutionary process of professional and technological development.

- While using collaborative technology in practical situations, user groups gradually discover the affordances provided by the system and come up with new, unforeseen ways of working. We believe that lots could be gained from collaborative technology if users exploit their group learning potential to a large extent.
- In several accounts of case studies, the implementation process did not take place in an optimal way, and the cause of this has been attributed to a lack of reflective restructuring among the users (Hettinga & Schippers, 2001; Tucker et al., 2001).

In the next section we present a theoretical framework for groupware implementation based on collaborative learning. Then we apply the framework to a longitudinal case study, involving implementation of the same system with two different user groups. The differences in success of the implementation processes can, at least in part, be attributed to the different learning processes involved. Finally we conclude that the case gives a first validation of the proposed framework.

Group Learning as a Focus for Groupware Implementation

The learning-based framework for groupware implementation is built upon different areas of knowledge. We will briefly summarize relevant characteristics from the different areas of research. Implementation of technology is considered from an organizational and management science perspective. Computer supported cooperative work is a distinct interdisciplinary research area that provides understanding of the design and use of collaborative technologies. Group learning, finally, draws upon educational sciences.

Groupware Technologies

Our study focuses on a specific type of IT that aims at supporting collaborative work. These systems are commonly called groupware, or collaborative technologies. Keeping in mind that groupware has existed in the research agenda

since the 1960s, we take the risk to broaden our understanding of it and introduce in this work our definition of groupware.

Holtman (1994) has recognized four generations of groupware: basis groupware (1960s), educational (1970s), commercial (1980s), and diverse (1990s). And probably, the beginning of the 2000s has brought the next, *multiple*, groupware bracket.

1960s

The basic functionalities of shared multimedia started in 1960s from the groupwork experiment with very basic equipment initiated and sponsored by U.S. Military and invented by Douglas Engelbart of the Stanford Research Institute. Engelbart had main problems with the display quality — VDUs were at the beginning of their development and the output was via the TV-style display. But that was the first mix of text and video on screen. The term *groupware* was not in use by that time, but it was a shared technology two decades before people had even heard of the term.

1970s

The era of educational applications of groupware began. First, it was for university distance education purposes. Secondly, groupware products supported groups of teachers who wanted to communicate at different times. Holtman (1994) distinguishes three notable educational groupware areas. First, the EIES — Electronic Information Exchange System from the New Jersey Institute of Technology — provided information and conferencing to distance students based on conventional telephone lines via modem access. Then, the PLATO — Programmed Logic for Automated Teaching Operations, based at the University of Illinois — supported campus students with inter-site connectivity via private leased lines. And finally, there was the rapid growth of the Unix operating system. Unix appeared at the AT&T Bell laboratories, and later on it was taken up by universities and research establishments in North America. That system indicated a significant change in groupware orientation. Without any commercial purposes, it was used by scientists and researchers, both individually and in groups, to develop small team applications, but besides all, to connect to each other.

1980s

By the end of 1970s groupware was focused mainly on special functions in the science and research domain. The introduction of IBM PC in 1981/82 determined a new era in business computing, which is still continuing. It was not initially a revolution in groupware applications, but the diffusion of the PC actually influenced groupwork. Several reasons motivated connecting PCs together. Firstly, it was the need to share databases; secondly, it was partly a top-down pressure from some IT departments to avoid the problems of individual PCs working in isolation. Thirdly, it was pressure from traditional hardware vendors seeking also to retain connectivity to their proprietary products. Fourth, there was bottom-up pressure from the new local area network vendors (LAN), each unfortunately with their own standard for communications. The mid- to late 1980s was the period of significant growth of group-oriented software, which mostly included group decision support systems. Introduction of the most innovative groupware products is usually credited to Lotus Notes. Notes improved the business performance of people working together by compressing the time and improving the quality of everyday business processes, such as customer service, account management and product development (Papows & Fielding, 1994).

1990s

During the 1990s groupware products clustered into several broad groups and attracted the most scientific and commercial attention. Coleman (1995) has noted that groupware never took off in the 70s and 80s because there was no sufficient network infrastructure. In the 90s infrastructure was put in place, and business was using groupware to restructure itself for global competition.

Numerous definitions of groupware were presented at various conferences (CSCW, ECSCW, GROUP). We have chosen two of them, the most illustrative in our view. Baecker (1993, p. 1) defined groupware as “any multi-user software supporting computer-assisted coordinating activities”. Ellis et al. (1991) considered groupware as “computer-based systems that support groups of people engaged in a common task and that provide an interface to a shared environment” (p. 40).

The 1990s were an intensive period of exponential growth of a variety of groupware systems. Organizations were offered video- and audio confer-

ences, group decision support systems, electronic meeting rooms, electronic mailing, shared document applications, shared whiteboard applications, project management tools, group calendaring systems, collaborative authoring systems, and so forth. The research community offered a variety of groupware typologies based on locus of control (Coleman, 1995), level of support, group processes (McGrath & Hollingshead, 1994), time/space taxonomy (Ellis et al., 1991), application level (e.g., Put, 1996), to name a few.

At the same time it became obvious that groupware lay at the convergence of a number of technical, economical, social, and organizational trends that had combined to propel groupware into the minds of managers in both the business and technical communities.

Meanwhile, the rise of the World Wide Web led to a revolutionary change in the possibilities, diffusion and perception of Internet and intranet technology.

2000s

While traditional understanding of groupware developed in the 1990s focuses very much on the support of group work in dedicated teams, nowadays in organizations the available IT infrastructure supports lots of fragments of cooperative work embedded in traditional tasks and group structures. Such cooperative fragments can be recognized often in different work situations ranging from document sharing, cross-functional and cross-departmental projects, to even incidental correspondence between employees linked by a given task. Stand-alone computers nowadays are limited to tests and experiments in organizations, while the norm is that workstations are linked in an organizational network. Common understanding of the way collaborative tasks are performed also gets a broader perspective: employees can work together virtually, intra- and inter-organizationally, globally, and so forth. Modern collaborative technologies have a role in almost all kinds of business and the public sector. Such a multiplicity of groupware in terms of its targeted sector, employees tasks and structure of collaboration, calls for a broader definition.

We define groupware as:

any software systems that facilitate and/or induce collaboration between end users. These can be either dedicated systems (traditional groupware), or embedded fragments that are part of more general applications such as ERP, CRM, or PDM.

Group Learning

The concept of group, or collaborative learning strengthens our view on the social issues in the adoption of groupware. This is the core of the theoretical foundation for groupware implementation, in our view. We define learning as changing knowledge and behaviour, and focus not on learning in general, but learning “in the work place” (Watkins & Marsick, 1996), or on-the-job learning (Onstenk, 1995).

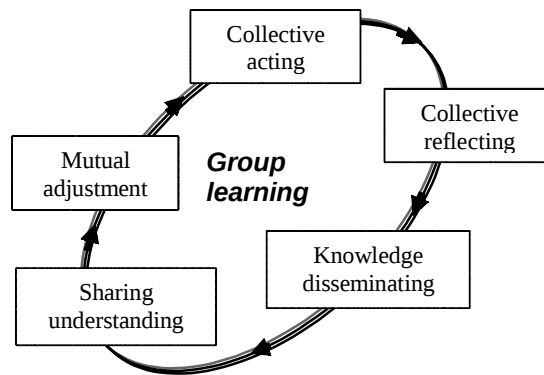
The findings from a number of studies (Crossan et al., 1999; Dixon, 1994; Onstenk, 1995) have validated that the fundamental characteristic of learning in the work place is work socialization. Socialization calls for collaboration, which includes mutual interdependence of individual and a group. Collaborative learning does not consist of the arithmetical sum of individual learning contributions, but appears to be a more complex and integrated phenomenon. If employees work collaboratively and engage in a common task with the use of technology, on-the-job learning gets the features of group learning. We view group learning as behaviour that consists of actions carried out by team members through which a team obtains and processes data that improves cooperation. In other words, group learning consists of group interactional processes, like seeking feedback, asking for help, talking about errors, experimenting, discussing failure, looking for information from outside, critiquing, comparing, evaluating, developing a collective vision, and so forth (Edmondson, 1999; Schippers et al., 2001; Stahl, 2000).

Numerous studies have shown that implementation of collaborative technologies is a process that takes time. User groups do not change their ways of working overnight but gradually appropriate the available technology. In order to allow further support of such processes, a further understanding of the true nature of these processes is needed.

In order to build our understanding of collaborative learning we have transferred the experiential individual learning cycle of “acting–reflecting–thinking–deciding” (Kolb, 1984) to a collective one. On the inter-personal level, the mechanism of group learning is described with the following wheel: “collective actions–group reflection–knowledge disseminating–sharing understanding–mutual adjusting” (Figure 1).

At a group level, learning is conceptualized as ongoing group interaction activities of group acting and reflecting (Edmondson, 1999).

Figure 1. Group Learning Processes.



A group learning cycle begins with the *collective experiences and actions*, when a group of people is given a certain task to perform. This step reflects apprehension of knowledge, when a group is expected to accept new knowledge through perceptions and direct experiences. According to West (2000), action refers to the goal-directed behaviours relevant to achieving the desired changes in team objectives and strategies. This stage is assumed to be important in all learning cycles as it helps to experience assumptions. Acting might lead to new information, which can lead to further reflection, planning, and again action as an ongoing process (West, 2000).

When a new technology is introduced to the targeted employees who are networked together, they will start operating with the system in order to execute the tasks. This can develop through different activities, including operating with basic modules in the performance of everyday tasks, or searching for new techniques in the system. The employees can simply replicate the techniques they have learnt during instructions or try to find out new functionality in using the system. More experienced members of a group may take the initiative for testing new techniques.

The next stage is *group reflection* — the extent to which group members reflect upon, and communicate about the group's objectives and strategies (e.g., decision-making) and update them to the current circumstances (Schipper, 2003). A group is expected to move inward to reflect upon previously acquired knowledge. Reflection takes place through a variety of activities such as discussions, asking questions, declaring difficulties, collective debates, and

presentations, which aim at knowledge externalisation. It is considered crucial in learning from experience because it might help neutralize biases and errors in group decision-making.

A lot of research has been conducted on group reflective processes. Swift and West (1998) have identified three levels of reflection based upon its depth. Shallow reflection is seen as the first level of group awareness (for example, discussing aspects of the tasks). Moderate reflection is viewed as a more critical approach towards tasks (for example, discussing strategies used by a group to accomplish the tasks). Deep reflection occurs when a group questions the norms and values of the group or an organization. Schippers (2003) summarises that reflective group behaviour includes evaluation of actions, ascertaining whether everyone in the group agrees about the way in which the task will be handled, discussing the effectiveness of methods of working and communication, and discussing the norms and values of the groups and organization.

A group may reflect on its knowledge before actions, during task execution, or after that. Reflection before task execution may include open dialogue about strategies and goals. Reflection during task execution mainly aims at identifying whether a group is still on track. It can be also achieved by organising dialogues, forum groups, and discussions (Schippers, 2003). Reflection after task execution is characterised by evaluation of the performance that might lead in our model to knowledge extension during the “deciding” processes.

In the situation with introduction of a new technology, group reflecting can take place at different stages, too: after some operations with the system, or along the way during implementation, but it can happen even before the system introduction when the future users discuss design issues of technology. In any case, group reflecting would include communicating upon the extent to which the system supports performing tasks. Discussions, open dialogue, focus groups, and meetings with a project team might concentrate on speaking out on difficulties in use of the system, comparing with another software experience and with another IT, and declaring individual problems in use of the system. Users might express doubts and suspicions or trust and beliefs in existing ways of solving IT-related difficulties, consider possible reasons and outcomes of mistakes made during operating the system, and discuss errors in working with different IT functionalities

The *knowledge disseminating step* brings the crucial difference between individual and group learning. When we are to transfer individual learning to the cooperative level, the act of knowing becomes more complicated. In a group

environment people would think together, which means they would share results of their thoughts. But knowledge is not something that can be easily passed around (Hendriks, 1999). There is no doubt that some information can be codified, stored and reused to enable effective action at a later stage, but a representation is not equivalent to knowledge (Sutton, 2001). Let us clarify these processes.

With the assumption that the knowledge is created through conversion between explicit knowledge (that is transmittable and communicable in formal language, and often referred to as information) and tacit knowledge (that has a personal quality and is hard to communicate), there are four modes of the knowledge conversion processes that can take place in group learning: externalisation — from tacit knowledge to explicit knowledge; combination — from explicit knowledge to explicit knowledge; internalisation — from explicit knowledge to tacit knowledge; and socialisation — from tacit knowledge to tacit knowledge (Nonaka, 1994).

In other words, to break experiences into meanings, a group would need two phases: first, reconstruction and codifying of knowledge (externalisation and combination); and only then, knowledge can be shared or transformed to a tacit form (internalisation and socialisation) (Hendriks, 1999). We label those phases *knowledge disseminating* and *sharing understanding*.

Knowledge disseminating can appear in many forms, including presentations, lectures, oral explanations of ideas, or “codifying it in any intelligent knowledge system” (Hendriks, 1999, p. 92). This process is not necessarily conscious. For example, employees can learn by watching someone’s performance, even if they are unaware of the specific knowledge needed for the task performance. But we are convinced that in almost all practical situations where knowledge sharing is going to occur that it is important to stimulate “knowledge owners” to externalise their knowledge in a way that is suitable for others.

Knowledge disseminating during the implementation process of a new information system would include behaviors of the group members that aim at externalization of ideas about the system in order to improve its usage. It might emerge in demonstrating working with technical modules both in formal situations (workshops) and informal (work pauses), proposing new actions to improve the usage, and clarifying difficulties and questions to the peers. Users may take the initiative to show their colleagues how to generate new options in the system or to come up with new suggestions to improve the system.

After that the wheel cycles to *sharing understanding*. That involves using insights to help people see their own situation better (Kim, 1993). Internalisation

also takes on a great variety of forms: learning by doing, reading books, and so forth. It is oriented to those people who look for acquisition of knowledge. It implies mutual informal acceptance and respectfulness of diverse ideas and suggestions. Nelson and Coopriider (1996) define sharing understanding as an appreciation of knowledge among the group members that affects their mutual performance (p. 410). Appreciation among the group members is characterised by sensitivity to the frames of reference and interpretations of others in a group. Effective shared understanding can be viewed as a synergy between group members that mutually respect and trust each other. Appreciation and trust are two main components of shared understanding.

Knowledge internalization concerning new technology will lead to a shared meaning of the system among the users. They will share their understanding of the global role of IT in a company and its intentions for every member of a group, as well as design intentions of the developers of the system. Understanding of technical possibilities and different functionalities (main and optional) can also be considered as a result of this stage. A group would come up with common attitudes towards the technical functionality and content of IT — whether technology helps to accomplish job tasks and responsibilities and to what extent.

The last step in the cooperative learning is *mutual adjustment*, or arrangements initiated by the group members. In Kolb's model this step ("deciding") is related to the extension of knowledge, when learners are expected to move beyond the selves to interact with an external environment. Reflections and knowledge sharing do not lead to changes in group learning. At this stage, the group engages in activities that lead to a choice to make decisions together, to reject or adopt, to evaluate or to ignore tasks, strategies, or new rules.

Some adaptations need to occur. Joint regulations, planning, arrangement and deciding — these are activities undertaken by group members in order to move the learning cycle further. In this phase, goals are presented and ways to achieve them are planned. According to some authors, adjustment takes place not only before task execution, but also during it as well (Schippers, 2003).

In a situation with a new technology, this step in the group learning cycle will include activities that aim at collective agreements to improve the use of the system in the group. Group members may take initiative to arrange (request) additional training, instructions, manuals, and other learning activities. Developing regulations in order to improve the use of technology can become a crucial issue, especially if the users never worked before as a group. For example, this might involve decisions about dividing responsibilities in making

inputs and schedules of making outputs. Decisions may be also made about sorts of documents to be submitted or about the data traffic and classification. IT might also concern group process issues like developing regulations for intermediate evaluations of the IT project, supporting on-line chat about hot issues in the project and news overviews.

These plans will be implemented in the action phase. After planning is completed, its implementing starts and this provokes a new wheel beginning with collective acting.

A new learning cycle will be based on the previous group experience and knowledge. Planning can also take place during the action, or executing of a task, when plans are developed and shaped by seeking feedback or group reflecting processes. This strengthens the importance of group reflexivity.

It should be noted that the five steps in group learning do not necessarily take place in consecutive order. The decomposition into five steps is not a temporal but a logical decomposition, which serves to understand and analyse group learning processes.

To summarise, group learning is understood in IT implementation as negotiations among the targeted employees aimed at developing implementation of a new system: they practice with the system and discuss the experience, experiment and search for new possibilities and communicate upon it, ask for help, clarify difficulties, talk about errors while working with it, propose new actions to improve its use, plan further implementation, develop common rules on working with the system, evaluate its use at different stages, and sometimes reject it.

Group learning in groupware implementation is defined as all interactional processes through which group members develop interpretive schemes about a newly introduced system that help them to implement it, that is, to work together with it skilfully and task-consistently.

Methods

We have conducted a case study research in one of the larger hospitals in The Netherlands, called Medinet, where a new personnel management system was introduced.

The case study lasted 10 months and was based on qualitative methods like semi-structured interviews, observations, field notes, and documents analysis. Thirty-four interviews were conducted, lasting from 45 minutes to two hours, in total of 48 hours. During interviews we asked employees to describe how and why the new system was introduced, what kinds of job tasks were supported by the system, characteristics of the system, and so forth. Such questions allowed listening for understanding of technological features and functionality, attitudes towards technology, examples of group learning behaviour, and learning climate in the company. Postscripts of all 34 interviews were again discussed with interviewees for verification.

The qualitative approach supported an analysis of different actors' interpretations of the technology and their actions around it. In order to analyse the qualitative data, we operationalised group learning processes for groupware implementation. The definitions are given in Table 1.

Table 1. Operationalisation of Adoption of Groupware through Group Learning.

Dimensions of group learning	Components
1. Collective acting – task-related operations with the system undertaken by members of a group.	- operating with basic modules in everyday tasks performance - searching for new techniques in the system
2. Group reflecting – communicating upon extent to which the system supports performing tasks.	- discussing difficulties in use of the system - comparing with another software experience - declaring individual problems in use of the system
3. Knowledge disseminating – behaviors of the group members that aim at externalisation of ideas about the system in order to improve its usage.	- demonstration of operating with technological options - proposing new actions in order to improve ongoing use - clarifying difficulties to the team members
4. Sharing understanding – the level of common meaning of the system regarding the role of the system and its functionality.	- clearness about the purpose of the system - users' needs in the system - understanding of operating with the modules in the system - attitudes towards functionality of the system - attitudes towards future state of the system
5. Mutual adjustment – activities that aim at collective agreements on ongoing use of the system in the group.	- arranging (further) learning activities to improve use of the system - developing regulations - evaluating intermediate results

Case Study

Our case study reports on the implementation of a personnel administration system — Beaufort — in one of the larger Dutch hospitals, called Medinet, which has 1,070 beds and around 3,700 employees. The project, involving acquisition of a new information system, development of the project plan, and realization, started in June 1999 and was expected to be completed in December 2001.

The project had two planned phases: introduction of the system to the central personnel and salary administration (PSA) department, and introduction of the system across the entire Medinet. From our theoretical perspective, these became two distinguishable sub-cases. The PSA department implemented Beaufort effectively, efficiently, and in accordance with the initial plan (sub-case 1). The introduction of the same system to the personnel specialists in other departments failed, which led to the blocking of the whole project in October-November 2001 (sub-case 2).

Organizational Context

There is a tight cooperation between the PSA and the local managers: every day the latter send information in special paper-based forms about all changes in personnel data to the PSA. Day-to-day communication between all representatives of the personnel service in all departments and units was made via internal paper-based mail, e-mail, fax and telephone.

The idea of the new system was that local managers could input the personnel data straight into the system and could share that information across departments. At the same time PSA employees could immediately use these data to make any salary mutations.

System Specification

The Beaufort system, developed by the Dutch software company Getronics, is a personnel and salary administration system extensible with modules for time registration, human resource management, financial management, and so forth. One of the strengths of the system is that it allows decentralized use. Data entry

can be done locally in each department. Department managers can have access to management information for their department.

Beaufort is a system that provides a company with the opportunity to improve and decentralize its internal personnel management processes. It is a module-based personnel and salary administration system that contains technical options for publishing, composing, structuring, improvisation, and storing personnel data. There are seven modules with which users can perform document administration: personnel management, salary administration, sick leave administration, formation and organization, time registration, office link, and report generator.

The basic module is personnel management, through which the users input and update all the information concerning personnel data (see Table 2). These inputs do not require specific codification, as they are registered using normal words.

The sick leave administration and time registration modules are very important in salary calculation. All inputs in those two modules are coded using special numbers, consisting of 3-5 digits. Any changes in the code numbers might indicate changes in the working conditions (for example, less or more working hours per week, or urgent working hours, or differences in types of sickness, including professional sicknesses) that will automatically modify the salary in the salary administration module.

The salary administration module also requires codified inputs. The users (salary administrators) combine all the personnel data in this module (such as sick leave days, participation in the optional schemes for fringe benefits, flexible and urgent working hours, types of professional qualification, and medical authorization). Any small mistake in numerical input would lead to an incorrect salary for an employee.

Beaufort's formation and organization module provides the structure of the company in a hierarchical manner: sub-departments and units, clusters, divisions, and so forth. It gives an overview of the whole company and allows one to see the place of any employee in this structure. Only Medinet's IT department is authorized to make changes in this module and update the information; other users can only read it.

Office Link is a special HRM module that allows HR administrators to send letters to employees using mailing lists within Medinet, for example to a certain department, or to all nurses. Such letters may concern a range of personnel

information—changes in work contracts, invitations to special events, update on labor conditions, information, and so forth.

The final module — “Informer” — provides the possibility to generate non-standard reports upon requests from the HR managers: reports about different expenses on yearly or monthly bases (such as travel expenses or telephone bills), salary and premium overviews, and so forth.

Specification of the Beaufort functionalities is given in Table 2.

The Beaufort project’s strategic plan (January 2000) contains information about the reasons for Beaufort’s introduction at Medinet. It states that the introduction of Beaufort is aimed at improving the efficient processing of HR

Table 2. Specification of the Beaufort Modules.

Module	Specification
Personnel Management	Registration of: • Personnel data: name, title, address, family status, date and place of birth, employee number, type of contract, department and function, special authorization issues, participation in the fringe benefit options, and so forth • Career development data: educational background, professional experience, ongoing professional development (courses, education, etc.), and social activities. Inputs are not coded.
Salary Administration	Operating with all inputs from other modules in order to calculate salary. All inputs and outputs are numerically coded.
Sick Leave Administration (SLA)	Registration of absence (total or partial) due to sickness, and notification of this absence to the various external administrative bodies related to the social security system in the Netherlands. Inputs are based on the date, type of sickness, necessary treatment, pregnancy, frequency of sickness, and relationship with the occupation in the hospital, and so forth. Inputs are crucial for salary administration. All inputs are numerically coded.
Formation and Organization	Detailed picture of the organizational structure and employees within the hierarchical order: divisions, clusters, departments, sub-departments, sub-units, and so forth.
Time Registration (TR)	Registration of working hours in accordance with the collective agreements for Dutch Hospitals (special registration of weekend and holiday working hours, emergency hours, day and night shifts, etc.). Inputs are essential for calculating monthly salaries. Inputs are numerically coded.
Office Link	Administration of various types of letters to employees (invitations, congratulations, bulletins, etc.).
Report generator “Informer”	Creating non-standard reports.

administrative data, simplifying admission to strategic information, and improving the protection of sensitive personnel information. Other goals were described as follows:

- To increase the efficiency of personnel administration by restructuring the HRM processes from a highly centralized approach to a decentralized one. Local HR managers were expected to carry out data processing directly using the system.
- To create shared information files, leading to the use and exchange of personnel information among local managers.

In the Beaufort project at Medinet, two modules were selected for decentralized use: sick leave administration and time registration. Sick leave administration involves registration of absence (total or partial) due to sick leave and notification of this absence to various external administrative bodies related to the social security system in the Netherlands. It is important that these notifications are timely and correct; failure to do so may lead to a situation where Medinet is held liable for a financial compensation that could have been claimed elsewhere. Time registration is essential for calculating the monthly salary. For doctors and nurses the salary is a function of the number of hours worked on different kinds of duties.

Findings

In this section we present our findings from the case study in the following order: first results of the implementation in the PSA department, after that the results among the decentralized users.

Beaufort and the PSA Department

The group learning processes in the PSA department in order to adopt Beaufort were characterised as moderately high. We provide the description of these processes based on the textual analysis of the interview transcripts.

The PSA employees operated with the system very actively in their day-to-day task performance. Mainly it was based on the running basis modules, while searching and testing new techniques were exceptional.

They critically reflected upon their experience with the system. Every morning they discussed different problems in ongoing use during special sessions. Also informal discussions took place often. They had special notebooks, where they noted every nuance from Beaufort that must be discussed together. It led, for example, to a long chat about rules for sending the salary data away. At the beginning the system used to make some unexplainable errors (e.g., mixing up the numbers, or miscalculating working hours). An employee who first found that immediately pointed out those errors.

Everybody felt free to declare their individual difficulties and lack of skills in use of some modules. They knew each other's difficulties with operating the system.

Knowledge disseminating was rather intensive and based on two streams. Firstly, some active members stimulated, proposed and demonstrated new ideas with the intention to improve the usage of Beaufort. Secondly, at a more modest level, colleagues clarified for each other different aspects of Beaufort. Sharing understanding among the PSA employees was moderate. What is interesting is that they all had similar ideas concerning the role and functionality of Beaufort, but their understanding did not reflect the real purpose of the system.

Mutual adjustment was moderate and mainly related to arranging further learning activities and suggestions concerning improvements of the system. Collective agreements and developing new regulations to apply new ways of working with new system were not initiated.

In sum, collaborative learning processes within the PSA group members can be characterised as strong. Task-related operations with Beaufort, communicating about different aspects of it, activities oriented towards knowledge externalisation and achieving collective agreements were strong. Only the group understanding of the role and functionality of Beaufort was moderate.

The PSA employees valued the system as very helpful and advanced in supporting their tasks. In particular, they rated highly that all the personnel information was placed on one screen. They estimated that they could perform the documents and administration procedures faster than with the previous system.

Also they found valuable that the system helped them in communicating with their clients (employees of the Medinet): during telephone calls it was enough to use only one screen without difficult paper-based searching processes.

Based on the observations and interviews we may conclude that PSA members have adopted the newly introduced system with high level of efficiency. All employees got used to Beaufort in accordance to the scheduled plan — within three months.

Beaufort and Decentralized Use

We identified group interactional processes among HR local managers as low: group acting, reflecting, sharing understanding, and mutual adjustment hardly took place, and only under strong pressure from the management. Only knowledge disseminating was observed as promising. Below we illustrate it.

Every time when decentralized users met even small technical difficulties, they stopped operations with the system. They were not clear about the idea behind the decentralized use. Actually they did not need Beaufort for their usual job tasks. Operating with the system brought only additional duties and complexity into their tasks. Collective acting did not develop through exercising; instead, end users had to start working with a new system immediately. Decentralized users did not try to search for any new techniques in the sick leave administration module.

We did not identify group reflecting at all. They did not want to discuss any problems, but passively waited for the external help. They did not communicate about errors in the system with each other, and preferred to talk about it directly at a higher level — to the project management.

Knowledge disseminating was initiated by the PSA employees, who gave advice anytime upon the request of the decentralized users. The low level of sharing understanding resulted in a lack of clarity about even the content of the sick leave inputs. Mutual adjustment was observed as absolutely low. Tasks and rules were not written down — there was not any agreement on how to work together.

The HR managers were of opinion that the system did not facilitate their tasks, but rather brought new ones for them. They acknowledged the importance of Beaufort for the salary administration, but did not find their participation in it essential. They stressed that time registration and sick leave administration

were just small administrative responsibilities among their HR work, but the system made them pay too much attention to those tasks.

At the same time the users even lacked some data necessary to make inputs to the system.

The system required changing the usual way of performing the tasks (new collaborative responsibilities, sharing the data, duplication or triplication of the task performance, new schedule for making inputs).

The local HR managers have not adopted the newly introduced two modules of the system in accordance to the project plan. They were struggling with the implementation process, described above, during seven months, and finally decided to stop it. All end users (100%) shared the opinion that it was necessary to suspend the project until better times.

Discussion

The perspective of group learning provides us with interesting notions about different outcomes between the two sub-cases. We discovered that group learning processes did take place in both cases, but the content of them was rather different. In the PSA department these processes helped to improve adoption of the new system and led to the stable use of it. In the group of decentralized users learning processes blocked adoption of the new system and contributed to termination of the whole project.

While we credit success and failure of Beaufort adoption to differences between group learning, we also realize importance of the organizational circumstances for those processes. First, we summarize and conclude about the content of group learning in adoption of Beaufort, and after that we discuss the organizational environment for the system implementation.

To estimate group learning we gave qualitative labels ranging from “weak” to “strong” (active-passive, high-low, intensive-fuzzy, etc.). Giving such labels, we kept our operationalisation scheme, where “high” learning meant the intensity of the users’ activities and orientation towards improvement of system adoption. We have categorized group learning in the PSA department as relatively strong towards adoption of Beaufort. In the group of decentralized users, group learning was labelled as weak towards adoption of Beaufort.

PSA employees communicated and discussed different aspects of Beaufort implementation with the aim to improve its use. We discovered the leading role of group reflecting and knowledge disseminating. “Activities-based” group learning processes (collective acting and mutual adjustment) were lower. Sharing understanding — the content of the shared meaning of Beaufort among PSA members — at the beginning slowed down implementation. This has changed while using the system: PSA members transformed their perceptions of the system from ignoring to acknowledging its advantages.

Decentralized users also communicated actively about different aspects of Beaufort. Their discussions aimed at sharing negative feelings concerning the system and the future introduction of it in the whole company. They exchanged their experience and evidence against using Beaufort, and suggested terminating the pilots. They perceived the system as unreasonably difficult and complex to operate.

It was interesting to find the development of employees’ needs in a new technology. We think that in an ideal situation, employees should need a new system before its introduction. These personal needs can differ from the main goal of a system in a company. However, in both Medinet sub-cases we have observed an absolute disregard of the individual needs in introduction of a new system. PSA employees developed and realised their needs in Beaufort while implementing it (this even helped them to clarify the intention of the system). Decentralised users kept on lacking any individual needs for more than six months.

The most illustrative opposite results were discovered in the processes, which we labelled “mutual adjustment”. In the PSA department, employees arranged educational activities to learn more about Beaufort; they strived to reach new departmental rules and agreements in order to ease the use of Beaufort. Decentralized users put efforts to arrange different sessions to convince the project team to stop the pilots. We have characterised the group learning process in the two settings in Table 3.

Table 3. Group Learning Processes in Two Settings.

	Group learning in PSA	Group learning among decentralized users
Collective acting	Moderate to Active	Passive
Group reflecting	Mostly strong	Moderate to weak
Knowledge disseminating	Mostly intensive	Fuzzy
Sharing knowledge	Moderate	Low
Mutual adjustment	Moderate to Strong	Weak

Although the insights that come out of the learning perspective are remarkable, the results need to be considered from a broader perspective.

The two sub-cases led us to the notion that functionality played an essential role and even to some extent predicted the results. The system aimed to carry organizational changes in the whole company regarding task design and collaboration among employees. In fact it is not a novel idea to say that the organizational change can hardly be realized by technical introduction of a new technology. Beaufort did not bring any task changes to the work of the PSA specialists. But the decentralized local managers had to change their work a lot. They had to learn new tasks, which were just secondary, and to take higher responsibilities to perform those tasks. The PSA employees did not face changes in the way they used to cooperate before introduction of Beaufort. But the local managers faced a new, very complex collaboration in a new situation. They faced the necessity to serve the system instead of getting support from it. At the same time the content of the tasks appeared to be crucial. The Medinet case study convinced us that the tasks related to the personnel information — administering and managing — were very sensitive. They are associated with the privacy and the security of very sensitive information, and therefore require strong responsibility if they are to be transferred.

In the PSA case, Beaufort played a role of the intensive groupware and supported reciprocal interdependence within one department. In the decentralized case there was a need for a higher cooperation between the departments, within the local communities, and with the PSA specialists. Beaufort became a multi-channel groupware and supported associated interdependence. A complexity of the groupware contributed to the negative results in the decentralized sub-case.

We suppose that before Beaufort was implemented for decentralized users, there was also a need to create collaboration among them. It does not mean that groups of users must have perfect collaborative prerequisites in advance in order to adopt the system. As we have said earlier, group processes do improve over the use of groupware. But essential group characteristics must be built up in advance. Those are interdependence, individual accountability, and task division. Such prerequisites prepare the basis for interactional processes, through which implementation of groupware, in our view, develops.

Conclusion

We have proposed a model for implementation of collaborative technologies that regards it as a learning process. The longitudinal case study in the Dutch hospital confirmed our theoretical assumptions that adoption of collaborative technology developed through group learning; when the system was introduced to the users they had to collaborate to perform the tasks. However, we should notice that the chapter presents the results of only one organization's experience. In order to validate the model, IT implementation in different organizations should be studied. That must include different types of companies and different types of information technologies.

Group learning includes interactional processes through which group members develop implementation of technology: they practice with the system and discuss this experience, experiment and search for new possibilities and communicate upon it, ask for help, clarify difficulties, talk about errors while working with it, propose new actions to improve its use, plan further implementation, develop common rules on work with the system, evaluate its use at different stages, and so forth. We have found that the five steps of group learning in accordance with our operationalisation scheme — collective acting, group reflecting, knowledge disseminating, sharing understanding, and mutual adjustment — existed in reality in both settings, PSA and decentralized users.

An important finding is that in both settings group learning emerged immediately after a new collaborative technology was introduced to the targeted users.

At the same time the content of group learning in sub-cases was opposite. In the PSA department it was categorised as strong, as it helped improve adoption of the new system and led to the stable use of it. Decentralised users blocked adoption of the new system and initiated termination of the whole project — also through group learning, which was oriented towards blocking system usage.

The technology may trigger group learning, requesting redirecting of its scope towards alignment with a new user group. We have seen that the higher the level of interdependency between the users was requested by the system, the more efforts were needed to redirect group learning from a smaller group to the entire group of users across different departments.

Investigation supports the idea that organisational support does influence adoption of the system. The idea is not new. However, based upon our research we propose that organisational support should include special practices to

advance group learning in order to promote implementation of collaborative technologies. We realise that this itself it is not a guarantee of successful implementation yet, but ignoring group learning processes by project managers may lead to slowing down or even terminating it.

To summarise our discussion we may conclude that group learning processes do play an important role during adoption of the newly introduced groupware system and can explain its implementation success or failure. Independently of the organisational conditions, group learning emerges immediately after introduction of a new groupware system. However, the direction of group learning can differ depends on the conditions in which it takes place.

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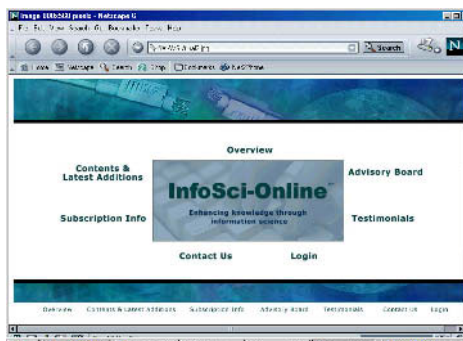
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