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# ACADEMY OF INFORMATION AND MANAGEMENT SCIENCES JOURNAL

An official Journal of the

Academy of Information and Management Sciences

C. Christopher Lee
Editor
Central Washington University

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**This is a combined edition containing both Volume 4, Number 1, and Volume 4, Number 2**

# ACADEMY OF INFORMATION AND MANAGEMENT SCIENCES JOURNAL

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# ACADEMY OF INFORMATION AND MANAGEMENT SCIENCES JOURNAL

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# ACADEMY OF INFORMATION AND MANAGEMENT SCIENCES JOURNAL

## CONTENTS

# LETTER FROM THE EDITOR

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As has been the case with the previous issues of the journals supported by the Allied Academies, the articles contained in this volume have been double blind refereed. The acceptance rate for manuscripts in this issue, 25%, conforms to our editorial policies.

The Editor of this Journal will continue to welcome different viewpoints because in differences we find learning; in differences we develop understanding; in differences we gain knowledge and in differences we develop the discipline into a more comprehensive, less esoteric, and dynamic metier.

Information about the Allied Academies, parent organization of the *AIMS*, the *AIMSJ*, and the other journals published by the Academy, as well as calls for conferences, are published on our web site. In addition, we keep the web site updated with the latest activities of the organization. Please visit our site and know that we welcome hearing from you at any time.

Chris Lee
Central Washington University
www.alliedacademies.org

# Manuscripts

# BUSINESS PROCESS REENGINEERING WITH GRADE**

**Diane Lockwood, Seattle University**
**Janis Tenteris, Infologistik Holdings, Inc.**
**A. Ansari, Seattle University**

## ABSTRACT

*This paper will first outline the GRADE (Graphical Re-engineering, Analysis and Design Environment) methodology. It then describes an actual case example of the Credit Processing department of a bank using GRADE tools.*

## INTRODUCTION

Huge investments in ERP (Enterprise Resource Planning) have been made recently to replace legacy systems. However, the resulting efficiency of the entire organization often does not increase dramatically because information technology projects are carried out without first reengineering the underlying business processes (Davenport, 1993; Keller & Brenner, 1995).

What is different about the systems development methodology embedded in GRADE (Graphical Re-engineering, Analysis and Design Environment) is that it explicitly begins with the basic reengineering principle advocated by Hammer and Champy (1993) that business processes should be redesigned before information systems are developed. That is, information systems are typically developed to model the existing "as is" way of doing business. In Hammer and Champy's own words (1993), "we are merely paving the cow paths," when we use this approach. Other common methodologies such as De Marco (1978), Yourdon and Constantine (1978), and tools based on structured methodologies (e.g., IEW, IEF, Excelerator), do not explicitly link business process modeling and redesign to subsequent applications development (as does GRADE), at least in any internally consistent way. This does not mean that these methodologies cannot be used to develop "as proposed" systems, but that there is no explicit formal method for articulating, simulating, and linking business process models with subsequent applications development. The purposes of this paper are twofold. First, it proposes a methodology to support the main tasks involved in Business Process Reengineering (BPR). Second, it describes ah way to model Business Processes (both "as is" and "as proposed") using a graphical software tool called GRADE (Graphical Re-engineering, Analysis and Design Environment).

## MAIN TASKS OF BPR METHODOLOGY

A model of business processes is required to develop a successful BPR. On the basis of such a model, three tasks of BPR can be performed using GRADE. First, the current business process

is modified in order to improve it by means of static analysis. Next, a dynamic analysis is performed to effect further improvements of the business processes. Finally, it coordinates the redesigned business processes with the organizational structure and skill sets of the employees (performers of tasks). These tasks are discussed in more detail in the following sections.

**Principles of Static Analysis**

The 'static analysis' refers to the analysis of the structure of business processes without recourse to simulation experiments. The goal of static analysis is to improve or optimize the business processes in accordance with several recommendations. A summary of such recommendations follows.

| | |
|---|---|
| *1.* | *Wherever possible, try to perform activities in parallel (concurrently) instead of in a sequential chain of tasks. This reduces the total duration of business processes considerably. According to Hammer and Champy (1993), a 50% reduction in total duration time is a realistic goal in BPR projects.* |
| *2.* | *Avoid organizational breaks within one business process. This means that the same person should perform any two sequential tasks if this person is qualified to do both tasks. Furthermore, this tends to minimize both the number of employees in each business process and the number of employees in any one business process and the number of different employees required to perform any particular task.* |
| *3.* | *Eliminate the execution of redundant tasks, especially those that do not add value or increase customer satisfaction.* |

**Principles of Dynamic Analysis**

Dynamic analysis of business processes consists of performing various simulation experiments in order to optimize the model. In order to obtain credible results the model requires a variety of process metrics, such as the duration of each task, transfer times, the expenses and productivity of each employee (referred to in the tool as "performer" of the task) , the underlying logic behind business rules and the frequency of inputs. Such information often is readily available in some form in many organizations, although it must often be reorganized in order to be put to use in the model.

**Coordination of New Business Processes with Organization Structure**

This step of BPR can be performed only after the dynamic analysis of the business process is completed. Coordination means that changes in the structure of the organization are needed to reflect changes in the new business process. Preferably this should be done for the system as a whole. If such activities are performed for separate subsystems (departments, branch offices, etc.) there is always a risk that these local changes might not improve the characteristics of the entire system.

GRADE provides a unique function 'Build System Model' (1999) to implement these recommendations. This function extracts the information from multilevel business process diagrams and organization charts and generates Communication Diagrams (CD). The CD's represent communication between different performers. In simple cases a visual inspection of the CD's is enough to make conclusions on how to restructure the organizational optimally. It is easy to determine from the CD's whether the performers that belong to the same organizational unit communicate intensively among themselves. If external communication (with performers from other branches) is more intensive than internal communication, appropriate changes in the structure of the organization (redeployment of performers) should be considered.

## CREDIT PROCESSING CASE

Realistically, it is often necessary to redesign several complex cross-functional business processes in a large application development project. However, to illustrate the methodology, the scope of this paper will be limited to two main business processes in the credit department of a commercial bank. The organization unit (credit department) involved and the two business processes are represented in Figures 1and 2, respectively. The GRADE software tool produced all figures used in this paper.

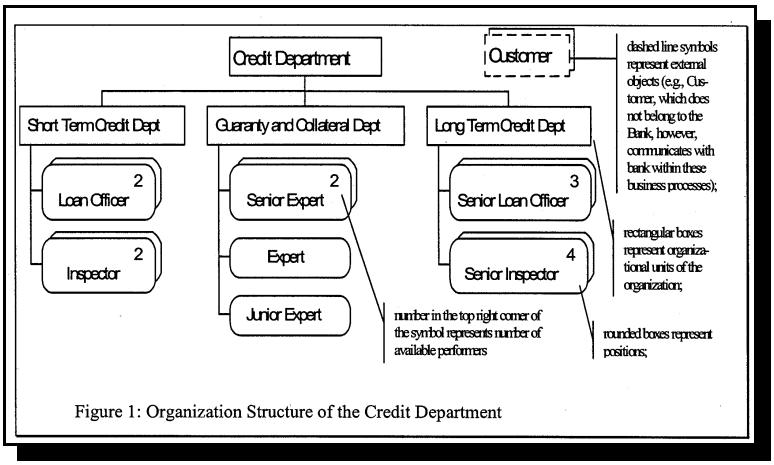


Figure 1: Organization Structure of the Credit Department

In addition to organization structure analysis, business processes are also required to undergo static analysis. The two main business processes, 'Short Term Credit' and 'Other Credit', reflect the current situation (as is) model, shown in Figure 2. The first model depicts the short term credit process for small and medium size credits, for current customers of the bank. The second model demonstrates the approval of other credits (large and/or long term and/or credits for new customers).

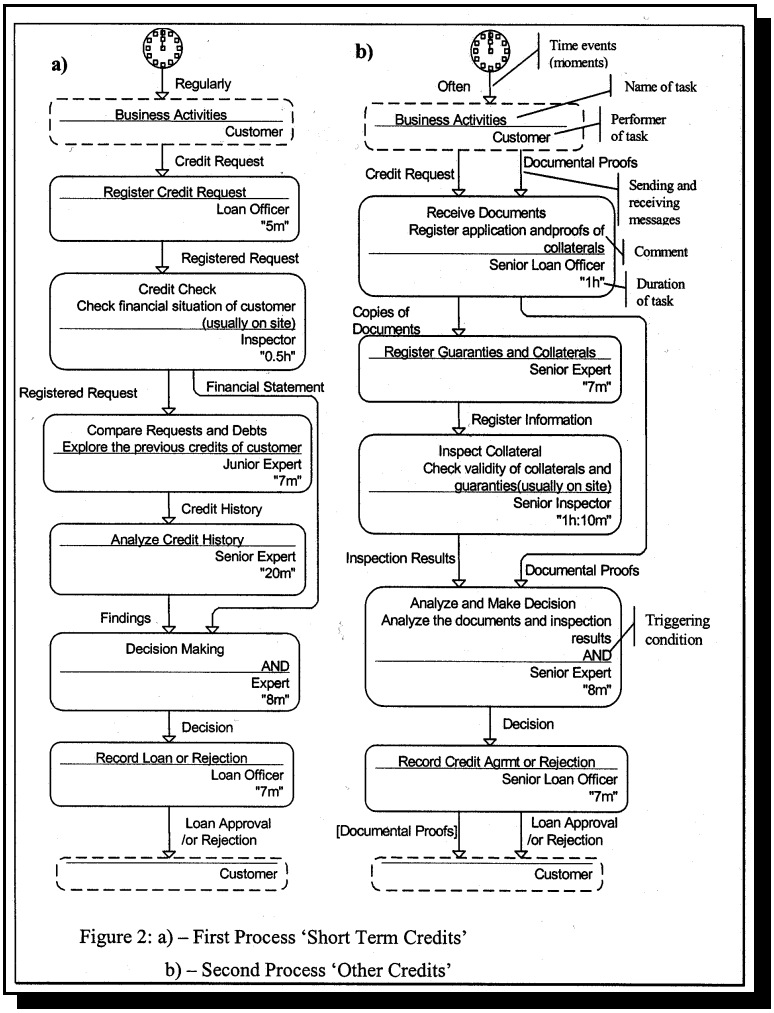


Figure 2: a) – First Process 'Short Term Credits'
b) – Second Process 'Other Credits'

## Application of Static Analysis

First Requirement: Perform Activities in Parallel. Although both business processes seem to be quite similar, the parallel execution of tasks can be introduced only in the first process, as show in Figure 2-a. The only input document required to start the task Compare Request and Debts is Registered Request. This task does not require Financial Statement which is produced by the previous task Credit Check. Thus, the first business process can be transformed so that the tasks Compare Request and Debts and Analyze Credit History are executed in parallel with the task Credit Check. The modified version of this business process is depicted in Figure 3.

However, as shown in Figure 2-b, a similar modification for the second business process is not possible. This is due to the fact that the task Register Guaranties and Collateral is initiated by Copies of Documents that are received from the previous task Receive Documents.

Second Requirement: Same Performer for Sequential Tasks. The tasks Compare Request and Debts and Analyze Credit History are performed in sequence by two different performers

(Junior Expert and senior Expert in Figure 2a. This causes an extra transfer of work materials from Junior Expert to Senior Expert. It is assumed that the task Analyze Credit History does not require the qualification of a Senior Expert, in which case a Junior Expert can manage it. This, consequently, leads to a change in the structure of the organization. Thus, we could reduce the number of Senior Experts and increase the number of Junior Expert positions. These changes in the organization diagram are reflected in Figure 4.

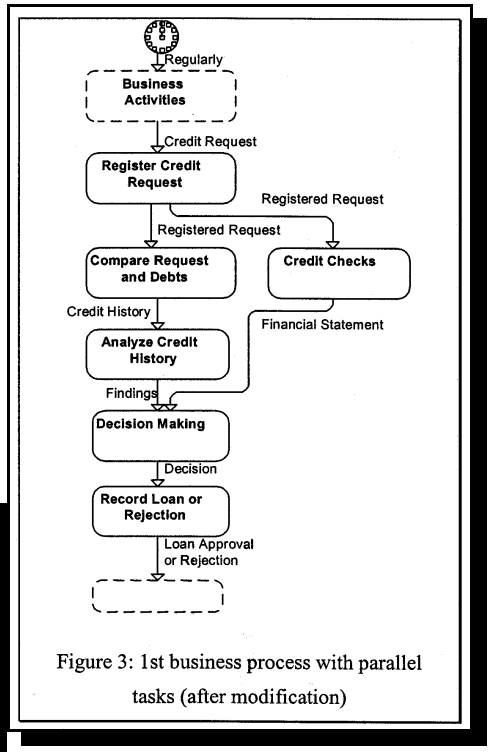


Figure 3: 1st business process with parallel tasks (after modification)

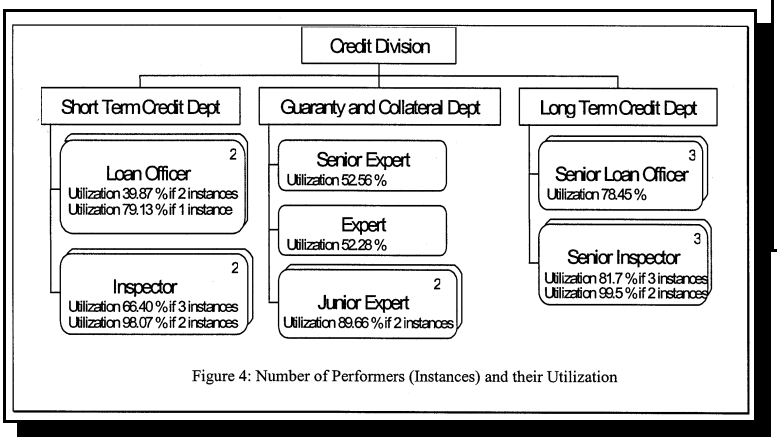


Figure 4: Number of Performers (Instances) and their Utilization

## Application of Dynamic Analysis

A number of simulation experiments were carried out with the model obtained after static analysis. During these experiments the number of positions was changed and the duration of the tasks and the utilization of the employees were varied. The number of concurrently active transactions and the lengths of queues were reasonably low and the Credit Division, as a whole, was able to manage the volume of incoming Credit Requests.

The utilization of performers (depending on the number of assigned performers) is represented in comment fields of the organization diagram in Figure 4. The optimal number of positions was determined experimentally (utilization analysis is not discussed herein for reasons of page limitations) but the results are represented graphically by comparing Figure 1 with Figure 4. Some comments on these results are:

| | |
|---|---|
| 1. | *The utilization of two Loan Officers is not sufficient (less than 40 %) and even when reduced to one, the utilization is not more than 80 % of the total work time;* |
| 2. | *The number of Senior Inspectors was reduced from four to three which gave an average utilization of 81.79%. Even two Senior Inspectors could manage the work load but then their high utilization (99.52%) would likely result in a waiting queue which would cause an increase in the cycle time of the process.* |
| 3. | *The replacement of one Senior Experts with another Junior Expert has proven to be successful from a utilization viewpoint. The two Junior Experts now have a combined load factor of 89%.* |
| 4. | *The utilization of Senior Expert and Expert is still too low (around 52%). In this case the options are to a) combine the two positions into one if the skills are transferable or b) give additional tasks to these experts in order to reduce slack time.* |
| 5. | *The total number of employees in the Credit Division can be reduced from 15 (see Figure 1) to 13 (see Figure 4). The tasks of Senior Expert and Expert would be combined in Figure 4 since the current utilization rate is low (around 50%).* |

The duration of business transactions after reducing the number of performers is depicted in Table 1. Although the duration of each task was given (see Figures 2, 3 and 4) as a constant value (which is an obvious simplification of reality), the duration of business transactions varied from 50 minutes to as long as 14 hours.

**Table 1: Elapsed Duration of Business Processes (results of simulation experiments)**

| Value | 1st Business Process | 2nd Business Process |
|---|---|---|
| Minimum | 50 m | 2 h 32 m |
| Average | 6 h 41 m | 3 h 25 m |
| Maximum | 14 h 24 m | 6 h 17 m |

The range of task duration for the second Business Process is relatively small when compared to the duration for the first Business Process. This can be explained on the basis of performer utilization. The average utilization of performers for the second Business Process is around 82% while that for the first Business Process, which has two Inspector positions, is 98%. The execution of the tasks of the Inspectors might often be delayed because they are still busy with the previous transaction.

This situation could be improved by increasing the number of Inspectors to three but this would decrease their utilization to 66 % (see Figure 4). This would also increase the total costs (14 employees versus 13). The positive result of such a change would be a shorter duration and range of the Business Process. This should be done if the customers consider the total processing time of Short Term Credit applications to be rather lengthy and if there is a risk that they might switch to another bank.

**New Organization Structure According to the Business Processes**

One of the Communication Diagrams (CD) obtained after the modification of the organization chart is represented in Figure 5.

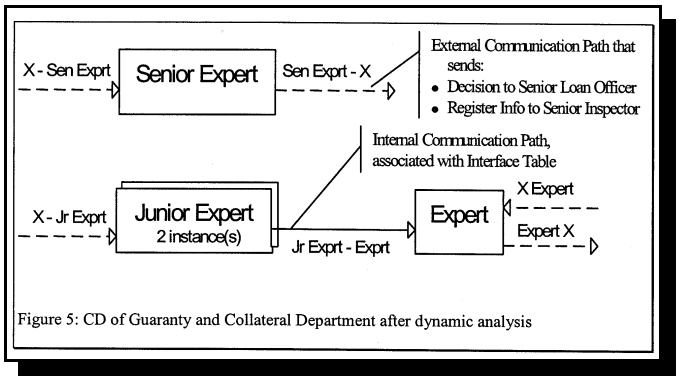


Figure 5: CD of Guaranty and Collateral Department after dynamic analysis

This example shows that the Guaranty and Collateral Department has an isolated (stand-alone) object - Senior Expert. However, the Senior Expert communicates with other objects (external to this department). This is depicted through external (dashed line) communication paths X - Sen Exprt and Sen Exprt - X where the Senior Expert sends messages to Senior Loan Officer and Senior Inspector of Long Term Credit Department.

These observations could lead us to the first modification step - move Senior Expert to the Long Term Credit Department thus improving the communication within the Long Term Credit Department. In contrast, analysis of additional interface tables (not shown here) for Expert and Junior Expert reveals that they are communicating mostly internally with performers of the Short Term Credit Department, i.e., the Loan Officer and the Inspector. This could be the basis for a major change in the organizations-move the Expert and the Junior Expert to the Short Term Credit Department and eliminate the Guaranty and Collateral Department.

Dynamic experiments with such changes are easy to make in the GRADE tool: one need only move (by drag and drop) both experts to another branch in the organization diagram. Then, with the push of a button, one can regenerate the communications structure of the Credit Division while maintaining referential consistency. Such changes in the organization of Credit Division might also reduce the total duration of each business process because the transfer time of messages between tasks (and their performers) would decrease as a result of the close proximity of each performer to his partners in the Business Process. In order to keep the model simple the transfer times are not represented in this case.

## CONCLUSION

Notice in this study that when the organizational changes are completed we have followed a strategy of maintaining a "flat" organization. The main results of these reorganizations can be summarized as follows:

- *Instead of three departments we now have just two - one for each business process. Both departments have similar numbers of employees, six to seven, and they both have intensive internal communication;*
- *The two new departments do not interact with each other. The next transformation possibly could be the elimination of the unit Credit Division in the next superordinate hierarchy level. This change would reduce the number of hierarchy levels, the number of manager positions, and make the entire organization more "flat".*

However, our goal was not to build a flat organization. GRADE equally well could help one follow the opposite strategy and create a traditional organization with specialized departments and a multilevel hierarchy.

A tool like GRADE can be helpful in understanding the current situation and in managing the changes to be made. GRADE consists of two primary components- Business Process Modeling and Information Systems Specification and Development. The front-end computer assisted systems engineering component (Business Process Modeling), can be used in undergraduate and graduate level MIS courses in Systems Analysis and Design, as well as in Operations Management courses where the focus is on process and work flow modeling.

The back-end application development component, Information Systems Specification and C-code Generation, can be used in upper division capstone MIS/CIS courses where the focus is project-oriented (i.e., the specification and development of a working prototype application). Ideally, GRADE should be used in a two-course sequence consisting of: (1) Business Process Modeling, and (2) Information Systems Specification & Development. Currently, GRADE is being used in a an MBA Business Process Re-Engineering course to model "as-is" processes, simulate and identify bottlenecks, and model proposed "as-redesigned" processes. A follow-up Computer Information Systems course on Applications Development could use the "as-redesigned" process as a starting point for applications protoptyping. It would capture re-useable entity relationship data models, document detailed process specifications, and automatically generate C-code for applications. All the model elements previously described (data, processes, performers, and user interfaces) are still kept in a central repository in a consistent and integrated manner. This makes any changes easy to accomplish. Used in this way, the emphasis on C-programming, per se, is minimized in favor of learning formal modeling and specification methods.

The BPR methodology and tool described in this paper are only one example of how Business Process Modeling can be systematically approached. Other methodologies and tools exist, but the integrated nature of the GRADE tool and documentation merits further examination and empirical testing of competing products.

## ENDNOTES

** *The GRADE tool is available for education institutions from Infologistik, 3 Wagnerbreite, Holzkirchen, D-83607, Germany. Phone: +49- 8024 30450. Web sites: www.infologistik.com and www.gradetools.com. Contact Mikus Grasmanis for further details on educational versions.*

## REFERENCES

*Business Modeling Language GRAPES-BM and Simulation Tutorial*. (1999). Infologistik, Holzkirchen, Germany.

Davenport, T. (1993). *Process Innovation*. Boston: Harvard Business School Press.

De Marco, T. (l978). *Structured Analysis and System Specification*. NY: Yourdon Press.

Hammer, M. & Champy, J. (1993). *Reengineering the Corporation*, NY: Harper Collins.

Yourdon, E. and L. Constantine (l978). *Structured Design*. NY: Yourdon Press.

Keller G., Brenner, W. (1995). *Business Reengineering mit Standartsoftware*, Frankfurt: Campus Verlag.

# DOMAIN NAMES AND TRADEMARKS - THE UNHAPPY MARRIAGE CONTINUES BUT THE RULES ARE CLEARER

**Brian McNamara, Cal State University Bakersfield**
**William Go, Go & Associates**

## ABSTRACT

*Did you hear about the domain name sold through ebay.com for 8 million dollars? The purchase was later found to be a hoax, however, a backup buyer did purchase the domain name for quite a considerable sum. Up until the end of 1999 there were no particular laws against cyber-squatting. To remedy the situation the plaintiff had to use traditional trademark law to resolve the dispute. In recognition of this problem, former President Clinton signed into law the Anticybersquatting Consumer Protection Act. Along with the Anticybersquatting Act passed by Congress, the Uniform Domain Dispute Resolution (UDRP) is another tool used by trademark owners. Both remedies have been successful to a great extent. This paper will review why cyber squatting exists, trademark law as it applies to cyber squatting, the remedies available as an alternative to trademark law and two suggestions to make this job description extinct.*

## INTRODUCTION

What's in a name? In cyberspace the answer is simple – MONEY. "Dot-com is the 800 number of the 1990s," said Chris Elwell, vice president of internet.com – a domain that Mecklermedia bought last month for more than $100,000. "I wouldn't be surprised if they go for over a million dollars in a few years," referring to the skyrocketing price of domain names [1].

In order to find a website you need an address, and the simpler the address the better. Mankind craves simplicity, so the idea of short and quick names is not a recent "cyberspace phenomena." By way of example, Champion Sparkplugs became "AC Sparkplugs," shoulder pork all meat is "spam," and REO Cars actually stood for Ranson E. Olds, the father of Oldsmobile.

To understand the importance of a domain name, one must understand that the domain name is the "key" that unlocks the website. A key that is too long and bulky in today's world could mean the visitor will just go on to the next door with easier access. This simple "truth" of cyberspace and human nature is that it did not take long to generate a new world of speculators who have invented the world of "cyber-squatting."

Making money as a cyber-squatter seems too easy. What about the law? Does it have anything to say on the business of registering and selling domain names? In order to understand its legality one must first examine what a domain name is and then review how traditional trademark law fits into the equation.

## DOMAIN NAMES

The technical aspects of domains names are as follows: A domain name is a unique address and each domain name is divided into fields separated by periods. It is made up of an IP network address and a local address. Together both parts make up the Uniform Resource Locator (URL) that is used to identify the location of some interface on the Internet. An alphanumeric domain name usually consists of two levels: a Second Level Domain and a Top Level Domain. For example, the Whitehouse's website, http://www.whitehouse.org/ the Second Level Domain is "whitehouse" and the generic Top Level Domain (TLD) is ".org." The http:// refers to the protocol used to transfer information, and the "www" simply refers to the World Wide Web.

## TOP LEVEL DOMAIN NAMES

Each domain name has three levels. The first is known as the top-level domain name. This is the last part of the URL. In our above example this would be COM. Currently there are several offerings in this regard and are as follows: .com, .web, .rec, .arts, .info, .store, .firm, and .nom. The problem here is that .com was the leader and it will remain indisputably the "Fifth Avenue" address [2].

With the addition of these new ".coms" offerings, the potential for new names has expanded exponentially. The question then becomes does Amazon.com have to register Amazon.Web, Amazon.firm, etc. as a defensive measure to protect the quality and value of the original Amazon.com [3]. These names are distinctive but do they sufficiently distinguish from the original trademark to satisfy trademark law?

As it stands the International Ad Hoc Committee (IAHC) has failed to address the issue of customer confusion over www.wal-mart.com and www.wal-mart.store. Moreover, in the alternative can a cyber squatter be able to purchase www.wal-mart.store if and when it becomes available exercising priority over other potential purchasers? [4]

The Patent and Trademark Office in its Examination Guide N0. 2-99 PTO specifically states:

> *When a trademark [or] service mark . . . is composed, in whole or in part, of a domain name, neither the beginning of the URL (http://www.) nor the TLD have any source indicating significance. Instead, those designations are merely devices that every Internet site provider must use as part of its address. Today, advertisements for all types of products and services routinely include a URL for the web site of the advertiser. Just as the average person with no special knowledge recognizes "800" or "1-800" followed by seven digits or letters as one of the prefixes used for every toll-free phone number, the average person familiar with the Internet recognizes the format for a domain name and understands that "http," "www," and a TLD are a part of every URL [5].*

The Courts, in general, agree with the above rationalization of top-level domain names indicating they have no trademark significance. The courts also find that other modifiers of a URL like "http://www" have no trademark significance [6].

## SECOND LEVEL DOMAIN NAMES

The second level identifies the organization or individual you are looking for on the Internet. In the above example that would be WHITEHOUSE.

## THIRD LEVEL DOMAIN NAME

The third and last level refers to the location of the site you are looking for on the Internet. Once again in the above example that would be WWW. To further complicate the matter we must now next look at the law as it applies to the "name," in reviewing this area, we must examine traditional trademark law.

## PROBLEMS IN THE PAST

The conflicts have arisen at the Second Level Domain Name level between trademark holders and others who have registered character strings identical or similar to their trademarks. This type of activity has been commonly known as cyber squatting. In these conflicts the person who registers the domain name has no intention of using the name on the Internet. They plan to hold the name and sell it at a later date for profit or hold it for ransom. It must be stated that not all people who register domain names do so in the hopes of reselling them. For example, firms themselves who own the trademark, register the domain name though they do not intend to use it or do so with the intent to use at sometime in the future. Ultimately however, many look upon domain names as a type of "Oklahoma Land Rush" scenario, in which the person who claims the most gains the most [7].

## THE TRADEMARK DILEMMA

A dilemma exists with conflicting pressures from existing trademarks and growth of the Internet. When a person registers an existing trademark as a domain name and uses it on the Internet without the trademark owner's consent, potential litigation could be the result. Consumers who access the site on the Internet may be misled about the source of the product on the site or service offered on the Internet. Worse could be that the owners of the trademark may not be able to protect their rights without taking the issue to court, this would generally cost a lot of money [8].

On the other side of the coin is the need for the Internet to function as an effective commercial market. People who take the time to register their trademarks must have confidence that their time and effort will be protected in this new environment. The Internet as a relatively new medium for business must respond appropriately considering the Internet as a whole and the needs of trademark owners [9].

It has been said that the law speaks through its cases, so next we will look at cases in this area.

There was a famous case MTV v. Curry. [10]. A VJ working for MTV registered the Internet site MTV.COM. After Mr. Curry left MTV, MTV demanded that Mr. Curry disable his

Internet site and set up another one for himself. Before trial the dispute was settled and Mr. Curry created another website and gave to MTV the domain name MTV.COM.

An enterprising magazine writer, named Quittner, noticed that no one had registered the domain name of McDonald's. The writer, to his credit, did contact McDonald's but received no response. He then registered the domain name of Mcdonalds.com. [11]. Later he did offer to give the name to McDonald's if they would give computer equipment to a grade school [12]. McDonald's in turn put pressure on the InterNIC (the body who registered the name) to retract the writer's registration. InterNIC were faced with a dilemma. They operate on a first-come, first serve basis. Here they initially did revoke the registration but then did a 180 degree turn and left the registration in the writer's name. McDonald's donating money to the grade school settled the case [13].

People have realized that there is money to be made in registering and later selling domain names that other people want. The defendant in the following case did understand this concept. The case, Panavision Intl, L.P. v. Toeppen, was finally resolved in 1998 [14]. In this case Toeppen registered the domain name panavision.com. The company Panavision owned the registered trademark Panavision. When the company tried to register their trademark name on the Internet they could not due to the previous registration of the name by Toeppen. Toeppen asked for $13,000 for the registered domain name.

Panavision rejected the offer and sued Toeppen for dilution of trademark. In essence the court found that the use of the domain name by Toeppen diluted the value of the mark as applied to Panavision. In reading the case Toeppen's behavior regarding the demand for $13,000 directed the court to find that Toeppen was in the business of buying and selling domain names and was not interested in the value of the domain name itself. In essence, Toeppen violated federal dilution statutes.

In the above example, the court used "intent" to profit by name not "use" as a guiding factor. Given the results in the above cases, trademark law will grant exclusive rights in the area of domain names to businesses who have registered trademarks by applying the dilution statutes. In the vast majority of disputes between registered trademark owners and cyber squatters that have actually gone to trial have resulted in victories for the registered trademark owner over the non-trademark holder. Moreover, it seems that every organized cyber-squatter who has found themselves in court appears to have lost, assuming they could not prove intent to use as discussed above [15].

There is another reality - what is a trademark holder willing to pay to exercise that right without going through the hassle and cost of litigation? It is well known that the cost of a trial can be very expensive [16]. The reality being that a "pay-off" to the cyber-squatter for the name is frequently the most expeditious and cost effective way to resolve a potential trial.

In addressing "reality" one must make a distinction between legal reality and economic reality. In essence does the cost of justice outweigh simply paying off someone who has laid claim to your desired web address? Cyber-squatting is a delicate game in which the winner or loser is frequently determined by the following equation:

$$Justice = ((Cost*Need)+Urgency) / Principle$$

A simple formula based upon fundamental economic realities, traditional common law, and constantly evolving case law and "flying on the seat of their pants Internet entrepreneurs" enables some to find a "silver lining" in every new technological development.

To remedy the problems once and for all over the uncertainty that cyber-squatting generated, the government signed the Anticybersquatting Consumer Protection Act into law in November 1999. In essence the law makes cyber squatters liable in civil suits under the following conditions:

| | |
|---|---|
| *1* | *Have a bad-faith intent to profit from a trademark or personal name* |
| *2* | *Register, traffic in, or use a domain name, that is:* |
| *3* | *Identical to or confusingly similar to a distinctive trademark;* |
| *4* | *Identical to, confusingly similar to, or dilution of a famous trademark; or* |
| *5* | *The name of another living person, or a name that is substantially and confusingly similar to such a name, with the specific intent to profit from the name by selling the domain name to that person or any third-party; and* |
| *6* | *Act without the permission of the trademark owner or the living person whose name they use. [17]* |

Along with an Anticybersquatting act passed by Congress last year, the Uniform Domain Dispute Resolution (UDRP) is another avenue for resolution used by trademark owners.

The UDRP was established as an alternative to taking the disputes to trial. Moreover, the process to a resolution is alot faster than getting involved in the court system. The Internet's governing authority, the Internet Corporation for Assigned Names and Numbers, put the UDRP together. In its short existence the UDRP has resolved over 1000 cases and it has been reported that 76% of domain names have been returned to the trademark holder [18].

The UDRP is incorporated into the registration agreement for new domain names. Therefore, disputes are resolved in this manner. Applicable disputes and evidence needed to prove your case are defined as follows:

| | | |
|---|---|---|
| *a* | *Applicable Disputes. You are required to submit to a mandatory administrative proceeding in the event that a third party (a "complainant") asserts to the applicable Provider, in compliance with the Rules of Procedure, that* | |
| | *i* | *your domain name is identical or confusingly similar to a trademark or service mark in which the complainant has rights; and* |
| | *ii* | *you have no rights or legitimate interests in respect of the domain name; and* |
| | *iii* | *your domain name has been registered and is being used in bad faith.* |
| | *In the administrative proceeding, the complainant must prove that each of these three elements is present.* | |

| | | |
|---|---|---|
| *b* | *Evidence of Registration and Use in Bad Faith. The following circumstances, in particular but without limitation, if found by the Panel to be present, shall be evidence of the registration and use of a domain name in bad faith:* | |
| | *i* | *circumstances indicating that you have registered or you have acquired the domain name primarily for the purpose of selling, renting, or otherwise transferring the domain name registration to the complainant who is the owner of the trademark or service mark or to a competitor of that complainant, for valuable consideration in excess of your documented out-of-pocket costs directly related to the domain name; or* |
| | *ii* | *you have registered the domain name in order to prevent the owner of the trademark or service mark from reflecting the mark in a corresponding domain name, provided that you have engaged in a pattern of such conduct; or* |
| | *iii* | *you have registered the domain name primarily for the purpose of disrupting the business of a competitor; or* |
| | *iv* | *by using the domain name, you have intentionally attempted to attract, for commercial gain, Internet users to your web site or other on-line location, by creating a likelihood of confusion with the complainant's mark as to the source, sponsorship, affiliation, or endorsement of your web site or location or of a product or service on your web site or location [19].* |

## A POSSIBLE RESOLUTION TO REDUCE THE NUMBER OF DISPUTES

The sad thing is that disputes will continue. As long as they do it is important to try and work to reduce the number of disputes. To do this one must balance the needs of people who have registered domain name holders with the legitimate concerns of trademark owners. This would benefit the Internet community as a whole. One suggestion is to make available in all registry databases the following information to people who are considering registering a domain name.

| |
|---|
| *up-to-date registration and contact information;* |
| *up-to-date and historical chain of registration information for the domain name;* |
| *a mail address for service of process;* |
| *the date of domain name registration;* |
| *the date that any objection to the registration of the domain name is filed; and* |
| *any other information necessary to resolve disputes between domain name registrants and trademark holders expeditiously [20].* |

With the above information one would be hard pressed to claim ignorance if a legal dispute arises over the new domain name.

## SOMETIMES THE ANSWER MAY BE TOO SIMPLE

Domain name registration and the Patent and Trademark Office are like two trains running on parallel tracks. The companies themselves who register domain names have no interest in protecting trademarks. Couple this with the entrepreneurship of people who see potential for making money in any loophole available on the Internet. This has been effectively utilized by buying large numbers of domain names and then holding them for ransom. Think for a moment, what if the two trains started at the same station? This concept was stated directly by Diane Cabell a fellow at Harvard law School's Berkman Center for Internet and Society when she said [21],

> *"The good thing is that there is a huge market demand for an inexpensive centralized, global procedure."*

What if the companies who register the domain names became an international administered process including working with trademark offices in all countries? [22] This body would be a clearinghouse for all domain names. In essence they would determine trademark rights "out of the box" before a new domain name was issued. In theory this would make extinct the need for a dispute resolution mechanism. However in the meantime, the unhappy marriage between domain names and trademarks will continue.

## REFERENCES


[1] http://www.wired.com/news/news/story/4258.html

[2] http://www.wired.com/news/news/story/4258.html

[3] http://www.wired.com/news/news/story/4258.html

[4] http://www.wired.com/news/news/story/4258.html

[5] Reference United States Department of Commerce, Patent and Trademark Office, Examination Guide No. 2-99, Marks Composed, in Whole or in Part, of Domain Names (Sept 29, 1999).

[6] http://www.icann.org/tlds/correspondence/iod-v-core-22jun00.htm

[7] http://www.law.miami.edu/~amf/commentary.htm

[8] http://www.icann.org/general/white-paper-05jun98.htm#Principle1

[9] http://www.icann.org/general/white-paper-05jun98.htm#Principle1

[10] Resnick R. (1994), Cybertort: The New Era, THE NAT'L L.J., July 18, 1994, at A1.

[11] Quittner, J (1994). You Deserve a Break Today, NEWSDAY, Oct. 7, 1994, at A05

[12] Id.

[13] McDonald's Gives $3,500 to Get Name Back on Net, ARIZ. REPUBLIC,Feb. 6, 1995, at E1.

[14] 945 F. Supp. 1296 (C.D. Cal. 1996). aff'd___F.3d___(9th Cir. Apr. 17, 1998)

[15] http://www.law.miami.edu/~amf/commentary.htm

[16] http://www.law.miami.edu/~amf/commentary.htm

[17] Impari, S., The Complete Guide published by STP Specialty Technical Publishers Inc. 267 West Esplanade, Suite 306, North Vancouver B.C. Canada V7M IA5, II 4-13.

[18] http://www.wired.com/news/politics/0,1283,37801,00.html

[19] http://www.icann.org/yokohama/new-tld-topic.htm

[20] http://www.icann.org/general/white-paper-05jun98.htm#Principle1

[21] http://www.wired.com/news/politics/0,1283,39992,00.html

[22] http://www.domainnotes.com/news/article/0,,3371_559551,00.html

## BIBLIOGRAPHY

Galler, B., Software and Intellectual Property Protection, Quorum Books, Westport, Connecticut.
Impari, S., Internet Law – The Complete Guide published by STP Specialty Technical Publishers Inc. 267 West Esplanade, Suite 306, North Vancouver B.C. Canada V7M IA5

# CUSTOMER RELATIONSHIP MANAGEMENT STRATEGIES FOR THE INTERNET

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## ABSTRACT

*The primary purpose of the research is to study how CRM (Customer Relationship Management) can be done via the Internet. CRM is a process of identifying, acquiring, developing and retaining long-term, mutually beneficial relationships with an organization's best customers. We have classified various CRM tools widely used on the Internet into a 3x3 matrix. The first dimension is the CRM process (i.e., acquisition, sales, and service) and second dimension is the level of web involvement (i.e., low, medium, and high). Internet tools can be incorporated into traditional marketing strategies to make what we call web strategies. In addition, fourteen Internet tools used to practice CRM have been categorized based on level of customer interface, cost to implement and maintain each tool, degree of personalization, and amount of reach possible.*

## INTRODUCTION

During the agriculture age, people exchanged agriculture goods, which the other one needed (i.e., barter trading). All exchanges were confined to certain regions and limited by geographical boundaries. So there was a high degree of inter-dependence on each other. In the industrial age, the seller & buyer concept was coined. At first, manufactured produced the products and sold them aggressively to buyers (i.e., selling concept). Later, the product was produced and marketed according to the customer's requirements (i.e., marketing concept). With the advent of the Internet, we see the dawn of the information age. The Internet economy makes it possible to offer customers an experience unlike any experience they have had before. Goods & services are now specially designed in order to cater to a particular group or even a specific customer. The term "mass customization", which is the mass production of individually customized goods and services, has been popularized. It is the intention of the firm to provide goods and services that offer greater value to the customer. Companies try to make the customer loyal towards the firm by offering products that satisfy their needs better that those offered by the competition. Many companies are using Internet technology to reach, identify, acquire, and serve their loyal customer. An integrated approach can give the company the competitive advantage that it needs to successfully cater to the needs of customers in today's networked economy. The primary purpose of the research is to study the underpinnings of Customer Relationship Management (CRM). More specifically, this research will identify how CRM can be practiced successfully via the Internet. Using the tools of CRM, the

research will highlight techniques that can assist marketing managers in optimizing their overall Internet marketing strategies.

**Table 1:Industry Definitions Of CRM**

| Author | Definition |
|---|---|
| Forrester Research (Lane, 2000) | Consistent, high-quality customer support across all communication channels and business functions, based on common, complete information shared by employees, their customers, and business partners. |
| Aberdeen Group | Customer Relationship Management (CRM) is a class of front-line business applications used by leading organizations to acquire and retain long-term, profitable customers. |
| META Group (Anonymous4, 1999) | In its pure form, customer relationship management is a business philosophy, not technology architecture. |
| Oracle (Anonymous5, 2000) | Customer Relationship Management (CRM) applications deliver a complete lifecycle view of customer interactions, including those across marketing, sales, and service via call centers, internet, and mobile computing devices, to help you attract and retain customers and increase your market profitably. |
| IBM (Anonymous6, 2000) | Customer Relationship Management (CRM) entails supporting, developing, and retaining profitable customers. |
| Andersen Consulting (Anonymous7, 2000) | Customer Relationship Management is the practice of identifying, attracting, and retaining the best customers to generate profitable revenue growth. |
| International Data Corporation (Anonymous8, 2000) | The strategy of servicing the customer relationship through the following steps:<br>Determining satisfaction.<br>Analyzing profitability.<br>Building the relationship. |

## CONCEPT OF CRM

As evident in Table 1, there are several disparate viewpoints of CRM. For example, IBM's definition talks about only the steps of CRM and does not mention it as a continuous process. While each of the definitions is accurate, none of them are all inclusive. Furthermore, in the various definitions, CRM is defined as a monadic concept, which is beneficial only to the company and not the customer. These and other short falls make no one definition the best. However, some common themes reoccur throughout the current literature. As an alternative, we propose the following definition of CRM.

*CRM is a process of identifying, acquiring, developing, and retaining long-term, mutually beneficial relationships with an organization's best customers.*

Three points need to be noted in this proposed definition. First, CRM occurs over time. That is, prospects have to be identified first, and then relationships have to be developed and preserved later. Second, the, relationship must be advantageous to both the parties. Relationships can not be uni-directional (i.e., benefiting one party), they must be bi-directional. More specifically, the result should be a "win-win" situation for all parties involved. Third, relationships do not have to be developed with every customer, only with the most profitable ones. Separating customers into categories based on their ability to make profits for a firm has been appropriately termed "lifetime value of customer". Basically, we can classify the process of CRM as follows. Customer acquisition involves identifying potential customers by understanding their needs, wants and desires. Then creating an interest in the firm by offering potential customers goods and services to satisfy their needs. Finally, offering customer support in the form of after-sales service to build loyalty to ensure customer satisfaction.

In line with the recent paradigm shift from transaction marketing to relationship marketing, CRM attempts to go beyond the selling process (i.e., completing the transaction). It aims at creating a mutually beneficial relationship with the customer by providing personalized goods and services. By this, the company attempts to create a bond with the customer and make him/her loyal towards the company. In the long run, loyal customers account for much of the company's sales (80:20 rule) and also save the company expenditure in acquiring new customers. Today, technology can be used to practice CRM both effectively and efficiently. Employees, both internal and external, can use CRM applications (also called front-office software), when they are in direct contact with customers and prospects. The software allows customers and prospects to place and track orders, obtain current product information, solve problems, and schedule service calls.

## THE IMPACT OF THE INTERNET ON CRM

The Internet is proving to be a very cost-effective and efficient means of reaching both new and old customers. Detailed information from simple brochure type of information to sophisticated e-commerce technology can be maintained on the Internet. At a fraction of the previous cost, customers have the ability to locate and select the information they need in as much detail as they want. Therefore, from the customers' points of view, the information is very personalized and available 24x7. Also, a company can make changes in product specifications and new products are made available as soon as they are developed. This information is both convenient to the customer and cost-effective to the company.

For firms subscribing to the marketing concept, the Internet is an economical tool to survey customers' reactions to new goods and services. This enables companies to identify product and market opportunities earlier and provide better new products. This can increase company revenues and give firms a competitive advantage over other companies.

E-commerce is gaining popularity on the Internet. Customers can order and even pay for goods directly over the Internet, similar to the interactions between companies and vendors. Customers can track the status of their orders whenever they want from where ever they want. Ordering directly on the Internet saves time for customers and the company saves money since orders do not have to go through a sales representative, which cost more. Perhaps the most important aspect of customer relations is not customer acquisition or the actual sale, but the customer support after the sale. For example, a company may use autoresponders to answer customer queries, which is more economical than maintaining call centers, which are more expensive.

## INTERNET TOOLS

The Internet offers many applications & tools, which a company can use to improve customer interactions. Fourteen commonly used tools will be presented in this paper. These tools can be applied to one or more aspects of CRM.

### Portals

A portal is a web site or service that offers a broad array of resources and services, such as e-mail, discussion forums, search engines, and on-line shopping. A portal is used for all aspects of CRM from customer identification to after sales support. However, unlike most current marketing-focused websites, which are created for potential customers, portals are specifically targeted towards current customers. There are two types of portals currently being used, business portals and customer portals.

Simply defined, a business portal is a web page that allows business customers to access their specific account information via the Internet (Wenninger, 2000). Business portals are similar to the EDI systems of the past. Using this Internet tool, customers can view a variety of details such as call and equipment histories, call statuses, maintenance contract details, project information, schedules, and billing. Equipment and facility documentation such as O&M (Operations and Maintenance) manuals, CAD (Computer Aided Design) drawings, and replacement parts can also be included. Some portals even facilitate submitting service requests online. In addition, companies may be able to customize the type of information they display to business partners. The actual process of accessing information on a business portal is similar to accessing any other website. Business customers point their Internet browser to the portal's web address and navigate through the web pages. For privacy and security purposes, most portals are firewalled and require a user ID and password, which allows customers to only view the details of their own account. Most business portals are integrated with a service management or project-oriented application. As a result, time-consuming double entry is eliminated and all information is displayed in real-time. This integration also allows for easy facilitation of online service calls.

From a consumer viewpoint, customer portals are public portals (B2C), which allow "personalized" versions of publicly available information. For example, "MyYahoo" and "MyExcite" users can create their own space in the Internet. Options include changing the color

scheme, adding modules like local weather forecast, news, etc. This offers a truly personalized experience to the customer where they can see information they want to see. This creates a customer "lock-on" where the user comes to the website on a regular basis. These services collect a user's profile information and detect the user's presence on the Internet so as to create direct marketing communication channels to the user. From a business perspective, they provide "mass customization" capabilities. Besides offering personalized information, portals can service a large number of customers. The disadvantage here is the high cost of maintaining expensive computer systems and technical staff. Therefore, this is strictly a high-level web involvement tool for the firm that serves all three aspects of CRM (customer acquisition, sale, and customer support).

**Email**

E-mail is the backbone of a company's CRM strategy over the Internet. E-mail allows customers to communicate directly with company experts who are best equipped to help them with their problems. E-mail can be much more efficient and effective than snail-mail and phone-based direct marketing programs. IMT Strategies' research indicates that e-mail can be 10 times more efficient than direct mail and 20 times more effective than banner advertising, and costs pennies to deliver (Anonymous1, 2000).

Email can be used for any and all aspects of CRM on the Internet. They can be used to reach out a widely dispersed audience with very low cost. Internet marketers should make extensive use of email to reach out to their customer. To be effective, the company should have a clear understanding of the customer when sending emails. Email is also a very strong tool for customer feedback. "Permission-based" e-mail has become a marketing tool that, when executed properly, can cost-effectively build customer relationships and reach out to many new prospects. Marketers using "permission-based" email must provide "opt-in" and "opt-out" option. "Opt-in" means users have voluntarily registered at the web site to receive specific email offers relevant to their self-selected interests. "Opt-out" means that you can tell a company that you don't want them to use your information for certain purposes or sell it to others. Typically, when you opt-out, you are not actually taken off a list but added to a list of people that do not want their personal information shared with other companies or who do not want to receive telemarketing calls or direct mail. If marketers continue to send e-mail, it is generally viewed as "spam" (i.e., unsolicited commercial e-mail). Research from IMT strategies has shown that users are more curious to read when mail is received via permission marketing (56%) than by spamming (11%). Also mails are less likely to be deleted without reading in permission marketing (59%) than Spam (6%) (Bruner, 2000).

Weekly newsletters and targeted e-mail campaigns enable the company to attract the customer into buying its products. Newsletters are e-mails on a specific topic sent on a regular basis to registered users. Newsgroups are publicly posted discussion forums for people with shared interests. Newsgroup users at times provide answers to customers' questions even before the company has had a chance to respond. Newsletters can have a very high reach and/or can be directed to very specific groups (e.g., newsgroups). However, the level of interface also varies inversely as the level of reach. Email is, therefore considered a low-end tool. For example, users registered at American Airlines website have a personal profile containing details such as travel

preferences and personal information. The website sends regular e-mails about airline deals to its registered users based on their profiles. This keeps customers informed about the company. This enables the airlines to identify, reach, and market to specific segments of the market.

**Autoresponders**

Autoresponders are artificial intelligent software products that integrate computer interaction and natural language understanding to bring a "human-like" presence to the points of contact between the company and its customers, partners, suppliers, and employees. They address all aspects of CRM to the customers, from marketing to sales and support (Sapir, 2000). Setting up an autoresponder can be an expensive and complicated task. Marketers need to anticipate questions and problems that users may face. However, it offers a high level of personalization and can cater to many users at one time. For example, suppose Mr. James has recently purchased a printer from mysite.com. He registers at the website. Later, he receives an email confirmation from the autoresponder that the information was received. A few hours after receiving the printer, Mr. James sends an e-mail message to the technical support, complaining that he cannot get it to work. Within seconds, he receives a friendly, polite reply from an autoresponder that knows who he is, what printer he purchased, and when he purchased it. The firm is able to offer detailed technical support without having to ask for model numbers or other basic information. A few weeks later, when the print cartridge for Mr. James' printer goes on sale, he receives a personalized advertisement through e-mail.

**Communities**

Generally speaking, a community is a specific group of people meeting and conversing on a regular basis in chat rooms or message boards. This includes both newsgroup forums and group-specific chat rooms. In a chat room, there is real-time exchange of text messages between users. These chat rooms can be on a specific topic. Users have specific interest when using such communities. Therefore, it allows the company to target community members with products specifically made for them. This tool is important from two aspects of CRM (i.e., customer acquisition and service). Generally, a community is very topic specific. Therefore marketers need to identify and market products specific to the needs to this group. In addition, users can assist one another and also give suggestions. This reduces the workload of the technical support staff. A community is also an important tool for public relations. Through lurking, the company can find out what are the user requirements, industry trends, as well their reactions to the various products of the company. Communities are useful tools for reaching out to a large number of actual and potential customers in an economical feasible manner. In many chat rooms, invariably the discussion tends to get out of focus. In almost every case, this is beyond the control of a marketer. In fact, live chats are generally limited to few people, thereby limiting participation and discussion. For example, the motley fool (www.fool.com) focuses on financial information and includes articles on personal investment, assessments of investment opportunities and private areas where groups can

set up their own global 'investment clubs'. It hosts discussions lists where users can express their opinion on various topics like industries, investment strategies, growth potential, etc.

**Shopping Carts**

A shopping cart is the electronic equivalent of the grocery cart. Minimally, the shopping cart allows the user to add or delete items, change quantities, calculate the order total and apply discounts, calculate shipping costs, and enable secure transaction. As a CRM tool, a shopping cart is a very useful tool in making the actual sale, particularly when the website has a large of products to offer. More complex shopping carts enable the website to suggest the user products which are compatible with his/her current order (i.e., crossing selling). A history of such purchases enables the company to zero in the customer's likes, needs and interests and offer products to that particular customer (i.e., customer profile). Shopping carts are complicated and expensive applications, but it is very beneficial to set up such a system because they can reach many people and are highly interactive and personalized. Unfortunately, shopping carts are unrecognizable by citizens of many countries where grocery carts do not exist.

**Online Catalogs**

The web has been a boom to mail order businesses. More and more direct marketing companies are selling products on the web. Online catalogs have many advantages over traditional catalogs. Items and prices can be updated continually, quickly, and at a nominal cost. Backorder expenses and complaints are greatly reduced. The printing, postage, and handling costs of a print catalog are avoided. Customers give their name and address in the process of generating an order. Online catalogs collapse the long interval between catalog inquiry and receipt by providing instant catalog delivery. The online catalog can be personalized to each customer's buying patterns. It can contain special offers based on how much they have spent in the past (Hoge, 2000). As a CRM tool, an online catalog is used in making the sale. It remains as a low-end web tool because of the lack of interactivity and personalization. However, it is advantageous for small businesses that are looking to have a web presence because of the high reach of customers with low costs.

**User Tracking**

User tracking tools are used to monitor user activity on the Web. Marketers can use information about such activities to provide a personalized Internet experience. As a CRM tool, user tracking allows the marketer to identify sales prospects. User tracking enables one-to-one marketing by determining purchase patterns and identifies cross-selling opportunities. There are several commonly used methods to track customers.

A cookie is a small file stored on an individual's computer allowing a site to tag the browser with a unique identification. When a person visits a site, the site's server requests a unique ID from the person's browser. If this browser does not have an ID the server delivers one (Gudmundsson, 2000). The main disadvantages of using cookies are overcoming customer privacy concerns.

However, cookies if used properly, can give marketers a competitive advantage. Individual pages will be matched to individual interests with a precision not seen before. And the result may be unnerving, as marketers start using the web as an instrument to peer not just into the habits, but also into even the thought processes of individual computer users (Anonymous2, 2000).

URL encoding works exactly like cookies, except nothing gets stored onto the user's hard drive, which is what privacy critics find most irritating about cookies. It's a code that can be embedded in the site's address or its URL. Most web sites use this method as an alternative to cookies when users set their browser to disable all cookie files. These are easily identifiable by a casual user. Typically the URL changes from a simple web address to a long string of letters and numbers preceded by a "?".

IP mapping which uses IP (Internet Protocol) addresses for tracking users. An IP address is a unique number given to a computer (e.g., "189.043.067.038"). A web site can always tell that "189.043.067.038" has accessed the site. By matching this number (or mapping it), against a database of IP addresses, the marketers can learns a lot about a user. From his area code to his zip code (if the user's surfing from the office) and technical details such as type of computer, operating system, and browser. Mapping is popular with advertising companies such as New York-based DoubleClick, which sells the information to companies eager to target their advertisements better (Gormley, 1999). Unlike traditional window shopping, customers and/or potential customers leave a valuable trail of information every time they visit a website. This information is recorded in the web log file. A web log file records valuable information, including what websites visitors came from, how long they stayed at your site, why they left, did they encounter any problems (i.e., errors), and where did they go. This information is a critical component to developing an e-commerce strategy. From a CRM perspective, all user-tracking techniques are used by websites to gain a better understanding of their audience. Setting up such tools is expensive, but allows a high reach, personalization, and interface with the customers.

**Banner Ads**

A banner ad is a graphical hyperlink to a marketer's website. Banners ads are low cost Internet tools used for marketing the website. The disadvantage here is low reach and less personalization (though recent technology indicates some level of personalization) and lack of interface. Only a year ago banner advertising was the darling of Internet marketing, achieving return rates of 5% or more. But as banner ads proliferated, return rates declined, to the current level of less than 0.6% (Anonymous3, 2000). Despite this decline, targeted banner ads can still be an effective source of traffic. Banner ads include stand-alone advertisements on individual sites, banner exchange programs, banner advertising program at portal sites like Yahoo and AOL which are high traffic gateways to the Internet, and affiliate programs. Most banner advertisements are displayed at popular websites. Some basic types of banner ads include static, dynamic, animated, JAVA based, and interstitals.

**FAQs**

One of the most frustrating problems in customer service is the management of repetition queries. These queries may be quite simple and easy to resolve. A list of Frequently Asked Questions (FAQ) is an important tool for customer service on the Internet. It reduces time and costs on the service staff and enables them to attend to more complex problems. It also reduces the frustration and time lack on the part of the customer in getting the query resolved and encourages them to learn more about the product's features and the company in general. A FAQ is a "must" on a web site. It has the benefit of high customer reach when compared to the low cost of implementation. The primary drawbacks are the lack of personalization and user interface.

**Downloads**

Downloads are an important tool widely used by software companies. This is a new version of an old sales promotion strategy used by marketers for years (i.e., free samples). This enables the user to try out the software before buying it. It also allows the company to reach potential customers in an economic way. From a CRM perspective, they are used both as a customer-acquisition tool and a customer maintenance tool. Companies can offer patches, add-ons, and updates on their website. This helps the customer by being more productive and also the company by creating more goodwill and loyalty. Downloads are cost-effective applications to reach out to many users at one time. The limitations are no personalization and lack of customer interface.

**Digital Broadcasting**

Digital broadcasting means transferring and displaying multimedia files from the Internet to the user's computer. In the foreseeable future, the television, computer and telephone are anticipated to come together into one device. One of the emerging technologies on the web is multimedia technology. It has a wide range of applications, ranging from entertainment and home shopping to distance learning and medical diagnosis. Users may be able to see and select audio-visual information over the Web personalized to there likes and needs. It is also possible to archive such information, which may result in a rich vault of information. Broadcasting companies are implementing web versions of their channels. One site worth mentioning is CNN interactive, which not only provide video clips of individual events; it aims at creating a video vault containing archives of past coverage. This will create a customer lock-on because such information may not be available elsewhere. In the future, the site may charge a fee when users access such information. Therefore, from a marketing standpoint, the web is an efficient channel of distribution. That is, once the software is uploaded, it costs practically nothing to download (sell) additional copies of the software (i.e., marginal cost is zero). Other applications include advertisements, product demonstrations, etc. This CRM tool holds high potential as the quantity and quality of bandwidth increases. In the future, a user may see 'TV' on the web with programs he/she wishes to see, scheduled as per his/her convenience and also shows ads of products he/she is interested in. As a

CRM tool, digital broadcasting is useful in both customer acquisition and support. Therefore, the costs, reach, customer interface, and personalization are all high.

**GIS**

Geographical Information System (GIS) is a computer system for capturing, storing, checking, integrating, manipulating, analyzing, and displaying data related to positions on the Earth's surface (Mehta et. al., 1999). Typically, a GIS is used for handling maps of one kind or another. These might be represented as several different layers where each layer holds data about a particular kind of feature (e.g., roads, sewage, and homes). Each feature is linked to a position on the graphical image of a map. As a CRM tool, GIS is used in customer identification (i.e., by locating customers that fit the target market).

Many companies have been slow at adapting GIS, in spite of being very personalized, interactive, and relatively inexpensive. GIS is an emerging technology, which holds promise for e-businesses. After all, a customer lives in a physical location. It can be a strong tool for websites who are traditionally brick-and-mortar businesses. For example, travel websites can determine the travel preferences of customers in a city. Combining business data in GIS could enable the company to send online ads to a web visitor in New York about airline deals or similar deals taken by other people in New York. It can automatically generate maps showing customer places of interests, the location of stores, business partners, etc. Traditional brick-and-mortar businesses can use GIS to provide physical locations and driving directions to a local store. GIS makes it possible for a company to create geo-demographic segments. That is by combining the business data about a customer's profile (a bank may have information about its customers) with their geographical location, we are able to evaluate and identify potential customers in a particular area (normally a ZIP code) who have similar interests, needs and wants. Using such information, a company may be able to customize its products and services towards that market (Tillett, 2000).

**Affiliate Programs**

Affiliate programs are getting very popular. A 1999 Forrester Research report rates affiliate programs as 2nd most effective method of driving traffic to web sites. An Affiliate program is an economical and interactive tool to identify large number of new customers. Because they lack personalization, affiliate programs are mainly used in customer acquisition. Affiliate programs are a hybrid of a banner exchange program and an advertising program. Generally an affiliate and a merchant agree that the affiliate will display the merchant's banner in exchange for a fee. The fee can be based on impressions (the number of times the banner is displayed), click throughs (the number of times someone visits the site), leads (the number of times someone fills out an application or contact form) or sales (the number of times someone buys a product or service). A single product affiliate programs works well for direct marketing. Pure-play businesses like Amazon.com, which are intermediaries, need to have affiliate programs with multiple products or services. The key to choosing the right affiliate program is to ensure that the affiliate program offers products that meet the needs of the potential customers.

**Multi-channel**

The ultimate and the most important CRM practices are the integration of multiple channels of communication into one single database. Building effective customer relationships starts with obtaining 360-degree view of each customer. This requires the automation and integration of various customer touch points into the overall CRM strategy. Companies must support seamless, tailored customer experiences across multiple channels, including the Web, fax, email, letters, etc. The Internet by itself cannot fulfill all the communication needs of the company. The prime reason is the lack of human interaction. 62% of shoppers never complete their purchases due to a lack of real-time customer service according to a survey of 25 top e-commerce sites (Anonymous3, 2000. Jupiter Communication reports that 90% of online shoppers prefer human interaction, and about half of those shoppers make frequent visits to a site before making a purchase. In the same survey, 41 percent of the respondents said they would be more likely to complete an online transaction if they had access to customer service via chat, web callback, or e-mail (Anonymous2, 2000).

As a CRM tool, deploying real-time multi channel customer interaction is a "win-win" situation for both the customer and the company. Customers get instant access to a personalized customer support system that is designed to respond immediately and remember their preferences. Companies save money on telephone support costs, which can be as high as $5 per service transaction for a live call agent, as compared to a few cents on the web. This enables one-to-one interaction, with one sales representative, attending to one person, at one time. Multi channel call centers require large investments of time and money. For example, Furniture.com employs 20 "design consultants" (many of them certified interior designers) who offer advice by phone, email, and live chat. These consultants are not traditional salespeople, but like traditional salespeople, they identify potential buyers and then offer to help.

## FRAMEWORK

While the primary purpose of this paper is to highlight the main CRM strategies being used to, the secondary purpose is to develop a framework to help Internet marketers optimize their web strategies. The fourteen Internet tools discussed in this paper can be scaled at various levels. The first being level of interface (i.e., how much can an application allow the company to get up close and personal with the customer). We dichotomized the level of interface into high (very close) and low (not very close). The second issue that marketers must consider is the actual cost of implementing and maintaining the tool. Costs were also dichotomized into high and low, but they were based on a relative scale rather than an absolute scale. The third scale is the level of personalization, which means how much can the tool allow the company to see the customer's behavior patterns and cater to his needs accordingly. Generally, technology plays an active role in providing personalized service. Finally, we evaluated the actual number of users the tool could cater too at one point in time. W appropriately labeled this as reach.

**Table 2: Web Involvement Matrix**

| | | | Personalization | | | |
|---|---|---|---|---|---|---|
| | | | High | | Low | |
| | | | High Reach | Low Reach | High Reach | Low Reach |
| Interface | High | High Cost | Autoresponders<br>Shopping Carts<br>Portals<br>User Tracking<br>Digital Broadcasting<br>GIS<br>Multi Channel Call Centers | | | |
| | | Low Cost | | Communities | Affiliate Programs | |
| | Low | High Cost | | | | |
| | | Low Cost | Email | | Online Catalogs, FAQs, Downloads | Banners |

**Table 3: Application of Web CRM Tools**

| Web Involvement | Customer Acquisition | Sale | Customer Service |
|---|---|---|---|
| High | Autoresponders<br>Portals<br>User Tracking<br>Digital Broadcasting<br>GIS | Autoresponders<br>Shopping Carts<br>Portals<br>Multi Channel Call Centers | Autoresponders<br>Portals |
| Medium | Communities<br>Affiliate Programs | | Communities |
| Low | Email<br>Downloads<br>Banners | Email<br>Online Catalogs | Email<br>FAQs<br>Downloads |

Table 2 summarizes the various Internet tools into a 4x4 matrix called web involvement matrix. Web Involvement is a multi-dimensional construct that can be defined as a combination of the above four factors (i.e., personalization, customer interface, reach and cost). A firm may decide to use one of more of these tools depending on the level (high v/s low) at which they want to get involved on the web. In addition, Table 3 categorizes the fourteen Internet tools into a 3x3 matrix. This should assist marketers in determining where in the CRM process (i.e., acquisition, sales, and customer service) and at what level of web involvement can the company use these tools.

## CONCLUSION

As the reach of Internet becomes wider, companies will find that going digital is no longer an option but a necessity. Visitors will be able to provide information and marketers will be able to access this information in real time. Like the agriculture age, we may once again see a high level of interdependence (but on a mega-scale) between the buyer (customer) and the seller. Customer may demand the companies provide goods and services made specifically for him. The company will need the customer to provide information to create and bring out new innovations, which it will need to have a sustainable competitive edge.

One of the main motivations of this paper was to highlight the Internet tools that traditional marketers could uses to develop a successful online strategy. While the list is not all-inclusive, it does shed light on the most popular CRM tools. Several marketing strategies could be employed using the tools discussed in this paper. First, viral marketing can be used in email campaign designed to attract customers (e.g., whenever a customer sends an email via hotmail.com, a little marketing promotion is inserted at the bottom of every email message). Therefore, customer spreads word of the service merely by using the service. Second, global niche marketing could be implemented, where online shopping sites are made for specific segments of the market. The advantage in this strategy is that geographical boundaries do not bind you. For example, MedBookStore.com sells medical books to medical students, doctors and nurses. This has a clear advantage over Amazon.com who is dealing in all subjects. Third, collaborative marketing is a strategy wherein two companies offer their products (may or may not be complementary) in one package. Banner exchange programs and affiliate programs can be used in collaborative marketing. Similarly, products and services offered by multiple marketers could be bundled together into one offering. These and other strategies could be used by marketers to gain a competitive advantage.

The Internet has been a major influence on the evolution of the concept of CRM. It is believed that given the wide array of Internet tools and the increasing number of Internet users, businesses (even local retailers) will have to adapt the Internet as a part of their lives, or risk going out of business. It is hoped that the framework presented in this paper will assist all marketers develop an optimum strategy that matches its internal strengths with opportunities that exist in the market place.

## REFERENCES

Anonymous1 (2000), IMT Strategies, *Email Marketing Report*, January.

Anonymous2 (2000), Anderson Consulting, *Houston Chronicle*, 10th January.

Anonymous3 (2000), Internet Marketing Center of California, http://www.imccal.com/marketing_banner_ads.htm

Anonymous4 (1999), META Group Urges "Ecosystem" Approach to Customer Relationship Management, June 28.

Anonymous5 (2000), Oracle Corporation, http://www.oracle.com/ebusiness/crm11i/

Anonymous6 (2000), IBM Corporation, http://www.ibm.com/e-business/customer

Anonymous7 (2000), Andersen Consulting Customer Relationship Management Survey, February.

Anonymous8 (2000), Webwatchers, http://www.forbes.com/1998/01/09/featprint.html

Bruner, Rick (2000), Interactive Direct Marketing Through CRM, http://bruner.crmproject.com/

Gormley, Thomas III (1999), "Web-Centric Customer Service, The Forrester Report, February.

Gudmundsson, Orn (2000), Commercialization of the World Wide Web: The Role of Cookies, http://www2000.ogsm.vanderbilt.edu/cb3/mgt565a/group5/paper.group5.paper2.htm

Haar, Steven V. (1996), Beyond Cookies, The Web Gets Personal, *Inter@ctive Week*, July 22.

Hoge Cecil C. (2000), The Electronic Marketing Manual, Chapter 20, http://archives.obs-us.com/obs/english/books/elecmanu/gh201.htm

Lane, Stephen (1999), A Guide to Customer Relationship Management Professional Services: 1999 Edition.

Mehta, Sanjay S., Mark R. Leipnik, and Balasundram Maniam (1999), "Application of GIS in Small and Medium Enterprises," *Journal of Business and Entrepreneurship, Vol.11 No. 2*, 77-88.

Nelson, Juliana (1999), Customer Relationship Management on the Web: Unlocking E-Commerce Profits, April.

Sterling, Robert & Johnson Marc (1999), Account Management, *Jupiter Communications*, April.

Tillett, Scott L. (2000), Companies Tie Maps with CRM, *Internet Week*, July 17, 2000.

Sapir, Daniel (2000), Autoresponders - Solutions for the Networked Economy, http://sapir.crmproject.com

Wenninger, Jim (2000), Capturing Commercial Business via Customer Portals, *Business News Publishing Company*, 24th August 2000.

# A PARSONIAN PERSPECTIVE ON CHANGE GIVEN THE ORTHODOX PARADIGM OF FUNCTIONALISM

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## ABSTRACT

*It has been asserted that positivism is the philosophical basis of research in the field of Information Systems by Goles and Hirschheim. This is seen as problematic in an area that undergoes swift and constant change because of its technologic nature. The change from context-based computing to that of graphic-based computing using the mouse as a pointing device is the focus of this paper. The mechanism for explaining change is the action theory of Talcott Parsons, a structural functionalist, whose theory, in turn, is attacked for the inability to account facilely for change.*


## INTRODUCTION

> *"Who now reads Parsons? It is difficult for us to realize how great a stir he made in the world...He was the intimate confidant of strange and rather unsatisfactory gods, whom he called Action Theory, Voluntarism and later Functionalism. Have we evolved beyond Parsons?"*
>
> (Robak, 1981, p. 1)

The above quote is a paraphrase of Parsons' from the beginning of The Structure of Social Action, which served as his formal introduction to the world of theory (Parsons, 1937/1968, p. 3). In a flurry of articles in regard to change occurring within the area of Information Systems Development (ISD) it has been asserted that the primary notion of paradigm used in the conception of the field's philosophical discussions is that of Burrell and Morgan (1979) (Goles and Hirschheim, 2000). It has often been noted that Functionalism (especially that brand espoused by Parsons), is adverse to adequate expressions of change, indeed one of the major criticisms of Parsons "grand theory" is the inability to allow and account for change.

The purpose of this work is to show how the mechanism of change can be explained using the theoretical formulations of Talcott Parsons within the area of Information Systems. Fear, Uncertainty, and Doubt (FUD) are often listed by those discussing innovation as a means that will freeze the actors and prevent the actualization of change within the field of Information Systems.

Change within our society continues to accelerate as can be illustrated in many contemporary works which address the subject (two excellent examples would be Alvin Toffler's Third Wave (1980) and Megatrends (1982) by John Naisbitt. The inexorable rate of change in modern day civilization is well documented as a staple of the present-day world. In ISD and within the field of technology this rate of change is exacerbated. Carver Mead (Gilder, 1988, p. 89) states: "The entire Industrial Revolution enhanced productivity by a factor of about 100…. The microelectronic

revolution has already enhanced productivity in information-based technology by more than a million…. The current transition in electronics, promises yet another 10,000-fold increase in the cost-effectiveness of computing in the next decade." It appears that his prognostications were on target as we closed that decade and entered the new millennium.

All of these change factors being a state of the area of Information Systems it would seem that an analysis of change using Talcott Parsons as the theoretical orientation would be difficult given the current belief that Functional Theory is ill-disposed toward the explanation of emendation at all levels of action analysis.

In the Goles and Hirschheim analysis of paradigm utilization within the area of IS, the authors conclude that it is positivism that is the pervasive paradigm. In addition, change within this paradigm is deemed difficult given any scenario. In an earlier work, Klein and Hirschheim (Boland and Hirschheim, 1987) devote an entire chapter in one of the Wiley Information Systems Series books (1987) to the issue of social change and its impact on Information Systems Development. It is here that the term ISD orthodoxy is encountered as fundamental paradigm. This exhibits the fundamental sharing of tenets and is juxtaposed with the "emergence of some radically different approaches to ISD, ones which do not share the same paradigm." Jumping ahead to the 2000 article by Goles and Hirschheim the application of the Burrell and Morgan framework is utilized to illustrate the viable extant paradigms for the analysis of organizational theory. The paradigms presented are functionalism, radical humanism, radical structuralism, and interpretivist. The research in the field indicates that the functionalist approach is the clearly the prevailing one and the positivist perspective generates the "vast majority of information systems research" (Goles & Hirschheim, 2000, p.254).

This single research perspective is deemed antithetical to change. Indeed, many authors as are cited in the Goles and Hirschheim article think that it is time to "break the mold" (p. 256) and present viable alternative approaches in order to attain "paradigmatic pluralism" (p. 258) which in turn will lead to more innovative, diverse, appropriate solutions, which would not be quite as difficult given the restrictions imposed by working within the "orthodox" paradigm of positivism and using some method of change imposed by functionalism.

The focus of this paper is to illustrate and explain how a fundamental change has occurred within the Information Systems field using a simple yet extensive example. The term WIMP was used to indicate the adoption of Windows, Icons, Menus, and Pointing Devices, by no less of a leader in the field than Gary Dickson during the summer, 1984, AACSB Management Information Systems Institute held at the University of Minnesota to train …"terminally qualified business school faculty members whose specialization and training is not in MIS, but who wish to move in this area to teach and to do research" (Banville & Landry, 1989, p. 57). To be sure, Dickson had his tongue firmly implanted in his cheek when he mentioned the term, however it did indeed illustrate the thinking of many who were in the field at the time. In 1984 the personal computer (PC) was still viewed suspiciously by the bulk of MIS professionals. If one can recall the IBM PC was introduced in 1981 and Lotus 1-2-3 in 1983, and it was not until 1983 that IBM shipped the PC XT which had a 10 MB hard disk. The only PC that had a Graphical User Interface (GUI) at the time was the Apple LISA, which cost $10,000. The Apple LISA was considered a failure at the time and only 100,000 units were produced. Therefore when put in the proper context and time frame the WIMP

factor was not an unreasonable exclamation. The perspective of those in the profession was contextual not graphical and COBOL was still the primary business-oriented language. In 1983 the Commodore 64 was the first PC to outperform the game consoles and the mouse was still viewed as a nice but not necessary peripheral. In terms of PC revenues the top three were IBM, Apple, and Commodore. Yet in a very few years the entire industry would change and Windows, Icons, Menus, and Pointing Devices would be used by all "serious end-users" and in fact, become the standard.

How was this change effected? How could these standards become universally accepted? This was a change of enormous proportion and yet it seemingly took place with hardly a stir. This paper will explain this change using the Talcott Parsons functionalistic formulation given within his framework for change, which is often, abbreviated LIGA. LIGA is used to represent the "functional requisites" which must be met for any action system in the Parsonian approach to survive. This terminology first appeared in the early 1950s with his publication of The Social System (Parsons, 1951) and Toward a General Theory of Action ( Parsons & Shils, 1951). The term "action system" for Parsons encompasses four separate, yet interrelated, levels of action. They are the Cultural, Societal, Personality, and the Organismic. The changes take place on all four levels, each in an inevitable way.

Parsons explains the relations among the subsystems through the term "cybernetic hierarchy of control" (Turner & Maryanski, 1979, p. 80). The systems vary in amount of "informational control" and "energy" and each level is necessary for control and regulation as well as provision of energy for the next. This is a complex process and needs to be grasped in order to show how the "functional requisites" act on each level. The levels arranged from high information, which provide regulation and control for lower systems are: Cultural, Social, Personality, and Organismic. These are reversed for energy provision and resources allocation with the Organismic having the most energy and the Cultural the least. All of these levels are necessary for the proper functioning of the entire system. There cannot be an imbalance of either energy or information for the totality to exist in a stable state. If, on the other hand, there is some imbalance certain consequences can be anticipated. Also, "disruptions between any two action systems reverberate up and down the hierarchy" (p. 81).

As there are four systems there are four "functional requisites" which are met in different manners within each system. These "functional requisites" are: Adaptation; Integration; Goal Attainment; and, Latency (also know as pattern maintenance), hence the utilization of the term LIGA. An excellent distillation and concomitant explanation of the four requisites is done by Turner and Maryanski (1979):

| | |
|---|---|
| *Adaptation* | *All action systems must seek resources from the environment, convert them into usable facilities, and then distribute them to the rest of the system. This is the requisite of adaptation.* |
| *Integration* | *All action systems must maintain coherent interrelationships among their constituent parts, and inhibit tendencies for abnormalities in the relations among the parts. This is the problem of integration.* |

| | |
|---|---|
| *Goal Attainment* | *All action systems must set goals, establish priorities and allocate resources in order to achieve them. This is the problem of goal attainment.* |
| *Latency* | *All action systems must (a) generate use units that can fit into the system (the problem of "pattern maintenance"), and (b) reduce tensions within units of the system ("tension management"). These combined problems are termed latency (p. 75).* |

Each of these in turn, rests primarily within a given action system but there are interchanges which allow for the viability of all of the subsystems. The primary adaptive subsystem is the organismic, the personality deals with goal attainment, the social systems meets integrative problems, and the cultural will deal with latency. It is important to remember that the interchanges among these subsystems are what allow for total system efficacy.

Given this abbreviated synopsis of Parsonian theory, it might be instructive to take the concrete example of WIMP and apply the theory to illustrate the explanation of change. Let us take the singular example of the mouse and its widespread adoption and, in fact, there was a concern about the adoption and proper utilization of the mouse, which was first made feasible through the award-winning Solitaire Program introduced by Wes Cherry, a Microsoft programmer (Schwartz, 1993). At the time (1990), there was a concern that the inclusion of the Solitaire Program along with the package that contained the mouse represented a frivolous waste of time for workers. This proved to be an effective manner to get the end-user familiar with the basics of mouse logistics important for the productive utilization of the peripheral.

In order to appreciate the introduction of this ISD "change" one must appreciate it on all four subsystems of action as Parsons delineates them. Latency (or Pattern Maintenance, as it is often referred to) will usually be mediated symbol systems and therefore located in the Cultural System. Integration is the primary dimension of the Social System. Goal Attainment occurs primarily within the Personality System, while it is the Behavioral Organism, which is the primary environment for Adaptation.

The Behavioral Organism, normally given the least amount of recognition in the Parsonian schema, would be concerned, in the example of the mouse, with the ergonomics of the device and the interface with the human biologic system. This in point of fact has undergone much iteration as the shape, sensitivity, and capabilities of the hand-held peripheral. Initially, there was resistance to using the mouse because it was felt to be awkward and unnecessary in a context oriented computer world. The mouse had limited use when it was introduced and seemed more inclined to game or unnecessary frivolous activity (e.g., the use for the solitaire game) which could be done faster and more accurately by using keyboard commands or some combination of the function keys. The eye-hand coordination for proper mouse activity was problematic for many adult users who were, at times, intimidated by the fact that young children playing computer games had much better mouse (and concomitant peripheral) control. At the time of the introduction, off the shelf packages, such as WordPerfect, dBASE II, and Lotus 1-2-3, were the top sellers for the three leading applications of word-processing, database, and spreadsheet. Note that Microsoft was not the manufacturer of any of these packages. The remainder of the industry was intensely keyboard oriented with the exception of machines produced by Apple, which used packages and programs dependent on the mouse,

especially their Desktop Publishing packages. With minor exceptions the Apple was not in the mainstream of the "serious" computing which was making inroads via the implementation of the PC.

Would the mouse be accepted as necessary by the end-users who were driving PC computer utilization? There were, to be sure, obstacles on all four of the Parsonian levels. There was a "Cultural" bias that indicated that serious users did not find the mouse a necessity. In addition, the connotation of WIMP was clearly pejorative. It was ingrained in the culture that multiple keystrokes and macros were the accepted manner to navigate the keyboard and perform all special functions. Keystrokes and macros were mastered by a sufficient majority of end-users to make the introduction of the mouse seem unworthy of serious attention and its incremental value would not be worth the effort. At the Personality Level, the perception was that there was no difficulty in attaining goals and completing tasks through use of traditional approaches. There also was a certain amount of trepidation introduced at this level of appearing foolish using this new piece of equipment.

Since Microsoft sold a mouse to work with its Windows programs, and since Microsoft was introducing a spreadsheet (Excel) to accompany its word-processing program (Word), it would clearly benefit Microsoft if mouse utilization became de rigueur. A number of factors, at this time, made for the rapid inclusion of the mouse as a essential peripheral. Microsoft programs were made much easier to maneuver if one could use the mouse, including shortcuts in addition to preferable options within each program. The similarity of operational steps among Microsoft programs enhanced this adoption that was sealed with Internet navigational properties, especially when HTML and Java utilization became the method for Web design.

If the personality system's functional prerequisite of Goal Attainment were to be achieved the incorporation of the mouse into every end-user's skill set was imperative. The Parsonian system level, which brought together and coordinated all of the separate parts in order for this to succeed, was the Social System whose function is integration.

## RECAPITULATION AND ELABORATION OF SYSTEM LEVELS

Fear, uncertainty and doubt (FUD) are often listed as the primary reasons that change is resisted. In the field of Information System Development (ISD) this is especially true. First, the field must by its very nature, is on the cutting-edge of technological development. It has been shown in this paper the magnitude of change in this area is among the highest if not the highest. How does one best analyze this process of most rapid change in a rapidly changing environment? This author maintains that the social theorist Talcott Parsons presents a manner to analyze this change even though Parson's perspective, that of Structural Functionalism, has long been accused of an inability to account for change in the social setting.

The change analyzed is the early 1980s derisive acronym WIMP (windows, icons, menus, and pointing devices) and how in a matter of a few years it has gone from a position of scorn to a situation of accepted practice, and indeed a standard needed to be used by those who wish to perform in the area of computing. Imagine, if you will, the emergence of the entire spectrum of visual languages without the application of windows, icons, and pointing devices. The visual languages are not only accepted but also clearly supplanting the third generation (FORTRAN, COBOL, etc.) of languages as a means for program execution.

There needs to be an explanation in order to appreciate such a major implementation to have occurred on a major scale with so little apparent resistance. The analysis of this situation is Parsonian. A brief definition of each level of Parsons' subsystems of action is now appropriate. This is best explained by Parsons himself (Parsons, 1977, pp.249-251).

| |
|---|
| *Cultural System a complex of symbolic meaning - the code in terms of which it is structured, the particular clusters of symbols it employs, and the conditions of its utilization, maintenance, and change as part of action systems.* |
| *Social System constituted by processes of mutual orientation of actors toward one another such that each actor is both actor and object of orientation for other actors as well as for himself. This mutual orientation gives rise to mutual responses of a plurality of goal-directed actors in a symbolically defined environment.* |
| *Personality System the agency of action processes; hence it implements cultural requirements. On the level of reward in the motivational sense the optimization of gratification to the personalities is the goal of action* |
| *Behavioral Organism the adaptive subsystem of the individual: the locus of the human facilities that underlie the other systems. It embodies conditions to which action must adapt and comprises the mechanism of interrelation with the physical environment, especially through the input and processing of information of information in the central nervous system and through motor activity in coping with exigencies of the physical environment.* |

Now, beginning with the last subsystem (Behavioral Organism) the reader can appreciate the importance of the physical appearance and "feel" of the object (in this case the mouse). The mouse has gone through several iterations and now even its contours fit the anatomical curves of the hand itself. It also contains a wheel to enable the web navigator and eye-hand coordination difficulties are minimized through software adjustment.

The interaction of the organism with the environment is stressed at this level. The system boundary consists of the corporeal body of the actor and things that he must use external to that body in order for action to occur. At this level symbolic activity is not important, it is the actuality of action in the physical environs. It is the engineer concerned with ergonomics that minimizes any resistance to change at this level.

At the level above (personality system) acts as the decision maker in order to maximize the attainment of goals. It is here motivation becomes an important factor. Parsons (1951/1962) will talk about drives and need-dispositions as integral for action at this level. Parsons states: "The drive component of a need-disposition is organized with cognitive and evaluative elements" (p.113). It is these cognitive and evaluative elements, which distinguish activity on this level from the one below it (Behavioral Organism). The ego, superego, id, all interact in order to achieve goals which fulfill the "need-dispositions" in a manner accordant with the attitudes of, and relationships with, social objects, cultural standards, and role expectations internalized by the personality.

So, when in an earlier time period, the mouse was looked upon as unproductive and ordinarily eschewed by the "serious" end-user, it takes on a set of new characteristics that the ego

can accept, and indeed, enhance the attainment of goals. The complex interaction of the intra-psychic forces is now amenable to utilization of this peripheral. This modification of attitudes, relationships, cultural standards and role expectations is enabled because the ego has internalized qualities that have taken place on the above levels of social and cultural systems.

At this point it is necessary to skip to the Cultural System because of the unique integrative function embedded in the societal level, which takes attributes from the other three and allows for their combined synergy resulting in approved activity.

The Cultural System provides value-orientations among other meaningfully symbolic products, which facilitate the positive circumstances for action on the part of a given actor. This level contains elements that are of fundamental importance for action to occur. This level being the highest is pervasive and all encompassing to the other three. Its function of "latency" serves the role of pattern maintenance for all of the others. The elements of action are "intrinsically transmissible from personality to personality by learning and from social system to social system by diffusion" (p. 159). Thus, these elements namely; attitudes, values, need-dispositions, role-expectations, are passed from actor to actor since the derived actions are observable they are powerful forces directing participant toward behavioral patterns deemed productive and essential in certain well-defined circumstances.

Therefore when the mouse is viewed as an indispensable part of the computing experience and a necessary element for control and utilization of task completion the proper cultural dispositions are in place to motivate actors to adopt the mouse and master any techniques for its proficiency. In the computing world the culture in regard to this peripheral went from disdain to necessity.

All of the system components are now set to allow for the integrative function of the Social System in order to ensure adoption of this element of computing. Among the four levels of action systems postulated by Parsons, the Social System is unique in that it involves all of the other three systems, and indeed, controls allocation, facilities, and rewards which make the action possible and in order to continue like activities. Human capacities and/or human resources that must be properly allocated are tied to a complex of roles that, in turn, are tied to members' dependence on the possession of certain qualifications. The familiarity and dexterity with the mouse has become a prerequisite for computer usage given the software of today. The role of computer user contains a set of expectations, one of which is facility with the mouse. "Facilities… are objects of orientation which are actually or potentially of instrumental significance in the fulfillment of role-expectations" (p. 199). Hence the mouse could be looked upon as a "facility" in this sense. It is the reward that allocates income, power, and/or prestige, which serve as the "systematic outcomes of gratification orientation of action" (p. 201).

What were the forces at work to assure the institutionalization of the components listed in the acronym WIMP? Although, the mouse, windows, and icons were available well before the founding of Microsoft or even Apple (Xerox - PARC Palo Alto Research Center had used windows, mouse and Smalltalk, an object oriented program (OOP) in the 70s), it was Apple that first made WIMP popular, and Microsoft that made WIMP necessary in order to program effectively. It was the strategy of Microsoft, which operated at the Societal Level that demanded and hastened the integration of the Windows environment into everyday computing.

As Microsoft garnered more and more of the application software, most notably the programs included in Microsoft Office, the mouse took on importance. As was stated earlier in this paper the "industry standards" before Word, Excel, and Access were WordPerfect, Lotus 1-2-3, and dBASE II, all of the latter (each manufactured by a different company), had diverse formats that were equally navigable with coordinated key strokes or a mouse. Since most serious end-users at the time began to use these early application programs prior to upgrades, which allowed for only minor mouse interaction, the mouse continued to be looked upon as a frivolous appendage. However, all of this changed with the adoption of the suite of application programs developed by Microsoft in Microsoft Office. They have similar software interfaces to one another, which allow for a faster mastery of a variety of programs. In addition, the introduction of the Internet and programming in the Visual Languages almost demands mouse navigation.

What can be seen is the integration of the ergonomics on the behavioral organism level, the ability to better and more facilely achieve goals on the personality level, and the permeating attitudinal and value dictates from the cultural level all brought together through the pervasive influence of a powerful manufacturer and dispenser of the software itself, Microsoft, all of which is performed at the social level of Parsonian analysis.

## CONCLUSION

Although the structural functionalism espoused by the social theorist Talcott Parsons is attacked for its inability to account for change, this paper attempts to illustrate just how it can account for an instance of change in one of the areas of society where pervasive and continual change is the norm, information systems development. The topic of change as an integral part of ISD has been grappled with by writers in the field of information systems from the earliest awareness of the field. Several authors have discussed various paradigms within the field and feel that prevailing positivistic perspective deemed the "orthodox" view is least capable of facilely accounting for change within the field.

Using a simple yet pervasive factor for change, essentially the change from a contextual orientation with the keyboard as the primary method of input this paper illustrates how the graphical orientation has not only been accepted but has become indispensable in today's computing environment. The one-time pejorative acronym WIMP has in reality become the standard for everyday end user practice.

Breaking the Parsonian action system into its basic functional requsites (LIGA), and levels of analysis: cultural, societal, personality, and organismic allows for the explanation of this change when each level and requisite is delineated in the change process.

## REFERENCES

Banville, C. & Landry, M. (1989). Can the field of MIS be disciplined? *Communications of the ACM*, 32, 48-60.

Boland, R. J., Jr., & Hirschheim, R. A. (Eds.). (1987). *Critical issues in information systems research*. Chichester, Great Britain: John Wiley & Sons.

Burrell, G., & Morgan, G. (1979). *Sociological paradigms and organisational analysis*. London: Heinemann Books.

Gilder, G. (1988, April 4). You ain't seen nothing yet. *Forbes*, 89-93.

Goles, T., & Hirschheim, R. (2000). The paradigm is dead, the paradigm is dead…long live the paradigm: the legacy of Burrell and Morgan. *Omega*, 28, 249-268.

Naisbitt, J. (1982). *Megatrends: ten new directions transforming our lives*. London: Futura.

Loubser, J. J., Baum, R. C., Effrat, A., & Lidz, V. M. (Eds.). (1976). *Explorations in general theory in social science. (Vols. 1&2)*. New York: The Free Press.

Klein, H. & Hirschheim, R. (1987). Social change and the future of information systems development. In R. J. Boland & R. A. Hirschheim (Eds.), *Critical issues in information systems research* (pp. 275-305). Chichester, Great Britain: John Wiley & Sons.

Martindale, D. (1981). *The nature and types of sociological theory*. (2nd ed.). Boston: Houghton Mifflin.

Parsons, T. (1951) *The social system*. Glencoe, IL: The Free Press.

Parsons, T. (1968). *The structure of social action: A study in social theory with special reference to a group of recent European writers. (Vols. 1&2)*. New York: The Free Press. (Original work published 1937)

Parsons, T. (1977a). *The evolution of societies*. Englewood Cliffs, NJ: Prentice-Hall.

Parsons, T. (1977b). *Social systems and the evolution of action theory*. New York: The Free Press.

Parsons, T. (1978). *Action theory and the human condition*. New York: The Free Press.

Robak, N. J. (1981). *An analysis of the present crisis of the Parsonian scientific research program.* Paper presented at the Eastern Sociological Society Annual Meeting. NY.

Parsons, T. (1977b). *Social systems and the evolution of action theory*. New York: The Free Press.

Parsons, T. & Shils, E.A. (Eds.) (1962). *Toward a general theory of action*. New York: Harper & Row. (Original work published 1951).

Schwartz, E. I. (1993, June 14). The power of software. *Businessweek*, 76.

Toffler, A. (1980). *The third wave*. London: Pan Books.

Turner, J. H., & Maryanski, A. (1979). *Functionalism*. Menlo Park, CA: Benjamin/Cummings.

# INCORPORATING DECISION ANALYSIS INTO SOLUTIONS TO INTEGER RESOURCE ALLOCATION PROBLEMS

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## ABSTRACT

*In this paper, we address a natural, ongoing question asked by students following lectures on solution methodologies to integer resource allocation problems. Namely, "How can I obtain other optimal or non-optimal solutions for comparison (decision analysis) purposes?" Hence, we investigate an algorithm to solve an integer resource allocation problem in terms of its isomorphically equivalent Linear Diophantine Equation (LDE). The algorithm utilizes an alternate approach for finding the general solution of an LDE. The alternative approach begins with the utilization of Blankinship's algorithm to find an initial LDE solution. Next, a general solution to the LDE's corresponding Homogeneous LDE is determined. Finally, the general solution to the LDE is found by applying the results of the first two steps to the Additive Theorem.*

*In order to demonstrate the benefits of this alternate approach, the algorithm is compared to the more traditional methodology of branch and bound enumeration. A comparison is made between the use of the branching algorithm and the alternative LDE approach. Interesting results from a general example problem are observed and discussed.*

## INTRODUCTION

In this paper, we explore the pedagogical concerns of integer resource allocation problems. A natural, ongoing question from students following lectures on integer resource allocation problems asks, "How can I obtain other optimal or non-optimal solutions for comparison purposes?" It has been our experience that students enjoy the decision analysis phase regarding resource tradeoffs after obtaining a solution to these problems by traditional means. Hence, we investigate an alternative algorithm to solve an integer resource allocation problem in terms of its isomorphically equivalent Linear Diophantine Equation (LDE).

An LDE is a linear equation with solutions in the set of integers (Barnett, 1969). Unlike most other Diophantine equations, LDEs can be solved algorithmically (Rowe, 1986; Stewart, 1992). We present an alternate, computer applicable approach to formulate the general solution of an LDE. The algorithm developed in this paper to find the general solution of an LDE involves three steps. Step one involves finding an initial solution to the LDE using Blankinship's Version of the Euclidean Algorithm as its basis. In the second step, the general solution to a Homogeneous LDE (HLDE) is determined. Finally, the general solution of the LDE is found by advancing the initial solution of the

LDE found in step one with the general solution of the HLDE obtained in step two through addition. Since the use of general solutions to LDEs is an alternate approach for finding multiple solutions to integer allocation problems, the methodology is compared to the more traditional approach of finding an optimal solution using branch and bound enumeration. A comparison of both methodologies as tools for quantitative decision analysis are discussed.

## AN EXAMPLE INTEGER RESOURCE ALLOCATION PROBLEM

To illustrate the students' question, we explore an integer resource allocation problem where an integer quantity must be allocated in integer amounts to two or more entities (Ibaraki and Katoh, 1988). Thus, the following integer allocation problem is posed.

*Problem: A real estate developer has a parcel of land with a frontage of 1,000 ft. The property is to be subdivided into lots having frontages of 60 ft. and 80 ft., respectively. In how many ways can this task be done?*

A typical model used to represent the problem is the linear equation

$$60X_1 + 80X_2 = 1{,}000, \tag{1}$$

where $X_1$ and $X_2$ respectively represent the number of lots with 60 ft. and 80 ft. frontages. The solution set for the problem is restricted to a subset of integers.

## BRANCH AND BOUND LITERATURE

Literature concerning branch and bound enumeration is wide in scope and crosses into many Operations Research topics. According to Salkin (1975), the classic enumeration algorithm and many of its variations were developed by Land and Doig (1960). Their specialized methodology was designed for the traveling salesman problem by Little, Murty, Sweeney, and Karel (1963). They termed the specialized procedure as *branch and bound*. Later, Thompson (1964) presented an algorithm for the integer program called "The Stopped Simplex Method" which was a consequence of Land and Doig's work. A year later, Dakin (1965) proposed a simple, yet interesting, variation which employed the use of integer solution space inequalities at each node of Land and Doig's branch and bound algorithm. Shortly there after, Beale and Small (1965) extended the Dakin method to include the linear programming post optimization procedures suggested by Driebeek (1966). Finally, Tomlin (1970; 1971), described a refined version of the Beale and Small algorithm.

## THE BRANCH AND BOUND APPROACH

In an effort to show the value of the LDE approach, we compare it to an equivalent integer resource allocation problem formulated as an integer programming (IP) problem. There are many

software packages on the market to solve IP problems, and many of these packages generally employ a branch and bound algorithm.

The algorithmic implementation of the branch and bound procedure utilizes the simplex or dual simplex method to solve the linear program, ignoring any constraints of integer only values. In those cases where an optimal solution is found which is feasible for the integer program, then that solution is the optimal integer solution. However, if any of the variables constrained to be integers do not satisfy that constraint in the optimal solution found, then the solution set must be partitioned to continue to search for possible optima of the integer program. This is done by taking a decision variable having a non-integer value such as $k < X_j < (k+1)$ and branching from that point into one subset for which $X_j \leq k$ and another for which $X_j \geq (k+1)$. The augmented linear program is solved for each case with the results leading to further partitioning of the subset or classifying the subset as *fathomed* (Hillier and Lieberman, 1974). A solution subset is said to be fathomed if it:

| | |
|---|---|
| 1 | contains no feasible solutions; |
| 2 | the bound for its optimal solution is not as good as a current optimal solution; |
| 3 | it is a feasible solution for the integer program and has an optimal value which is better than the best current value. |

When all subsets have been fathomed, the optimal solution (if one exists) is whatever the best current optimal solution happens to be. The process in effect eliminates subsets of possible solutions until it identifies the solutions which can be considered optimal. Many have considered this form of solution methodology to be rigid.

## SOLVING THE EXAMPLE USING BRANCH AND BOUND ENUMERATION

Consider our original real estate developer's dilemma in integer programming form:

Maximize/Minimize: $60X_1 + 80X_2$
Subject to: $60X_1 + 80X_2 = 1000$, where $X_1$ and $X_2$ are nonnegative integers.

The branch and bound approach would first ignore the constraints that $X_1$ and $X_2$ be integers and an optimum solution to the linear program would be found at $X_1 = 0$ and $X_2 = 12.5$. Because this is not a feasible solution for the integer program, the solution set would be partitioned into two separate subsets identified by $X_2 \leq 12$ and $X_2 \geq 13$, respectively. The latter of these contains no feasible solutions and is therefore fathomed and need be examined no further. The former, however, provides the linear program:

Maximize/Minimize: $60X_1 + 80X_2$
Subject to: $60X_1 + 80X_2 = 1000$; $X_2 \leq 12$

and an optimum solution exists at $X_1 = 2/3$ and $X_2 = 12$. As this is not a feasible solution for the original integer program, the branching would continue with partitions identified by $X_1 \leq 0$ and $X_1 \geq 1$, respectively. The branch for which $X_1 \leq 0$ becomes fathomed as it contains no feasible solutions, while the branch for which $X_1 \geq 1$ produces an optimum solution at $X_1 = 1$ and $X_2 = 11.75$. The latter subset must again be partitioned over $X_2$ with $X_2 \leq 11$ and $X_2 \geq 12$ identifying the two new subsets, respectively.

The linear program:

Maximize/Minimize: $60X_1 + 80X_2$
Subject to: $60X_1 + 80X_2 = 1000$; $X_2 \geq 12$; $X_1 \geq 1$

has no feasible solutions and that branch is therefore fathomed. However, the linear program:

Maximize/Minimize: $60X_1 + 80X_2$
Subject to: $60X_1 + 80X_2 = 1000$; $X_2 \leq 11$; $X_1 \geq 1$

has an optimal solution at $X_1 = 2$ and $X_2 = 11$. Because that optimal solution of the linear program is also a feasible solution to the original integer program, it represents an optimal solution to the original integer programming problem.

The branch and bound enumeration approach therefore produces an optimum solution to our problem at $X_1 = 2$ and $X_2 = 11$, indicating the developer should create two of the 60 ft. wide lots and eleven of the 80 ft. wide ones.

## THE LINEAR DIOPHANTINE EQUATION APPROACH

The framework necessary to employ the LDE methodology is presented in the following four sections. In the first section, a brief overview of two theorems found in elementary number theory is introduced. In the second section, Blankinship's version of the Euclidean Algorithm is demonstrated as an alternative to finding a greatest common divisor (gcd) and solution to a gcd equation of *n* integers. The next step of the process requires obtaining a solution to a HLDE. This step is discussed in the third section. If no unit coefficients exist in a HLDE, use of the *Unit Coefficient Reduction Algorithm* is demonstrated. Finally, use of the Additive Theorem for finding a general solution to an LDE is presented in the fourth section.

## AN OVERVIEW OF THE LDE APPROACH

Two theorems, found in elementary number theory books, are given that involve the existence and determination of solutions to LDEs (Barnett, 1969; Stewart, 1952).

*Theorem 1:* Let $A_1*X_1 + A_2*X_2 + ... + A_n*X_n = C$ (for $n \geq 2$) represent an LDE and D represent the gcd of $A_1$, $A_2$, ..., $A_n$. If D divides C, then the LDE has a solution in the set of integers.

For example, if we are given the LDE:

$$3X_1 + 6X_2 = 12, \quad (2)$$

then it has a solution in the set of integers because the gcd of 3 and 6 is 3 which divides 12.

*Theorem 2:* Assume the LDE $A_1*X_1 + A_2*X_2 + ... + A_n*X_n = C$ has a solution and D is the gcd of $A_1, A_2, ..., A_n$. If $X_1^*, X_2^*, ..., X_n^*$ represents a solution to the gcd equation $A_1*X_1 + A_2*X_2 + ... + A_n*X_n = D$, then $X_1^{**} = k*X_1^*, X_2^{**} = k*X_2^*, ..., X_n^{**} = k*X_n^*$ represents a solution to the LDE, where k = C/D.

Theorem 2 allows one to find a solution to an LDE given a solution to its gcd equation. For example, consider the LDE:

$$172X_1 + 20X_2 = 1000. \quad (3)$$

The gcd of 172 and 20 is 4 and a specific solution to the gcd equation $172X_1 + 20X_2 = 4$ is $X_1^* = 2$ and $X_2^* = -17$. Since k = C/D = 1000/4 = 250, then $X_1^{**} = k*X_1^* = 250*2 = 500$ and $X_2^{**} = k*X_2^* = 250*(-17) = -4250$ provide a solution to the LDE.

## BLANKINSHIP'S VERSION OF THE EUCLIDEAN ALGORITHM

In the previous section, Theorem 2 implied that to find a solution to an LDE one could first solve its related gcd equation $A_1*X_1 + A_2*X_2 + ... + A_n*X_n = D$, where D is the gcd of $A_1, A_2, ..., A_n$. In general, computer application is necessary for obtaining a solution to the related gcd equation of an LDE.

The typical method found in quantitative texts to solve a gcd equation with n = 2 variables involves two procedures (Barnett, 1969; Kurosaka, 1986; Stewart, 1952). First, the gcd of $A_1$ and $A_2$ must be found. This procedure employs the Euclidean Algorithm which involves repeated use of division until a zero remainder occurs. The second procedure involves finding a solution to the gcd equation. Completion of this task involves reversing the computations performed in computing the gcd of $A_1$ and $A_2$. This method of solution can be tedious to employ. Furthermore, the algorithm is limited to solving gcd equations with only two variables. Repeated application of the process is required when there are more than two variables.

W.A. Blankinship's article unveiled an alternate method for finding the gcd for more than two integer variables and a solution to the corresponding gcd equation of *n* integers (Blankinship, 1963). Blankinship's Version of the Euclidean Algorithm (BVEA) is straight forward to execute and easily implemented using a computer.

Suppose we are interested in finding the gcd of $A_1, A_2, ..., A_n$ and solving the gcd equation $A_1*X_1 + A_2*X_2 + ... + A_n*X_n = D$. According to Blankinship's algorithm we first formulate an *n* by *(n+1)* matrix M defined as:

$$M = \begin{bmatrix} A_1\ 1\ 0\ 0\ .\ .\ 0 \\ A_2\ 0\ 1\ 0\ .\ .\ 0 \\ A_3\ 0\ 0\ 1\ .\ .\ 0 \\ .\ .\ .\ .\ .\ .\ . \\ .\ .\ .\ .\ .\ .\ . \\ A_n\ 0\ 0\ 0\ .\ .\ 1 \end{bmatrix}.$$

The basis of this algorithm consists of performing elementary row operations on the matrix according to the following procedure.

| |
|---|
| *Step #1:* Select the row with the smallest non-zero first element. Call this row the *operator row* and its first element the *operator*. |
| *Step #2:* Find all rows with non-zero first elements. Call these rows *operand rows* and their first elements *operands*.<br>a. If one or more *operand rows* are found, then go to Step #3.<br>b. If no *operand rows* are found the process terminates with the solution set for the problem found in the *operator row*. The gcd D is the *operator* while the solution to the gcd equation defined by $X_1^*$, $X_2^*$, ..., $X_n^*$ is found in the corresponding columns *2* to *(n+1)* of the *operator row*. |
| *Step #3*: For each *operand row* determine the integer quotient Q equal to the row's *operand* divided by the *operator*. |
| *Step #4*: For each *operand row* replace each element of the row with the corresponding difference between itself and Q times the corresponding element of the *operator row*. |
| *Step #5:* Return to Step #1. |

To illustrate the algorithm, assume $A_1 = 10$, $A_2 = 12$ and $A_3 = 8$. Thus matrix M becomes:

$$M = \begin{bmatrix} 10\ 1\ 0\ 0 \\ 12\ 0\ 1\ 0 \\ 8\ 0\ 0\ 1 \end{bmatrix}.$$

From matrix M we observe that row 3 is the *operator row* and its first element 8 is the *operator*. The *operands* are the first elements of rows 1 and 2. Table 1 that follows demonstrates the execution of the algorithm. In the table, Matrix $M_i$ denotes the row equivalent matrix to matrix M after the $i^{th}$ iteration of Step #4 of the algorithm. From Table 1 we find the gcd of 10, 12, and 8 to be 2 and a solution to the gcd equation $10X_1 + 12X_2 + 8X_3 = 2$ is $X_1^* = 1$, $X_2^* = 0$, and $X_3^* = -1$.

## SOLVING HOMOGENEOUS LINEAR DIOPHANTINE EQUATIONS

A HLDE is one with its constant term C on the right hand side of the equation equal to zero. For example, $3X_1 + 5X_2 + 6X_3 = 0$ is a HLDE. In this section, our goal is to find a method for determining the general solution of a HLDE.

**Table 1: Illustration of BVEA for $A_1 = 10$, $A_2 = 12$ and $A_3 = 8$**

| i | Operator | Operand | Q | Matrix $M_i$ | Compute |
|---|---|---|---|---|---|
| 1 | 8 | 10<br>12<br>(Operator Row) | 1<br>1<br>==> | 2 1 0 -1<br>4 0 1 -1<br>8 0 0 1 | $M_{1j} - Q*M_{3j}$<br>$M_{2j} - Q*M_{3j}$<br>for j = 1 to 4 |
| 2 | 2 | (Operator Row)<br>4<br>8 | ==><br>2<br>4 | 2 1 0 -1<br>0 -2 1 1<br>0 -4 0 5 | for j = 1 to 4<br>$M_{2j} - Q*M_{1j}$<br>$M_{3j} - Q*M_{1j}$ |

It is important to note, if one of the coefficients of the HLDE is ±1, we can find a general solution by solving for that variable. For example $3X_1 + 6X_2 + 2X_3 + X_4 = 0$ has a general solution $X_4 = -3X_1 - 6X_2 - 2X_3$ for arbitrary integer values of $X_1$, $X_2$, and $X_3$.

The question at this point is how do we find the general solution to a HLDE if it has no unit coefficients. The *Unit Coefficient Reduction Algorithm*, which is based on a similar algorithm generally found in textbooks involving the theory of equations, is used to resolve the question (MacDuffee, 1954).

Assume the HLDE $A_1*X_1 + A_2*X_2 + \ldots A_n*X_n = 0$ with $A_i \neq 0$ for i = 1 to n and where the gcd of $A_1$, $A_2$, ..., $A_n$ is equal to 1. Then the process that follows defines the *Unit Coefficient Reduction Algorithm*:

| | | | |
|---|---|---|---|
| *Step #1:* | Choose Min = $A_m$ to be the smallest $A_i$ for i = 1 to n. Then let SMin = $A_s$ represent the smallest of the remaining $A_i$'s that is relative prime to Min (i.e. has gcd of 1). | | |
| *Step #2:* | Apply the division algorithm and find the quotient *q* and the remainder *r* using Min as the divisor and SMin as the dividend. Namely, find integers q and r such that | | |
| | SMin = q*Min + r,<br>where $0 \leq r < Min$. (4) | | |
| *Step #3:* | Substitute $X_m = X_m' - q*X_s$ in the HLDE. It is easily seen that this substitution yields a coefficient of r for $X_s$. Furthermore, repeated applications of Step #3 leads to the desired result of r = 1 or a unit coefficient for the HLDE. | | |
| *Step #4:* | a | If r is not 1, then return to Step #1. | |
| | b | If r = 1, then a general solution to the HLDE can be found by doing the following. | |
| | | 1 | First, solve the HLDE for the variable which has a unit coefficient. |
| | | 2 | Next, utilize the substitutions performed in Step #3 and the equation obtained in 1 above to determine the general solution of the HLDE. |

To illustrate the algorithm let us consider the HLDE:

$$3X_1 + 5X_2 + 17X_3 + 156X_4 = 0. \quad (5)$$

Because the gcd of 3, 5, 17, and 156 is 1, then the algorithm can be applied. Details of the *Unit Coefficient Reduction Algorithm* for the example are given in Table 2.

**Table 2 : Illustration of the Unit Coefficient Reduction Algorithm**

| HLDE | Iteration | Step | Action |
|---|---|---|---|
| $3X_1+5X_2+17X_3+156X_4 = 0$ | 1 | 1 | Min = $A_1 = 3$<br>SMin = $A_2 = 5$ |
| | | 2 | Use Div. Algorithm<br>$5 = 3q + r$<br>$q = 1; r = 2$ |
| $3(X_1'-X_2)+5X_2+17X_3+156X_4 = 0$<br>$3X_1'+2X_2+17X_3+156X_4 = 0$ | | 3 | $X_1 = X_1' - X_2$<br>Substitute<br>Simplify<br>$r \neq 1$ |
| $3X_1'+2X_2+17X_3+156X_4 = 0$ | 2 | 1 | Min = $A_2 = 2$<br>SMin = $A_1 = 3$ |
| | | 2 | Use Div. Algorithm<br>$3 = 2q + r$<br>$q = 1; r = 1$ |
| $3X_1'+2(X_2'- X_1')+17X_3+156X_4 = 0$<br>$X_1'+2X_2'+17X_3+156X_4 = 0$ | | 3 | $X_2 = X_2' - X_1'$<br>Substitute<br>Simplify<br>$r = 1$ |

Since r = 1 we have a HLDE with a unit coefficient which we can solve as follows:

$$X_1' = -2X_2' - 17X_3 - 156X_4. \quad (6)$$

By combining $X_2 = X_2' - X_1'$ from Iteration #2, Step #3 with equation 6 yields:

$X_2 = X_2' - X_1' = X_2' - (-2X_2'-17X_3 - 156X_4)$, which reduces to

$$X_2 = 3X_2' + 17X_3 + 156X_4. \quad (7)$$

Also by combining $X_1 = X_1' - X_2$ from Iteration #1, Step #3 and equations 6 and 7 yields:

$X_1 = X_1' - X_2 = (-2X_2' - 17X_3 - 156X_4) - (3X_2' + 17X_3 + 156X_4)$, which also reduces to

$$X_1 = -5X_2' - 34X_3 - 312X_4. \quad (8)$$

Thus, for arbitrary integers $X_2'$, $X_3$, and $X_4$ and equations 7 and 8, one can find a solution to the HLDE $3X_1 + 5X_2 + 17X_3 + 156X_4 = 0$.

## USING THE ADDITIVE THEOREM

This section develops a method for finding a general solution to an LDE (Blankinship, 1963). The process formulated is dependent on Theorem 3 below, which is based on a similar concept used to solve ordinary linear differential equations (Kaplan, 1958). The theorem and its proof follows.

*Theorem 3 (Additive Theorem):* If $I_1, I_2, ..., I_n$ represents an initial solution to the LDE, $A_1*X_1 + A_2*X_2 + ... + A_n*X_n = C$, and $G_1, G_2, ..., G_n$ represents a general solution to its HLDE, $A_1*X_1 + A_2*X_2 + ... + A_n*X_n = 0$, then $X_i^* = G_i + I_i$, for i = 1 to n, represents a general solution to the LDE $A_1*X_1 + A_2*X_2 + ... + A_n*X_n = C$.

*Proof: To display that $X_i^* = G_i + I_i$ for i = 1, ..., n represents a general solution, it is necessary to show that $X_i^*$ satisfies the given LDE. To do so we obtain:*

*1* $\Sigma A_i*X_i^* = \Sigma A_i*(G_i + I_i)$ *by substitution,*
*2* $\Sigma A_i*X_i^* = \Sigma(A_i*G_i + A_i*I_i)$ *by the distributive law of multiplication, and*
*3* $\Sigma A_i*X_i^* = \Sigma(A_i*G_i) + \Sigma(A_i*I_i)$ *by the additive law for summations.*

*Since $G_1, G_2, ..., G_n$ is a general solution to the HLDE, then $\Sigma(A_i*G_i) = 0$. In addition, since $I_1, I_2, ..., I_n$ is an initial solution to the LDE, then $\Sigma(A_i*I_i) = C$. Thus from 3 above and the last two observations it follows that:*

*4* $\Sigma A_i*X_i^* = \Sigma(A_i*G_i) + \Sigma(A_i*I_i)$ *or* $0 + C = C$.

As an illustration let us consider the LDE:

$$3X_1 + 5X_2 + 17X_3 + 156X_4 = 2. \quad (9)$$

An initial solution to the LDE is $I_1 = 3$, $I_2 = 2$, $I_3 = -1$, $I_4 = 0$. Furthermore, the general solution to its HLDE developed previously is $G_1 = -5X_2' - 34X_3 - 312X_4$; and $G_2 = 3X_2' + 17X_3 + 156X_4$, where $X_2'$, $X_3$, and $X_4$ are integers. Since $X_3$ and $X_4$ are arbitrary, let $X_3 = t$ and $X_4 = s$. Now by Theorem 3, and equations 7 and 8, a general solution to the LDE is represented as follows:

$$X_1 = (-5X_2' - 34X_3 - 312X_4) + 3, \quad (10)$$
$$X_2 = (3X_2' + 17X_3 + 156X_4) + 2, \quad (11)$$
$$X_3 = t - 1, \quad (12)$$
$$X_4 = s + 0, \quad (13)$$

where $X_2'$, t, and s are arbitrary integers.

## SOLVING THE EXAMPLE PROBLEM USING THE LDE APPROACH

The algorithm advanced by the authors to find the general solution of the LDE requires:

| | |
|---|---|
| 1 | an initial solution to the LDE be found, |
| 2 | a general solution to the model's corresponding HLDE be obtained, and |
| 3 | that the Additive Theorem be employed. |

To find the initial solution of the LDE for the real estate developer's problem, we first use Blankinship's Version of Euclidean Algorithm (BVEA) to find a solution to the LDE's corresponding gcd equation. Employing BVEA requires we define the matrix M below.

$$M = \begin{bmatrix} 60 & 1 & 0 \\ 80 & 0 & 1 \end{bmatrix}.$$

Table 3 summarizes the actions of the BVEA.

**Table 3: BVEA Applied Using $A_1 = 60$ and $A_2 = 80$**

| Pass i | Operator | Operand | Q | Matrix $M_i$ | Compute |
|---|---|---|---|---|---|
| 1 | 60 | 80 | 1 | 60 1 0<br>20 -1 1 | for j = 1 to 3<br>$M_{2j} - Q*M_{1j}$ |
| 2 | 20 | 60 | 3 | 0 4 -3<br>20 -1 1 | $M_{1j} - Q*M_{2j}$<br>for j = 1 to 3 |

From Table 3 we find the gcd of $A_1 = 60$ and $A_2 = 80$ is 20 and a solution to the gcd equation $60X_1 + 80X_2 = 20$ is $X_1^* = -1$ and $X_2^* = 1$.

Now applying Theorem 2 we find an initial solution to our integer allocation problem modeled by $60X_1 + 80X_2 = 1{,}000$. The value of k is found as $k = C/D = 1{,}000/20 = 50$. The initial solution to the LDE is $X_1^{**} = k*X_1^* = 50*(-1) = -50$ and $X_2^{**} = k*X_2^* = 50*1 = 50$.

Next, we determine a general solution to the HLDE:

$$60X_1 + 80X_2 = 0, \tag{14}$$

by employing the *Unit Coefficient Reduction Algorithm*. The algorithm requires the coefficients of the HLDE to be relatively prime. This condition is satisfied by factoring 20 from the coefficients of the HLDE to yield $3X_1 + 4X_2 = 0$. Table 4 contains the details of the algorithm.

| Table 4: Unit Coefficient Reduction Algorithm Applied to $3X_1 + 4X_2 = 0$ | | | |
|---|---|---|---|
| HLDE | Iteration | Step | Action |
| $3X_1+4X_2 = 0$ | 1 | 1 | Min = $A_1 = 3$<br>SMin = $A_2 = 4$ |
| | | 2 | Use Div. Algorithm<br>$4 = 3q + r$<br>$q = 1; r = 1$ |
| $3(X_1'-X_2)+4X_2 = 0$<br>$3X_1'+X_2 = 0$ | | 3 | $X_1 = X_1' - X_2$<br>Substitute<br>Simplify<br>$r = 1$ |

Since $3X_1' + X_2 = 0$ has a unit coefficient, it can be solved as:

$$X_2 = -3X_1'. \tag{15}$$

By substituting $X_1 = X_1' - X_2$ and employing equation 15 we obtain:

$$X_1 = 4X_1'. \tag{16}$$

Thus equations 15 and 16 for an arbitrary $X_1'$ yield a general solution to the HLDE. Now according to Theorem 3 the general solution to our LDE is defined by adding $X_1^{**}$ and $X_2^{**}$ to equations 15 and 16 respectively to obtain:

$$X_1 = 4X_1' - 50, \tag{17}$$
$$X_2 = -3X_1' + 50. \tag{18}$$

The mathematical model for the problem requires the values of $X_1$ and $X_2$ to be nonnegative. Thus the inequalities ($4X_1' - 50 \geq 0$) and ($-3X_1' + 50 \geq 0$) are solved. Applying basic algebra yields ($X_1' \geq 12.5$) and ($X_1' \leq 16.3$) and the integer values satisfying these inequalities are $X_1' = 13, 14, 15,$ and 16.

Using these four values of $X_1'$ and the general formulas for $X_1$ (equation 17) and $X_2$ (equation 18) yields the following four sets of solutions:

| | |
|---|---|
| 1 | $X_1 = 2$ and $X_2 = 11$, |
| 2 | $X_1 = 6$ and $X_2 = 8$, |
| 3 | $X_1 = 10$ and $X_2 = 5$, and |
| 4 | $X_1 = 14$ and $X_2 = 2$. |

## COMPARING THE SOLUTION METHODOLOGIES

In an effort to compare the two methodologies, the branch and bound algorithm was first employed to solve the real estate developer's dilemma. The following result was obtained:

$X_1 = 2$ and $X_2 = 11$.

The branch and bound methodology provided one of the four solutions the LDE approach produced. Any attempt to obtain other solutions would involve "seek and destroy" branching strategies with no guarantee of finding other integer solutions, indicating some rigidity with the enumeration technique. Additionally, offering an initial solution to a software package in an attempt to obtain an alternate solution on another branch proved unsuccessful.

Thus, a limitation of the branch and bound approach to solving integer allocation problems has been revealed. The use of branching algorithms to solve integral resource allocation problems offers little control in obtaining a solution much less a full set of multiple solutions. The use of such algorithms provides no mechanism for obtaining alternative solutions without an exhaustive search.

Although the LDE approach provides no single optimum solution, it does have the flexibility of providing all possible alternate solutions to an integer resource allocation problem. This gives decision-makers the choice of observing alternate solutions and performing their own sensitivity analysis, maybe even satisfying other less important objectives that are overlooked by the use of the branching technique. For our example, the real estate developer may feel that 60 ft. wide lots could be easier to sell and therefore wish to have more of them.

## CONCLUDING REMARKS

The authors' purpose in exploring this topic is threefold. First, the purpose served by this research is to present a methodology to confront problems with alternative solutions incurred by decision makers. The authors, all of whom teach quantitative analysis (QA) courses, realize the need to incorporate the solution of integer allocation problems in QA curriculums. Students enrolled in QA for Management courses are encouraged to apply various techniques to organizational decision-making situations. However, analyzing the solution of integer allocation problems is not usually presented in great detail in most QA texts (Kurosaka, 1986). The methodologies presented in this paper would be welcomed by many students due to the simplicity and straightforward solution process.

Second, in exploring an alternate approach to solving LDEs, it has been found that a general solution to an LDE can be formulated for any LDE which has an initial solution. Naturally, the advancement of a general solution to LDEs is beneficial for any application in which multiple solutions are desirable. The integer allocation example cited here is just one of numerous applications which could benefit from this methodology. Problems in which integer solutions are desired have traditionally been explored as IP problems (Elmaghraby and Elimam, 1980). In a practical sense, the modeling of problems as LDEs in many cases can provide a more realistic view of decision tradeoffs.

The third purpose of this paper was a comparison of the methodology of the LDE approach to the results obtained by solving the same problem using the branch and bound approach. By utilizing the more traditional technique of branching in order to solve the developer's dilemma, it was shown that the branch and bound approach does not provide the flexibility of the LDE method.

The authors hope to continue to pursue a range of applications using this alternate approach to solving LDE's. Hopefully, this pursuit will lead to a greater realization for management's need to develop skills to solve problems with multiple solutions.

## REFERENCES


Barnett, I.A. (1969). *Elements of Number Theory*. Boston, Massachusetts: Prindle, Weber & Scmidt, Inc.

Beale, E., and R. Small (1965). Mixed Integer Programming by a Branch and Bound Technique. *Proceedings of the Third IFIP Congress, 2,* 450-451.

Blankinship, W.A. (1963). A New Version of the Euclidean Algorithm. *American Mathematical Monthly, 70(September),* 742-745.

Dakin, R. (1965). A Tree Search Algorithm for Mixed Integer Programming Problems. *Computer Journal, 8,* 250-255.

Driebeek, N.(1966). An Algorithm for the Solution of Mixed Integer Programming Problems. *Management Science, 12(7),* 576-587.

Elmaghraby, S.E., and A.A. Elimam (1980). Knapsack-Based Approaches to the Makespan Problem on Multiple Processors. *AIIE Transactions, 12(1),* 87-96.

Hillier, F.S., and G.J. Lieberman (1974). *Operations Research*. San Francisco, California: Holdan-Day, Inc.

Ibaraki, T., and N. Katoh (1988). *Resource Allocation Problems: Algorithmic Approaches*. Cambridge, Massachusetts: The MIT Press.

Kaplan, W. (1958). *Ordinary Differential Equations*. Reading, Massachusetts: Addison-Wesley.

Kurosaka, R.T. (1986). Diophantine Equations. *Byte Magazine, 11(March),* 343-350.

Land, A., and A. Doig (1960). An Automatic Method of Solving Discrete Programming Problems. *Econometrica, 28(3),* 497-520.

Little, J., K. Murty, D. Sweeney, and C. Karel (1963). An Algorithm for the Traveling Salesman Problem. *Operations Research, 11(6),* 972-989.

MacDuffee C.C. (1954). *Theory of Equations*. New York City, New York: John Wiley.

Rowe, N.C. (1986). Diophantine Inference on a Statistical Database. *Information Processing Letters, 18(1), January 20,* 25-31.

Salkin, H.M. (1975). *Integer Programming*. Reading, Massachusetts: Addison-Wesley.

Stewart, B.M. (1952). *Theory of Numbers*. New York City, New York: The MacMillan Company.

Stewart, I. (1992). The Riddle of the Vanishing Camel. *Scientific American, 266(June),* 122-124.

Thompson, G. (1964). The Stopped Simplex Method: I. Basic Theory for Mixed Integer Programming; Integer Program. *Revue Francaise de Recherche Operationnelle,* 155-182.

Tomlin, J. (1970). Branch and Bound Methods for Integer and Non-Convex Programming. In Abadie (Ed.), *Integer and Nonlinear Programming*. North Holland.

Tomlin, J. (1971). An Improved Branch-and-Bound Method for Integer Programming. *Operations Research, 19(4),* 1070-1075.

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# ACADEMY OF INFORMATION AND MANAGEMENT SCIENCES JOURNAL

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# LETTER FROM THE EDITOR

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# Manuscripts

# THE ETHICAL DIMENSION OF INFORMATION TECHNOLOGY WORKERS – AN EMPIRICAL STUDY [1]

**Gary A. Williams, Western Carolina University**
**Debasish Banerjee, Western Carolina University**

## ABSTRACT

*Since at least the 1960s, attention has focused on moral and ethical issues. Of particular concern here is the moral and ethical framework of information systems professionals. Several research studies have focused on the information technology (IT) profession and have developed interesting hypotheses concerning the ethical perspective of IT professionals; however, little empirical research has been done relating to IT professionals.*

*Data collected for this empirical study included Rest's DIT scores and responses measuring attitude, normative beliefs, and ethical intention. Because initial analysis showed little correlation between the measurement variables and attitude and no correlation between the measurement variables and intent, the initial conclusion is that the P and D scores are not valuable as predictors of either intent or attitude of IT professionals toward ethical behavior. This contradicts numerous studies that have reported significant regression coefficients for attitude or intent to behave ethically and the P, D and U scores. Meta analyses from other studies also have shown a significant strength of association between the measurements variables and attitude/intent.*

*The interesting question which begs further research, is whether IT professionals do possess a different moral compass than other professionals, and if so, why.*

## INTRODUCTION: A THEORY OF MORAL JUDGMENT

In his 1932 book The Moral Judgment of the Child, Piaget was able to make major contributions to the understanding of the moral plane by

| | |
|---|---|
| *1* | *defining the problem area and the theoretical construct of moral judgment,* |
| *2* | *introducing methods for studying a subject's moral judgment,* |
| *3* | *identifying a dozen specific features in children's moral thinking for making inferences about their underlying thought structure, and* |
| *4* | *providing cross-sectional age trend data to support his theories.* |

Piaget's approach offers only a limited characterization of the cognitive structures underlying the verbalizations of many different people; however, it is imperative to the understanding of this subject matter that one recognizes that the study of morality is multifaceted. Piaget, in prioritizing certain phenomena, certain research strategies, and certain questions, supports the notion that no

single theory or research approach can adequately diagnose all aspects of the psychology of morality.

Lawrence Kohlberg proposed the stage theory (1969) of the development of ethical understanding. The theory insists that individuals pass through six stages of ethical understanding. Each stage is characterized by the way in which the individual conceptualizes social and societal relationships and determines justice. Kohlberg postulated that all individuals pass through these stages, that the order of the stages is invariant, and that no stage could be "skipped." He also noted that the stages are universal, meaning that the results of the test should be the same across gender, culture, or other demographic factors (Kohlberg, 1971). Kohlberg then developed a measurement instrument, the "Moral Judgment Interview", the result of which should be a determination of the individual's current stage of moral development. This instrument, however, requires an expert interviewer and can only be conducted on an individual basis; it cannot be administered in groups (Fisher and Sweeney, 1998).

In 1980, Kohlberg found that esteem-motivated individuals do not submit to group pressure; that is, their moral posture remains quite consistent among differing situations (Colby & Kohlberg, 1984). On the other hand, safety-motivated individuals tend to surrender to group pressure and display irregular moral behaviors (Dejoie, Fowler, & Paradice, 1991).

In contrast to Kohlberg's position, numerous cross-sectional studies support claims that moral judgment is developmental. Differences in gender are also prevalent among DIT scores. It is generally believed that females tend not to progress to postconventional morality as often as males because of differential societal pressures on females; however, at younger ages, females are historically more advanced in terms of moral reasoning. (Dejoie, Fowler, & Paradice, 1991). DIT research also indicates that self-esteem may play a relevant part in moral decisions, especially in highly educated individuals. Other studies have used demographic variables, including age, sex, and education level, to predict moral reasoning (Ma & Cheun, 1996).

Although many studies either continue to extend or directly replicate Piaget's and Kohlberg's work, three major centers of activity that have contrasting interests have developed from Piaget and Kohlberg's work, outlined below. The latter is the focus of this study.

| | |
|---|---|
| *1* | *studies focusing on the re-examination of the processes of children and the materials used by Piaget as a stimulus,* |
| *2* | *studies attempting to identify and describe the basic organizational principles of social knowledge of children in early and middle childhood, and* |
| *3* | *research on the Defining Issues Test (DIT).* |

## THE DEFINING ISSUES TEST

The Defining Issues Test (DIT), developed by James Rest, is multifaceted and requires developing some background so that one can fully grasp the importance of the concept. Unlike many studies on morality, DIT research is primarily concerned with an older group of subjects; it

is also primarily concerned with developmental differences in individuals. As compared with Kohlberg's Moral Judgment Interview, the DIT was intended to be an easily quantifiable and objective measure of moral and ethical development (Reall, 1998). It consists of six ethical situations, or dilemmas (only three of which are used in a short version). Following each situation, a list of twelve considerations is used in deciding how to resolve the matter at hand. Each consideration is supposed to represent the typical thinking processes of a particular stage of ethical development. The subjects are required to rate these statements on a five-point scale with level of importance ranging from "great importance" to "no importance." The four most important considerations from these rankings are then derived. The P-score, or principled score, is calculated from these final rankings.

## THE SCORES

The Principled Score (P-score), measures the percentage of the time that the subject chose statements meant to represent Stage 5 or Stage 6 reasoning (Leming, 1978). This is possible because the stage scores have direct correspondence to Kohlberg's stages of moral development, although the DIT splits Kohlberg's stage five into two substages – 5A and 5B.

Mark Davison denotes "D" as a superior index. The D-score captures ones ratings of specific questions regarding their importance in the context of a particular ethical dilemma. It is a weighted sum of double standardized item responses where the weights are derived empirically from a scaling algorithm described by Schoneman (Rest 1986, p. 4.2). Davison's work introduces an overall strategy for test improvement and provides for a more powerful use of the DIT. Further analysis of the DIT results in the conclusion that the empirically weighted sum presents the most desirable overall measure of development. Because it takes into account information from all stages, one conclusion suggested by this research is that the empirically weighted sum is more sensitive to longitudinal change than is P because it takes in information from all stages—particularly when the change occurs in lower stages (Markoulis, 1989). The empirically weighted sum yielded a significantly higher correlation with Kohlberg's measure and the more powerful longitudinal trends as compared to the theoretically weighted sum.

The U-score (utilization score) was proposed by Thoma (1985) to measure the degree to which the two sources of information used in deriving the P-score and D-score overlap. His premise is that the U-score measures the degree to which moral judgments operate in making a decision on a particular ethical dilemma. Empirical evidence supports this claim (Thoma, 1985).

A summary of the test reliability data from various samples reveals high overall reliability (P and the empirically weighted sum) with internal consistency and test-retest reliability in the high .70s and low .80s for age heterogeneous samples (Markoulis, 1989).

## DIT: HARD STAGE VERSUS SOFT STAGE ANALYSIS

Colby and Kohlberg (1984) posit that individuals can be typed as being currently in a particular stage within the DIT (often referred to as the "modal" stage). The individual would predominantly rely on ethical reasoning typical of that stage, and would only occasionally use

reasoning typically found in lower or higher stages. As the individual advances through the stages, lower level reasoning would be viewed as inadequate, and would be discontinued from use in any situation. Reasoning that is considered to be one level above the modal stage may also be used, but reasoning of the next higher stage(s) would neither be understood nor used (Gilligan, 1982).

Rest's beliefs differ substantially from those of Colby and Kohlberg. He feels that ethical development should be viewed as a distribution of reasoning (Rest, 1983). This simply means that the individual may use reasoning related to a particular stage to a greater or lesser degree, and at the same time, depending on the situation, will use reasoning related to all other stages.

The P-score which results from administration of the DIT does not measure what stage the individual is currently in; neither does it give an indication of what stage the individual predominantly uses. It simply indicates the degree to which the individual applied higher level (Stage 5 or 6) ethical reasoning in responding to the moral and ethical situations. A subject who almost entirely employed Stage 4 reasoning and chose only a few Stage 5 or Stage 6 possibilities would receive the same P-score as a subject who used almost entirely Stage 2 reasoning, but chose the same number of Stage 5 or Stage 6 possibilities (Emler, Renwick, & Malone, 1983). Kohlberg's theory would seem to indicate that these two subjects are not operating on the same level of ethical standards, but in a study based on the DIT, they would be treated as if they were.

Rest (1983) states that his views regarding the distribution of responses as opposed to Kohlberg's hard stage beliefs are a result of his being informed by the data. A brief review of any completed set of responses to the DIT makes it much easier to understand how this developed (Emler, Renwick, & Malone, 1983). According to Kohlberg's theory, a Stage 5 respondent should choose as most important all those considerations that are consistent with Stage 5-level thinking, with possibly some occasional Stage 4 thinking and perhaps the beginning of Stage 6 thinking. On the DIT, respondents do not necessarily choose as most important the considerations that are even predominantly from one stage (Richards and Davison, 1992).

DIT research has revealed many relationships; most important, however, are these fundamental claims:

| | |
|---|---|
| *1* | *that moral judgment is developed internally as a person travels through the stages of life,* |
| *2* | *that moral judgment has a role in everyday and real life decision making, and* |
| *3* | *that moral judgment is primarily governed by cognitive processes (Sweeny and Fisher, 1998).* |

Authoritarianism, neuroticism, and level of anxiety have also been related to differing indices of moral reasoning (Sweeny and Fisher, 1998). Several conclusions were drawn from these studies. Among them:

| | |
|---|---|
| *1* | *the more educationally advanced students and older adults, the higher the moral judgment scores and* |
| *2* | *doctoral students enrolled in political science and moral philosophies have achieved the highest DIT scores of any student groups (Sweeny and Fisher, 1998).* |

Numerous empirical studies into moral reasoning result in at least some some inconsistencies concerning the DIT. However, the body of research has established several principles in support of the basic tenets of cognitive development. Main points include:

| | |
|---|---|
| *1* | *the direct association between level of education and moral judgment scores,* |
| *2* | *a pattern of lower DIT scores for those individuals that maintain conservative religious beliefs, and* |
| *3* | *inconsistent results based on sex differences on the DIT.* |

The application of the framework of moral reasoning by information systems professionals has also been studied.

## ETHICS AND INFORMATION TECHNOLOGY PROFESSIONALS

A number of studies have addressed the issue of ethics in both business and information systems, but few of them have developed compelling empirical evidence about the relationships between ethical tendency and action (Loe and Ferrell, Sims and Keon, Wyld and Jones, Soutar and McNeil, Pemberton). Laudon discusses ethical concepts as they apply to IT professionals. While he develops a thesis focused on , among other issues, technological determinism, his work lacks an empirical component (Laudon). However, other studies do attempt to address that issue. Among those is a model developed by Thong and Yap (1984) that applies theory developed by Hunt and Vitell specifically for marketing-related environments. Their research supported the use of this model in the IS domain. They conclude that it is superior to the theory of reasoned action as developed in a study by Loch and Conger, with explanatory power being approximately twice that of the latter model. Another study develops a model of potential determinants of softlifting (Simpson, et al.). That studies specifically address the link between ethical perception of softlifting and softlifting behavior. Other studies that focus on ethics in business environments include Cummings and Harris, Robertson, Buckley and Wiese, and Mahmood and Sullivan. None of these, however, focuses on the IT professional.

The Defining Issues Test (DIT) forms the basis of a substantial number of information technology ethics research studies (Ponemon and Glazer, Shaub, Jeffrey). The test, intended to measure the level of ethical development of the subject, has been used widely to compare the ethical development of students striving for degrees in information-technology fields to that of other business students (Ponemon and Glazer, 1990). It has also been used to compare the ethical development of practicing information technology professionals across levels of seniority within corporations, as well as to compare the average level of ethical development of IT professionals to other college educated individuals (Ponemon and Glazer, 1990; Shaub, 1994).

Because of the results of these comparisons, concern has developed that the level of ethical development of both IS/IT professionals and students is deficient. Some researchers and professional organizations have called for interventions to be undertaken by the profession and by

educators aimed at eliminating this perceived deficit (Fisher and Ott, 1996). In most cases, the P-score has most often been used in IS/IT ethics research (Jeffrey, 1993).

## PURPOSE OF THE STUDY

The popular press has extensively reported incidents of moral and ethical lapse by information technology (IT) professionals and students during the past several years; as a result both the public and government agencies have become concerned about the implications of these lapses – or, more particularly, of unethical and/or illegal actions – by IT professionals. The researchers sought to develop a model to predict moral attitude and intent of IT professionals in an attempt to measure the extent of the problem.

## THE SAMPLE

Employees of five companies and a major state university located in the central and south-central United States participated in the study. The companies were in the oil and computing industries and included IS departments of varying sizes. Subjects completed a questionnaire consisting of Rest's DIT and an instrument designed to measure attitude, personal normative beliefs, and intention to behave ethically. Additionally, demographic data were captured. Of the 256 instruments distributed, 141 were returned with 129 being usable. This represents a usable response rate of 50%.

## ANALYSIS OF THE DATA

The data collected were analyzed using the statistical program SAS. The results follow. Table 1 illustrates the univariate descriptive statistics of the collected data.

**Table 1: Simple Statistics**

| Variable | N | Mean | Std Dev | Sum | Minimum | Maximum |
|---|---|---|---|---|---|---|
| PSCOR | 266 | 38.94286 | 15.87438 | 10359 | 3.30000 | 83.30000 |
| DSCOR | 266 | 22.80554 | 3.58554 | 6066 | 14.54100 | 31.66100 |
| USCOR | 266 | 0.32255 | 1.71417 | 85.79710 | -0.48550 | 9.99990 |
| ATTITUDE | 260 | 11.83462 | 6.21242 | 3077 | 3.00000 | 21.00000 |
| INTENT | 263 | 2.76426 | 2.26438 | 727.00000 | 1.00000 | 8.00000 |

Table 2 describes the Pearson Product-Moment coefficients of correlation (r) for the data. Examination of the r scores indicates no statistically significant correlation between any pairs of variables except that the correlation between the P-score and the D-Score of .52 proves to be significant. Over 25% of the variance can be explained. This is reasonable since both scores are

derived from the same data; the computation of the two scores differs in that, while the P-score depends solely on the responses related to stage 5 and 6 reasoning, the D-score uses a weighted sum-of-scores derived from the respondents' scores across all six stages of the model. Thus, some degree of duplication is inherent in the models.

**Table 2: Correlation Matrix**

| | PSCOR | DSCOR | USCOR | ATTITUDE | INTENT |
|---|---|---|---|---|---|
| PSCOR | 1.00000<br>0.0<br>266 | 0.52397<br>0.0001<br>266 | 0.09233<br>0.1331<br>266 | 0.12315<br>0.0473<br>260 | -0.02686<br>0.6646<br>263 |
| DSCOR | 0.52397<br>0.0001<br>266 | 1.00000<br>0.0<br>266 | -0.00106<br>0.9863<br>266 | 0.18182<br>0.0033<br>260 | -0.04902<br>0.4286<br>263 |
| USCOR | 0.09233<br>0.1331<br>266 | -0.00106<br>0.9863<br>266 | 1.00000<br>0.0<br>266 | -0.00157<br>0.9799<br>260 | -0.02680<br>0.6653<br>263 |
| ATTITUDE | 0.12315<br>0.0473<br>260 | 0.18182<br>0.0033<br>260 | -0.00157<br>0.9799<br>260 | 1.00000<br>0.0<br>260 | -0.05680<br>0.3617<br>260 |
| INTENT | 0.02686<br>0.6646<br>263 | -0.04902<br>0.4286<br>263 | -0.02680<br>0.6653<br>263 | -0.05680<br>0.3617<br>260 | 1.00000<br>0.0<br>266 |

Table 3 illustrates the results of analysis of variance. No statistical significance is apparent.

**Table 3: Analysis of Variance**

| Source | DF | Sum of Squares | Mean Square | F Value | Prob>F |
|---|---|---|---|---|---|
| Model | 5 | 8.16255 | 1.63251 | 0.316 | 0.9030 |
| Error | 254 | 1311.05284 | 5.16163 | | |
| C Total | 259 | 1319.21538 | | | |
| Root MSE | 2.27192 | R-square | 0.0062 | | |
| Dep Mean | 2.76154 | Adj R-sq | -0.0134 | | |
| C.V. | 82.27012 | | | | |

| Table 4: Parameter Estimates | | | | | |
|---|---|---|---|---|---|
| Variable | DF | Parameter Estimate | Standard Error | T for H0: Parameter=0 | Prob > \|T\| |
| INTERCEP | 1 | 3.199397 | 2.26378828 | 1.413 | 0.1588 |
| ATTITUDE | 1 | -0.017382 | 0.02315163 | -0.751 | 0.4535 |
| PSCOR | 1 | 0.005760 | 0.05615908 | 0.103 | 0.9184 |
| COMSCOR | 1 | -0.003746 | 0.10189255 | -0.037 | 0.9707 |
| DSCOR | 1 | -0.000392 | 0.00235405 | -0.167 | 0.8677 |
| USCOR | 1 | -0.031949 | 0.08213561 | -0.389 | 0.6976 |

The value of the study, however, is in determining the validity of the measurements as related to the respondent's attitude toward ethical action and his/her intent to act ethically. The results of the analysis are somewhat disappointing in that intent is not significantly correlated with any of the scores. On the other hand, attitude reflects mild correlation with both the P-score and the D-score, although there is no significant correlation with the U-score. Attitude explains less that one percent of the variance in the P-score and just over three percent of the variance on the D-score, both at alpha > 5%.

## CONCLUSIONS AND RECOMMENDATIONS

Because initial analysis showed little correlation between the measurement variables and attitude as well as no correlation between the measurement variables and intent, the initial conclusion is that the P and D scores are not valuable as predictors of either intent or attitude of IT professionals toward ethical behavior. This contradicts numerous studies that have reported significant regression coefficients for attitude or intent to behave ethically and the P, D and U scores. Meta analyses that have summarized results of various such studies also have shown a significant strength of association between the measurements variables and attitude/intent.

Since it is difficult to reason that significant differences exist between the subjects of this study (i.e., IS or IT professionals) and of the other studies that have used the same instrument, it is logical to believe that results of this study might have been convoluted by covariates. It is hoped that an analysis of covariance of the data with external factors such as companies, and scenarios will eliminate the imperfections and show positive correlations as expected.

The researchers recommend that additional analysis of covariance be performed to further explore the validity of the proposed model. Should such an effect still not be found, interesting questions arise:

| | |
|---|---|
| *1* | *Are information systems professionals different from subjects of the other studies?* |
| *2* | *Does the IS or IT profession impact moral judgment of its practioners?* |
| *3* | *Does the profession inculcate opportunities that affect moral reasoning of IS or IT professionals?* |

Additional research will be conducted in two stages. First, an analysis of covariance will be performed with effects of the moderating variables held constant. Then, depending on the outcome of the first stage, additional research will be directed toward identifying differences in IS/IT professionals (and the profession itself) and other professionals.

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## REFERENCES

Buckley, M. Ronald and Danielle S. Wiese (1998). An Investigation into the Dimensions of Unethical Behavior, *Journal of Education for Business*, 73(5), 284 ff.

Colby, A. and L. Kohlberg (1984). Invariant Sequence and Internal Consistency in Moral Judgment Stages. In W. Kurtines and J. Gerwirtz (Eds.), *Morality, Moral Behavior, and Moral Development*, (pp. 41-51). New York: John Wiley and Sons.

Cummings, Maeve and James Harris (1999). Using Information Technology: A Model of Ethical Decision Making, *International Journal of Management*, 16(2), 251 ff.

Dejoie, R., G. Fowler, and D. Paradice (1991). *Ethical Issues in Information Systems*. Boston: Boyd and Fraser.

Emler, N., S. Renwick, and B. Malone (1983). The Relationship Between Moral Reasoning and Political Orientation, *Journal of Personality and Social Psychology*, 45(5), 1073-1080.

Fisher, D. and J. Sweeny (1998). The Relationship Between Political Attitudes and Moral Judgment: Examining the Validity of the Defining Issues Test, *Journal of Business Ethics*, 17(2), 905-916.

Jeffrey, C (1993). Ethical Development of Accounting Students, Non-Accounting Business Students, and Liberal Arts Students, *Issues in Accounting Education*, 8(1), 86-96.

Kohlberg, L (1969). Stage and Sequence: The Cognitive-Developmental Approach to Socialization. In T. Mischel (Ed.), *Handbook of Socialization Theory and Research (pp.347-480). Chicago:* Rand McNally.

Leming, James S. (1978). Cheating Behavior, Situational Influence, and Moral Development, *The Journal of Educational Research*, 71(4), 213-217.

Loch, Karen D. and Sue Conger (1996). Evaluating Ethical Decision Making and Computer Use, *Communications of the ACM*, 39(7), 74 ff.

Loe, Terry W. and Linda Ferrell (2000). A Review of Empirical Studies Assessing Ethical Decision Making in Business, *Journal of Business Ethics*, 25(3), 185 ff.

Ma, H. and C. Cheun (1996). A Cross-Cultural Study of Moral Stage Structure in Hong Kong, Chinese, English, and Americans, *Journal of Cross-Cultural Psychology*, 27(6), 700-713.

Mahmood, Mo Adam and Gary L. Sullivan (1999). A New Approach to Evaluating Business Ethics: An Artificial Neural Networks Application, *Journal of End-User Computing*, 11(3),11 ff.

Markoulis, Diomedes. (1989). Political Involvement and Socio-moral Reasoning: Testing Emler's Interpretation, *British Journal of Social Psychology*, 28(3), 203-212.

Pemberton, J. Michael (1998). Through a Glass Darkly: Ethics and Information Technology, *Records Management Quarterly*, 32(1) 76 ff.

Piaget, Jean (1966). The Moral Judgment of the Child (Translated by Marjorie Gabain). New York: Free Press.

Ponemon, T. and A. Glazer, A. (1990), Accounting Education and Ethical Development: The Influence of Liberal learning on Students and Alumni in Accounting Practice, *Issues in Accounting Education*, 5(2),195-208.

Reall, M., J. Bailey, and S. Stoll (1998). Moral Reasoning "On Hold" During a Competitive Game, *Journal of Business Ethics*, 17(3),1205-1219.

Rest, J. (1983). "Morality." In J. Flavell and E. Markman (Eds.), *Handbook of Child Psychology* (pp. 526-629). New York: John Wiley and Sons.

Richards, P. and M. Davison (1992). Religious Bias in Moral Development research: A Psychometric Investigation, *Journal for the Scientific Study of Religion*, 31(4), 467-485.

Robertson, Diana C (1993). Empiricism in Business Ethics: Suggested Research Directions, *Journal of Business Ethics,* 12(8) 585 ff.

Shaub, M. (1994). An Analysis of the Association of Traditional Demographic Variables with the Moral Reasoning of Auditing Students and Auditors, *Journal of Accounting Education*, 12, 1-26.

Simpson, Penny M., Debasish Banerjee and Claude Simpson (1994). Softlifting: A Model of Motivating Factors, *Journal of Business Ethics*, 13(6), 431 ff.

Sims, Randi L. and Thomas L. Keon 1999). Determinants of Ethical Decision Making: The relationship of the Perceived Organizational . . ., *Journal of Business Ethics*, 19(4), 393 ff.

Soutar, Geoffrey and Margaret M. McNeil (1994). The Impact of the Work Environment on Ethical Decision Making: Some Australian Evidence, *Journal of Business Ethics*, 13(5), 327 ff.

Sweeney, J. & D. Fisher (1998), An Examination of the Validity of a New Measure of Moral Judgment, *Behavioral Research in Accounting*, 10, 138-158.

Thoma, S. J (1985). On Improving the Relationship Between Moral Reasoning and External Criteria: The Utilizer/Nonutilizer Dimension, (Doctoral Dissertation).Minneapolis: University of Minnesota.

Thong, James Y. L. and Chee-sing Yap (1998). Testing An Ethical Decision-Making Theory: The Case of Softlifting, *Journal of Management Information Systems*, 15(1), 213 ff.

Wyld, David C. and Coy A. Jones (1997). The Importance of Context: The Ethical Work Climate Construct and Models of Ethical Decision Making,16(4), 465 ff.

# TRADITIONAL MEDIA AND NEW IT: INVESTIGATING THEIR MEDIA RICHNESS VERSUS THEIR TECHNOLOGICAL RICHNESS

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## ABSTRACT

*Since the mid 1980's, many studies have been performed in order to verify the Media Richness Theory (MRT) developed by Daft and Lengel (1984, 1986). According to MRT, there is a hierarchy among the available media (some of them are supposed to be rich; others to be poor) and an optimal fit between the type of communication needed by managers and the type of media chosen. Some studies (Huber & Daft 1987; Trevino et al. 1990; Rice 1992) tried to integrate new information technologies (IT) such as e-mail in the MRT hierarchy and concluded that they are less rich than traditional media like face-to-face or the telephone. But since 1990 other studies have suggested that new IT are not simply poor media but they provide some new form of richness not taken into account by the MRT. One objective of this study was to build an inventory of the sources and criteria of richness associated with traditional media and new IT. A second objective was to investigate the concept of technological and classical richness trade-off as a valid extension to MRT. Twelve (12) different criteria were identified. Two research hypotheses were proposed on the ranking and evaluation of the media based on these criteria. The responses of 40 experts (representing 520 evaluations of 13 traditional media and new IT) were analyzed in the light of our hypotheses. We found support for the notion that media choice may be a question of compromise between classical richness and technological richness.*

## INTRODUCTION

Media Richness Theory (MRT) as initially formulated by Daft & Lengel (1984, 1986) proposes a hierarchy among media and suggests that there will be an optimal fit between the type of communication needed by managers and the type of media to choose. According to MRT, media are characterized by the level of richness in communications they can provide, based on four criteria: (1) the opportunity for instant (or timely) feedback, (2) the ability to convey multiple cues, (3) the tailoring of messages to persons and circumstances and (4) the language variety permitted when communicating with the media. Based on these criteria, some media such as face-to-face and the telephone are supposed to be rich and others like written documents are supposed to be poor. At the same time, for the proponents of MRT, performance improves when managers use richer media for equivocal tasks (where there are multiple and possibly conflicting interpretations for the available information) and leaner media for nonequivocal tasks (Daft & Lengel 1984, 1986, Daft, Lengel & Trevino 1987). Since the mid 1980's, many studies have been performed to verify MRT. Some of

these studies (Daft, Lengel & Trevino 1987; Fulk et al. 1987, 1989; Huber & Daft 1987; Trevino & Daft 1987; Lengel & Daft 1988) tried to integrate new information technologies (IT) such as e-mail in the MRT hierarchy and concluded that new IT are less rich than traditional media. But by 1990, other studies began to contest the MRT and showed that new IT are not simply poor media but they provide some new form of richness not taken into account by the theory (Sproull 1991; Rice 1992; El-Shinnawy & Markus 1992; Markus 1994; Lee 1994; Huang, Watson & Wei 1998). Some other studies invalidated the MRT's hierarchy and the linkage between media richness and performance at work (Dennis & Kinney 1998; Kinney & Watson 1992; El-Shinnawy & Markus 1998; Rice 1992). An important agenda for future work on MRT is to define how new IT may be classified and considered in comparison with traditional media (Markus 1994; Sproull 1991).

The purpose of this paper is, first, to construct an inventory of the criteria of richness associated with traditional media and new IT; and second, to verify two research hypotheses on the ranking and evaluation of traditional media and new IT based on these criteria. We first discuss the research performed on MRT and establish a list of new criteria for IT. Then we describe a study designed to evaluate the ranking of media based on both classical and technological richness criteria. We conclude by discussing the implications of the results on media evaluation and media choice.

## THE MRT AND THE RANKING OF TRADITIONAL MEDIA AND NEW IT

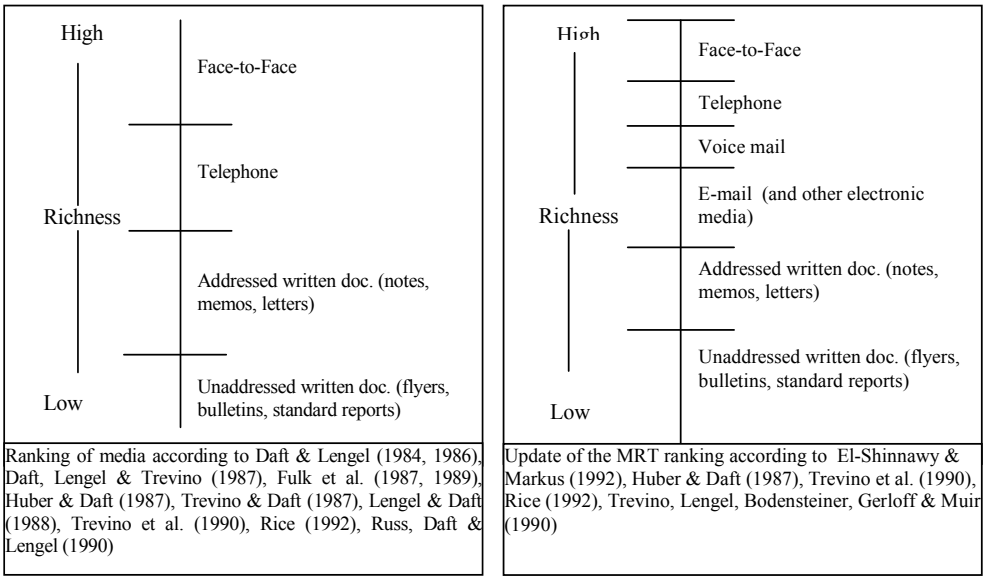
As mentioned previously, since Daft & Lengel (1984, 1986) developed the MRT, many studies tried to verify the two main aspects of the theory: (1) the ranking it proposes and (2) the linkage it suggests between the media's level of richness and performance at work. First Daft, Lengel & Trevino (1987), consider four media (or group of media) and show some support for the MRT. One principal result of the study was a confirmation of the ranking of traditional media based on the four richness criteria proposed by the MRT. According to the ranking, face-to-face is the richest media followed by telephone, then by addressed written documents, and finally by unaddressed written documents.

Until the early 1990's, many of the studies about the MRT validated or took for granted its ranking (Fulk et al. 1987, 1989; Huber & Daft 1987; Trevino & Daft 1987; Lengel & Daft 1988; Trevino et al. 1990; Rice 1992; Russ, Daft & Lengel 1990). Some of the studies tried to update the ranking by integrating new technology such as e-mail and voice mail into the hierarchy. El-Shinnawy & Markus (1992), Huber & Daft (1987), Trevino et al. (1990), Rice (1992) and Trevino, Lengel, Bodensteiner, Gerloff & Muir (1990) all suggested that e-mail and voice mail would rank somewhere between the telephone (supposed to be richer) and addressed written documents. For almost all these studies voice mail was considered richer than e-mail based on the four richness criteria. Figure 1 presents the ranking of traditional media and it's update.

At the turn of the 1990's the ranking began to be seriously under dispute due, in part, to a new kind of richness revealed by new information technologies (IT). Culnan & Markus (1987), Markus (1994) and Sproull (1991) attempted to show that new IT provide a technological richness such as multiple addressing and memory. On another front, Lee (1994) suggested that richness is not simply an inherent property of media, but an emergent property of the interaction of the media with it's organizational context of use. Lee's study, like Huang, Watson & Wei (1998), Walther

(1995) and Chidambaram (1996) concluded that e-mail is a rich media contrary to what was suggested by the proponents of the MRT.

**Figure 1: Ranking of Traditional Media and Its Update**




Studies like those of Lee (1994), Huang, Watson & Wei (1998), Culnan & Markus (1987, Sproull (1991), and Markus (1994) which dispute the MRT's ranking and the four richness criteria it is based on, call for a new inventory of the richness criteria in order to establish a defensible media ranking.

## THE RICHNESS CRITERIA

As mentioned earlier, the MRT's ranking of media is based on four richness criteria. On the basis of these criteria oral media (e.g., face-to-face and telephone) are richer than written media (e.g. interoffice mail), and synchronous media (i.e. those that provide for immediate feedback like the telephone) are richer than asynchronous media, such as e-mail (Markus 1994). However, new IT offer new opportunities of communication that are not taken into account by the MRT. For example: (1) the variety of signals we can use when communicating or accessing information with the media or the new IT (video, audio, graphic, text, color, …), and (2) the use of simultaneous signals (degree to which we can use signals together). Furthermore, according to Culnan & Markus (1987), Sproull (1991) and Markus (1994), two other criteria must be taken into account when evaluating richness: (1) the capacity to store/memorize message or information, and (2) the retrieval/accessibility to message or information stored. In the same way, Rice et al. (1984) and Hirschheim (1985) present three other criteria to consider when comparing media and new IT. These three criteria are: (1) the variety of communications supported (One-to-One, One-to-Many, Group), (2) the ability to

communicate or access information 24 hours a day, and (3) the control over access to message/information and participation in communication. These new criteria are integrated in the overall evaluation of media in Table 1.

Examination of Table 1 reveals two important tendencies:

| | |
|---|---|
| 1) | Traditional media and new IT seem to respond to two different kinds of criteria: on the one hand, traditional media respond well to classical richness criteria, but respond less to technological richness criteria. On the other hand, new IT respond well (or better) to technological richness criteria, and respond less to classical richness criteria. |
| 2) | If we were to take into account both classical and technological richness criteria the ranking of the media would be different from that proposed by the MRT. |

## HYPOTHESES

One important question emerges from the previous discussion: would the choice of traditional media or new IT to communicate or to access information be a matter of trade-off between the level of desired classical richness and the level of desired technological richness? Studies like Markus (1991, 1994), Sproull (1991), Culnan & Markus (1987), Rice et al. (1984), and Hirschheim (1985), do suggest this. And the content of Table 1 provides additional support because it shows that, in general, when we use new IT we take advantage of their high level of technological richness while at the same time concede with a lower level of media richness. Inversely, when we use traditional media, we take advantage of a higher level of media richness but at the price of a lower level of technological richness. Thus, in the present study we hypothesize the following:

| | |
|---|---|
| *Hypothesis 1:* | *There will be a negative relationship between classical and technological richness for all media (H1).* |

If in fact choosing a communication media is a question of optimizing technological and classical richness simultaneously, then we should observe that the most popular IT media are those who present a higher level of technological richness, while maintaining an acceptable level of traditional richness. According to different surveys, the e-mail and WEB are the most popular communication technologies today (see Internet use surveys like AITP 2000, Fidelman 1997, SMARTI 2000 in particular). We therefore hypothesize the following:

| | |
|---|---|
| *Hypothesis 2:* | *The evaluation of the most popular new IT (e-mail and WEB in particular) would show higher levels of classical and technological richness compared to the other new IT.* |

| Table 1: Richness criteria* | | | | | | |
|---|---|---|---|---|---|---|
| Traditional media | | | | | | |
| | | Face-to-Face | Telephone | Voice Mail | Addressed Written Doc | Unadressed Written Doc |
| Classical richness criteria | | | | | | |
| Capacity for instant feedback | | Responds perfectly | Responds perfectly | Not respond asynchronous | Not respond asynchronous | Not respond asynchronous |
| Ability to convey multiple cues (voice inflection, body language, mood, etc.) | | Responds perfectly | Voice inflection, mood | Voice inflection, mood | Mood (?) | Mood (?) |
| Personalization of messages / information | | Responds perfectly | Responds well | Responds well | Responds well | Not respond |
| Tailoring message / info to circumstances | | Responds perfectly | Responds well | Responds a little | Responds a little | Respond a little |
| Technological richness criteria | | | | | | |
| Storage / Memorization of messages or information | | Responds a little | Responds a little | Responds moderately | Respond moderately (archive) | Respond moderately (archive) |
| Retrieval / Accessibility to messages or information | | Responds a little | Responds a little | Responds moderately | Respond moderately | Respond moderately |
| Possibility to communicate all time | | Not respond | Not respond | Respond moderately | Respond a little | Respond a little |
| Ability to reach geographically dispersed people | | Not respond | Respond moderately | Respond moderately | Respond moderately | Respond moderately |
| Control over access and participation to information / communications | | Responds a little | Responds a little | Responds a little | Responds a little | Responds a little |
| Type of signals used: audio, video, text, graphic, color, etc. | | All signals | Audio | Audio | Text, Graphic, color | Text, Graphic, color |
| Type of communications supported: 1 to 1, 1 to many, Group | | All types | 1 to 1, 1 to many | 1 to 1 | 1 to 1, 1 to many | 1 to 1, 1 to many |
| Quantity of signals | | Many | Few | Few | Medium | Medium |
| New information technologies | | | | | | |
| | E-Mail | Video Conference | The WEB | Intranet | Extranet | Instant messaging |
| Classical richness criteria | | | | | | |
| Capacity for instant feedback | Responds a little asynchronous | Respond perfectly synchronous | - | - | - | Responds well |
| Ability to convey multiple cues (voice inflection, body language, mood, etc.) | Mood (?) | Responds well | - | - | - | Mood (?) |
| Personalization of messages / information | Responds well | Responds well | Responds well | Responds well | Responds well | Responds well |
| Tailoring message / info to circumstances | Responds a little | Responds a little | - | - | - | Responds a little |

| Table 1: Richness criteria* | | | | | | |
|---|---|---|---|---|---|---|
| Technological richness criteria | | | | | | |
| Storage / Memorization of messages or information | Responds well | Responds well | Responds well | Responds well | Responds well | Responds well |
| Retrieval / Accessibility to messages or information | Responds well | Responds moderately | Responds well | Responds well | Responds well | Responds moderately |
| Possibility to communicate all time | Responds perfectly | Responds a little | Responds perfectly | Responds perfectly | Responds perfectly | Responds moderately |
| Ability to reach geographically dispersed people | Responds perfectly | Responds perfectly | Responds perfectly | Responds perfectly | Responds perfectly | Responds perfectly |
| Control over access and participation to information / communications | Responds moderately | Responds moderately | Responds well | Responds well | Responds well | Responds moderately |
| Type of signals used: audio, video, text, graphic, color, etc. | Text | All signals | All signals | All signals | All signals | Text |
| Type of communications supported: 1 to 1, 1 to many, Group | 1 to 1, 1 to many | 1 to 1, 1 to many, Group | 1 to many | 1 to many | 1 to many | 1 to 1, 1 to many |
| Quantity of signals | Few | Many | Medium | Medium | Medium | Few |

* The evaluations are based on the MRT and on our interpretation of Markus (1991, 1994), Sproull (1991), Culnan & Markus (1987), Rice et al. (1984), and Hirschheim (1985) in particular.

## METHODOLOGY

### Evaluation Grid

Based on the inventory of richness criteria (section 2), we developed a grid to evaluate the richness of traditional media and new IT. This grid contained 7 traditional media and 6 new IT, these in turn evaluated by 12 richness criteria. As in Dennis, Valacich & Nunamaker (1990), Durand & Vanhuss (1992) and Valacich, Dennis & Connolly (1994), a 5 point Likert scale was used (1=Does not respond to 5=Responds perfectly).

Four experts with extensive experience in communication and teaching/implementing IT examined the grid in order to verify: (1) that the items were correctly expressed according to the characteristics they referred to, (2) that no aspect of the grid was prone to confusing interpretations and (3) that the scale allowed a good appreciation of the richness criteria. The four experts' remarks helped to improve the quality of the grid.

### Data Collection

235 experts were identified as potential evaluators. Eighty six of them were teachers and researchers whose principal interest was related to IT. They were identified through the ISWORLD WEB site. The 149 other experts were IT & telecommunication specialists from professional and government institutions. They were also identified through the Internet. All of the evaluators received a e-mail inviting them to take part in the study. The grid was attached to the e-mail

message. Of the original 235 potential evaluators, 43 filled the evaluation grid, 3 of these were incomplete and discarded, so 40 responses were used in the analysis (for a 17.02% response rate).

**Reliability of the Grid**

The collected data was first used to test the reliability of the grid. The analysis was performed using Confirmatory Factor analysis (Varimax) and the SPSS "Reliability Analysis" function to verify for concept and measurement validity. As Table 2 shows, the reliability coefficients were .81 for the classical criteria of richness, and .80 for the technological criteria of richness. So, they satisfy Hair et al.'s (1998) criteria for reliability. However, the low level of the a coefficient in the " other forms of richness " category indicates that these criteria are not reliable enough. Therefore we did not consider them in our analysis.

**Table 2: Results of the reliability test**

| Characteristics | Loadings | Reliability Coefficients |
|---|---|---|
| Classical richness criteria | | .81 |
| Capacity for instant feedback | .87 | |
| Ability to convey multiple cues | .85 | |
| Personalization of messages / information | .80 | |
| Tailoring message / info to circumstances | .71 | |
| Technological Richness criteria | | .80 |
| Storage / Memorization of messages or information | .85 | |
| Retrieval / Accessibility to messages or information | .84 | |
| Possibility to communicate all time | .88 | |
| Ability to reach geographically dispersed people | .68 | |
| Control over access and participation to communication | .78 | |
| Other forms of richness | | .55 |
| Quantity of signals | .60 | |
| Simultaneous signals | .56 | |
| Type of communication supported | .51 | |

## RESULTS AND DISCUSSION

Table 3 shows the mean scores of the evaluation of media on all dimensions of richness. As expected, new IT scores are generally higher on the technological richness criteria and lower on the classical richness.

To test hypothesis 1, we calculated the correlation coefficient between both categories of richness. We found a significant negative correlation (-.226, p<.001) between classical and technological richness, thus providing support for H1. These results seem to suggest that choosing traditional media or new IT to communicate or to access information is a matter of trade-off between the level of desired classical richness and the level of desired technological richness.

**Table 3: Mean scores of traditional media and new IT**

| | Classical richness criteria | | | | Technological richness criteria | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Feedback | Cues | Person | Circumst | Memorize | Retrieve | Alltime | Geograph | Control |
| Traditional media | | | | | | | | | |
| Face-to-Face | 4.62 | 4.61 | 4.60 | 4.50 | 2.05 | 3.35 | 1.60 | 1.60 | 2.00 |
| Telephone | 4.43 | 4.32 | 4.43 | 4.20 | 1.38 | 1.40 | 3.13 | 3.22 | 1.70 |
| Voice Mail | 3.90 | 4.18 | 4.28 | 4.05 | 4.37 | 4.36 | 3.13 | 3.22 | 1.78 |
| Addressed written doc | 4.00 | 4.02 | 4.13 | 3.90 | 3.75 | 3.75 | 3.08 | 3.20 | 1.50 |
| Unaddressed written doc | 3.88 | 3.95 | 4.08 | 3.85 | 3.70 | 3.69 | 3.03 | 3.18 | 1.55 |
| Fax | 3.98 | 4.03 | 4.17 | 3.90 | 3.75 | 3.74 | 3.08 | 3.18 | 1.55 |
| Telegraph | 4.00 | 3.95 | 4.22 | 3.95 | 3.75 | 3.70 | 3.03 | 3.13 | 1.55 |
| New IT | | | | | | | | | |
| Video-conference | 4.43 | 4.30 | 4.43 | 4.20 | 4.37 | 4.37 | 3.13 | 3.22 | 2.55 |
| E-mail | 4.05 | 3.65 | 4.20 | 4.00 | 4.45 | 4.43 | 4.45 | 4.45 | 4.42 |
| WEB | 3.95 | 3.50 | 4.13 | 3.85 | 4.50 | 4.49 | 4.40 | 4.43 | 4.39 |
| Intranet | 3.73 | 3.45 | 4.05 | 3.82 | 4.43 | 4.43 | 4.40 | 4.42 | 4.39 |
| Extranet | 3.85 | 3.45 | 4.03 | 3.78 | 4.45 | 4.45 | 4.35 | 4.35 | 4.30 |
| Instant messaging | 4.10 | 3.78 | 4.08 | 4.03 | 3.40 | 3.43 | 2.93 | 3.25 | 2.23 |

Hypothesis 2 states that the evaluation of the most popular new IT (e-mail and WEB in particular) would show higher levels of classical and technological richness compared to the other new IT. To test this hypothesis, we first calculate inter-evaluators reliability coefficients using the generalizability method developed by Cronbach et al. (1972). The reliability coefficient was .82, which is comparable to those considered as acceptable in other studies (Dennis, Valacich & Nunamaker 1990; Durand & Vauhuss 1992; and Valacich, Dennis & Connolly 1994).

As we can see in Table 4, e-mail ranks first on the technological richness criteria (M=4.44) and third according to classical richness criteria (M=3.97) behind video-conference (M=4.34) and instant messaging (M=4.00). Thus e-mail is probably the richest new IT when we consider classical and technological richness together, because video-conference and instant messaging (with the highest classical richness scores) had the lowest technological richness scores. At the same time, the WEB, the second new information technology when we consider technological richness (M=4.42), scored relatively high according to classical richness (M=3.86); this gives it a substantial double richness compared to video-conference and instant messaging in particular. These results provide some initial support to the idea that the e-mail and the WEB are characterized by a double richness

(classical and technological). Given these characteristics and the observed popularity of these media (AITP 2000, Fidelman 1997, SMARTI 2000 in particular), it is reasonable to suggest that the two dimensions of richness (classical and technological) are important to consider together when trying to understand patterns of use and predicting choices of communication media. Although video-conference does rank well on both technological and classical richness, its use is not as popular as e-mail and the WEB. There may be two possible explanations for this. First, the bandwidth required to provide high quality videoconferencing is still relatively rare and expensive, which can moderate people's use of this medium. Second, the cost of reducing classical richness is not sufficiently compensated by its added technological richness.

**Table 4: Traditional media and new IT ranking**

| | | Mean scores on classical richness criteria | Ranking | Mean scores on technological richness criteria | Ranking |
|---|---|---|---|---|---|
| Traditional media | | | | | |
| 1 | Face-to-Face | 4.58 | 1 | 2.12 | 13 |
| 2 | Telephone | 4.35 | 2 | 2.17 | 12 |
| 3 | Voice mail | 4.10 | 4 | 3.37 | 6 |
| 4 | Addressed written doc. | 4.01 | 7 | 3.06 | 7 |
| 5 | Unaddressed written doc. | 3.94 | 10 | 3.03 | 11 |
| 6 | Fax | 4.02 | 6 | 3.06 | 8 |
| 7 | Telegraph | 4.03 | 5 | 3.03 | 10 |
| New IT | | | | | |
| 8 | Video-conference | 4.34 | 3 | 3.53 | 5 |
| 9 | E-mail | 3.97 | 9 | 4.44 | 1 |
| 10 | WEB | 3.86 | 11 | 4.42 | 2 |
| 11 | Intranet | 3.76 | 13 | 4.41 | 3 |
| 12 | Extranet | 3.78 | 12 | 4.38 | 4 |
| 13 | Instant messaging | 4.00 | 8 | 3.05 | 9 |

## CONCLUSION

### Discussion of Results

The original model proposed by the media richness theory, which prescribes a match between information processing requirements and communication channels for optimal effectiveness, has been repeatedly contested and contradicted by empirical verification. According

to MRT, effective managers match the characteristics of the communication media to the requirements of their communication tasks. Since richness has been defined as the capacity to reduce ambiguity, that is, the capacity of (a) facilitating feedback, (b) communicating multiple cues, and (c) presenting individually tailored messages adapted to circumstances, one of the MRT predictions has been that effective managers would use rich media (such as face-to-face or the telephone) to convey highly ambiguous information, and use lean media (such as e-mail or memo) for routine, non-ambiguous tasks. Empirical evidence, however, has not supported this prediction. Highly effective managers have been shown to use e-mail extensively, very often to convey content of an equivocal nature.

Many authors have suggested that social factors play an important role in media choice and use, and that this explains why MRT does not appear to find support in empirical studies. Although we do not underemphasize the role of social factors on the choice of a communication media, we argue that MRT may still offer some validity if we were to include another dimension, technological richness. Managers may prefer media that can offer a significant amount of classical richness, but simultaneously can need technological features such as the "possibility to communicate at all time" in order to save time, or memorization capabilities for later reference.

In this paper, our first objective was to establish a list of technological richness criteria. This list was composed of factors previously cited in research papers discussing the limitations of the MRT. Our first hypothesis stated that for media richness evaluation, their would be a significant inverse relationship between classical and technological richness. This hypothesis was supported by the data. We can therefore conclude that new IT are better qualified by some technological criteria than the classical criteria and visa-versa for traditional media. More research is needed to validate the criteria and possibly complete the list with other significant factors that play a role in media choice.

We also established a ranking of media based on both classical and technological criteria. The ranking showed that new IT do indeed score lower than traditional media such as face-to-face and telephone on classical criteria, but higher on technological richness. Also, the ranking among new IT on technological richness shows e-mail and the WEB as higher ranking on these criteria than video conferencing and instant messaging. These last two, however, are higher scoring on the classical richness criteria. This suggests that media choice may be a question of trade-off between classical and technological richness.

Technologies such as videoconferencing and instant messaging, although offering a substantial amount of classical richness, are not as popular as e-mail and this may be because they do not provide substantial levels of technological richness to compensate for classical richness loss. If this is the case, we can predict that these technologies may become more popular if their features are improved to increase either their classical richness (for instance with a faster stream that can provide high quality video) or technological richness (through better storage and accessibility mechanisms).

This study suffers many limitations. First, it was not possible with the limited set of media available, to verify the notion that a reduction in classical richness is compensated by an increase in technological richness (or that there is a necessary trade-off between the two). In order to further investigate the notion of trade-off, we will need to better describe the way people actually choose

among available media. We also used the evaluations of IT professionals and educators in our survey. This sample may represent people that have different views of technology (possibly more positive ones) from general managers. Therefore more research is needed to validate that media perceptions and rankings are similar in the general population.

We also ranked media on two dimensions, either classical or technological richness, and argued that there may be a trade-off between the two. However, each criterion can play a role in determining why a technology is chosen over another, depending on the communication task. For instance, the need to communicate at a distance is very distinct and different from the need to memorize information for future use. Having to communicate with someone in a different country will dictate the choice of e-mail or video-conferencing over face-to-face. There is therefore an important agenda for future work that will identify the change in weight of the criterion depending on the characteristics of the task and the work environment.

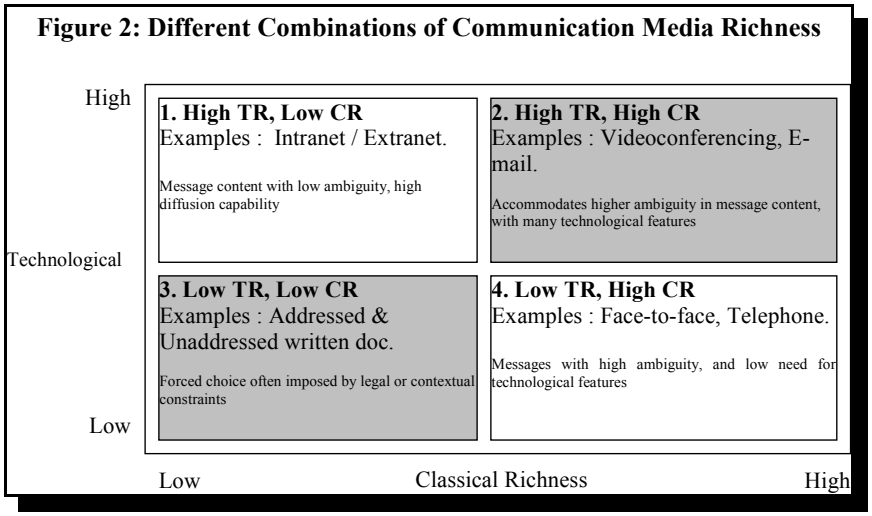
**Towards a Trade-off Theory of Media Choice?**

Past research and the results presented here seem to indicate that it is not possible to predict new IT media choice simply on the basis of classical richness criteria, as previously suggested by MRT. Globally, new IT provide alternative types of richness, and media choice will probably be better explained as a compromise between classical richness and technological richness. With the widespread availability of new technology and its coexistence with traditional media, the idea of media richness trade-off may be at the heart of managers' choices between one or the other media to communicate or access information.

In modern organizations, media choice can not only be based on the need to reduce ambiguity as suggested by MRT. According to the theory, efficient managers will choose rich media for equivocal communications and poor media for routine, non-equivocal communication. However, previous research has shown that e-mail, for instance, is used even for messages of highly equivocal content, which is contradictory to MRT predictions. Following the research results presented in this study, we state that the presence of IT media permits managers to pursue the advantages of their technological richness. They will be motivated by (1) the necessity to memorize messages, (2) the possibility to communicate at any given time, and (3) and to go beyond geographic restrictions. The idea of media choice as being a question of tradeoff between classical and technological richness can be illustrated as in figure 2.

Ideally, a manager will attempt to maximize classical richness and technological richness, under the constraints of cost and communication quality. The popularity of e-mail can therefore be explained as being related to its high technological richness, at the expense of little classical richness, and in a low cost, easy to use environment. On the other hand, videoconferencing offers higher classical richness than e-mail, but lower technological richness (because of the memorization limitations and same time requirements), and is more expensive and harder to use.

**Figure 2: Different Combinations of Communication Media Richness**




Inversely, when a manager uses media in quadrant 3, s/he must compose with both low levels of classical and technological richness. Here, there is not much place for compromise and their choice is mainly based on legal aspects or to more easily reach a large audience. However, we can observe the decrease in the use of this type of media as the availability of new IT increases and the legal restrictions decrease.

## REFERENCES

AITP (Association of IT Professionals), (visited on January 21, 2000) "Internet Use Survey", (http://www.edfoundation.org/detail.htm).

Cronbach L., Gleser G., Nanda H. & Rajaratnam N., (1972) *The dependability of behavioral measurement: The theory of generalizability for score and profiles*, Wiley, New York,

Chidambaram L., (1996) "Relational development in computer-supported groups", *MIS Quarterly*, June, 143-165.

Culnan M. J. & Markus L. M., (1987)" Information technologies" in Jablin Frederick, Putman Linda L. Roberts Karlene H. & Poter Lyman W. (eds), *Handbook of Organizational Communication: An Interdisciplinary Perspective*, Newbury Park, Sage Publications.

Daft R.L. & Lengel R.H. (1984), "Information Richness: A new approach to managerial behavior and organization design", *Research in Organizational Behavior*, 6, 191-233.

Daft R. L. and Lengel R. H., (1986) « Organizational Information Requirements, Media Richness and Structural Design », *Management Science*, 32 (5), 554-571

Daft R. L., Lengel R. H. and Trevino L.K., (1987)« The relationship among message equivocality, media selection, and manager performance » *MIS Quarterly* 11 (3), 355-366

Dennis Alan R. and Kinney Susan T., (1998) « Testing Media Richness Theory in The New Media : The Effects of Cues, Feedback, and Task Equivocality », *Information Systems Research*, 9 (3), 256-274

Dennis Alan R. Valacich Joseph S. & Nunamaker J.F., (1990),"An experimental Investigation of the Effect of Group Size in an Electronic Meeting Environment", *IEEE Transactions on Systems*, Man & Cybernetics, 25 (3), sept., 1049-1056.

Durand D. E. & Vanhuss Susie H., (1992) "Creativity Software and DSS, Cautionary findings", *Information & Management*, 23, pp. 1-6.

El-Shinnawy Maha & Markus Lynne M., (1998) "Acceptance of Communication Media in Organizations: Richness or Features?", *IEEE Transactions on Professional Communication*, 41 (4), 242-253, Dec.

El-Shinnawy Maha M. & Markus Lynne M. (1992) "Media Richness Theory and New Electronic Communication Media: A Study of Voice Mail and Electronic Mail*", Proceedings of the thirteenth ICIS*, Dallas Texas. Pp. 91-105, Dec. 13-16.

Fidelman Carolyne G., (1997), "The third Annual Internet Use Survey of Language Professionals", *Agora Newsletter*, 3 (1).

Hair J. F.; Anderson R; Tatham R. & Black W. (1998) "*Multivariate data analysis*", 5th ed., Prentice-Hall.

Hurscheim R. S., (1985) "*Office automation: Concepts, technologies and issues*" Reading, MA:Addison-Wesley.

Huang W., Watson R.T. & Wei K.K. (1998) "Can a lean e-mail medium be used for rich communication? A psychological perspective", *European Journal of Information Systems*, Vol. 7, 269-274, Dec.

Huber G. P. & Daft R. L. (1987) "The information Environments of Organizations", in Jablin F., Putman L. L., Roberts K. H. & Poter Lyman W. (eds), *Handbook of Organizational Communication: An Interdisciplinary Perspective*, Newbury Park, Sage Publications, 130-164.

Kinney Susan T. & Watson Richard T., (1992) "The effect of medium and Task on dyadic communication" *Proceedings of the thirteenth ICIS*, Dallas Texas. Pp. 107-117, Dec. 13-16.

Lee Allen S., (1994) « Electronic Mail as a medium for rich communication : An empirical investigation using hermeneutic interpretation », *MIS Quarterly*, 3 (2), 143-157

Markus Lynne M.,( 1994) "Electronic Mail as the medium of managerial choice", *Organization Science*, 5 (4), 503-527, Nov.

Rice Ronald E., (1993) « Media Appropriateness : Using Social Presence Theory to compare traditional and new organizational media », *Human Communication Research*, 19 (4), 451-484.

Rice Ronald E., (1992) "Task Analyzability, Use of New Media, and Effectiveness: A multi-site exploration of media richness", *Organization Science*, 3 (4), 475-500, Nov.

Russ G. S.; Daft R. L. & Lengel R. H., (1990)"Media selection and managerial characteristics in organizational communications", *Management Communication Quarterly*, 4, 151-175

SMARTI (Science & Math Asynchronous Reform with Technology Innovation), (visited on January 22, 2000) "Internet Survey Use", (http://www.monroe.k12.il.us/smarti/internet.htm)

Trevino L. K.; Lengel R. H.; Bodensteiner W.; Gerloff E. & Muir N. K., (1990) "The richness imperative and cognitive style: The role of individual differences in media choice behavior", *Management Communication Quarterly*, 4 (2), 176-197

Valacich Joseph S., Dennis Alan R. & Connolly Terry, (1994) "Idea Generation in Computer-Based Groups: A New Ending to an Old Story", *Organizational Behavior and Human Decision Processes*, 57, pp. 448-467.

Walther J. B. (1995) "Relational aspects of computer-mediated communications: experimental observations over time", *Organization Science*, 6(2), 186-20.

# CREATING A VIRTUAL MEETING SYSTEM (VMS) FOR PUBLIC AGENCY EMPLOYEES: A FIELD STUDY OF THE ILLINOIS DIVISION OF ORAL HEALTH

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## ABSTRACT

*This paper describes the development of a Virtual Meeting System (VMS) for the Division of Oral Health (DOH) in the Illinois Department of Public Health (IDPH) to reduce the amount of travel and meeting time of DOH staff. The VMS is a web-enabled synchronous/asynchronous group collaboration system that includes: an Electronic Brainstorming Tool (EBS); an Idea Organizer Tool (IO); an Electronic Voting Tool (Voting); an Alternative Evaluator Tool (AE); Document Sharing; Document Co-editing; E-mail; a Discussion Group; and many other media rich tools. The VMS was implemented on the Internet, so the costs for operation and maintenance were minimal compared to establishing a private LAN/WAN infrastructure for the DOH. The preliminary findings seem to indicate that the VMS is a useful tool for the DOH. It is anticipated that more savings in time and travel could be realized by the agency in the future when the group performs decision problems more frequently and members gain even more familiarity and comfort with the VMS system.*

## INTRODUCTION

A Web-enabled Virtual Meeting System (CyberCollaboratory) can improve productivity and job satisfaction.

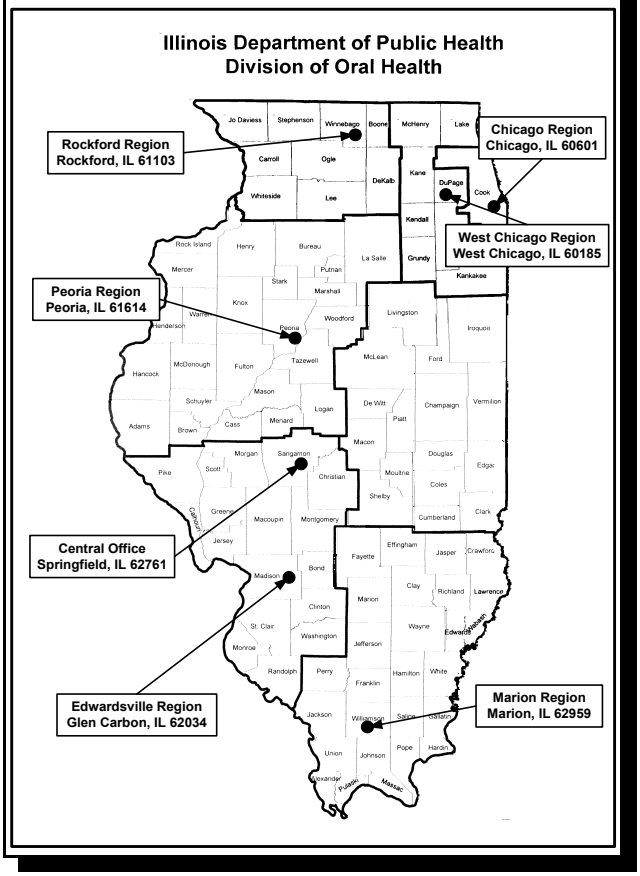
Over a decade ago, Huber (1984) stated that there was a perceived need for the means of aiding group processes to compensate for the limitations of human decision-making. At approximately the same time in 1984, Rice and Bair (1984) pointed out the need to improve white-collar productivity. These observations by Huber and Rice and Bair were almost prophetic for American businesses and are even more true today, given the economic climate of deregulation, intense competition, and corporate downsizing.

It is a commonly held belief that group support systems such as the Virtual Meeting System or CyberCollaboratory (presented and discussed on the following pages) offer many exciting opportunities to improve the quality of work and decision-making and, at the same time, increase the productivity of groups. Groups hold the promise of more democratic decision-making, synergy, more objective evaluation, stimulation, and learning, but only if those group performance inefficiencies called "process losses" (McGrath and Hollingshead, 1994) can be prevented (Hoffnam, 1979; Nunakamer et al., 1992).

It is also a commonly held belief that use of group support systems can generate "process gains" such as increased group productivity, effectiveness, creativity, and member satisfaction, since they eliminate the need to coordinate and attend face-to-face- meetings. Group support systems also have the potential to improve communication, learning, timeliness of decisions, and satisfaction with the process and with outcomes (Bostrom, Van Over and Watson, 1990; DeSanctis and Gallupe, 1985, 1987; Dufner, Hiltz and Turoff, 1993; Hiltz, 1988; Hiltz et al., 191; Hiltz and Turoff, 1981, 1982, 1992, 1993; Huber, 1984; Jarvenpaa et al., 1988; Kraemer and King, 1988; Nagasundaram and Bostrom, 1994). Based on these findings, the Director of the Division of Oral Health (DOH) was interested in using the Group Support System, called "CyberCollaboratory" to explore methods for improving productivity by reducing of travel for meetings, as well as by improving the quality of DOH's group decisions.

The Illinois Department of Public Health (IDPH) has functioned with significantly reduced levels of staffing due major budget cuts since 1991 (State Journal Register, 1991). The Division of Oral Health, which is the focus of the study presented here, is a part of the Illinois Department of Public Health, and is located in the Office of Health and Wellness. Consequently, the DOH has suffered from these budget cuts as well. Following the budget cuts, the DOH now has responsibility for serving the entire state of Illinois which covers a geographical area of 55,593 square miles with a staff of eight full-time employees and four consultants as shown in Figure 1.

**Figure 1: DOH Regions**




The DOH establishes programs designed to prevent and control oral diseases through organized community efforts focused on community water fluoridation, dental sealants, baby bottle tooth decay, school-based fluoride mouth-rinsing, craniofacial anomalies, orofacial injuries, oral health needs assessment and planning, smokeless tobacco, and a variety of oral health education programs designed to meet the oral health needs of groups throughout the state of Illinois. The goal of the DOH is optimal oral health for all of the residents of Illinois.

Currently, the DOH has a central office in Springfield, Illinois, and seven regional offices located through out the state in Chicago, West Chicago, Rockford, Peoria, Champaign, Edwardsville, and Marion. A regional office of the DOH must serve approximately 30 counties, each with an area of about 6,220 square miles. A regional office has the responsibility for providing oral health technical assistance to the local agencies located within the counties of the

region. As a result of the budget cuts, four of the seven regional DOH offices (Rockford, Chicago, West Chicago and Marion) do not have permanent staff. Rockford, Chicago, and West Chicago have not had permanent staff for the last five years and the Marion office has been without permanent staff for over two years.

A consultant located in Peoria now serves the Rockford region and must travel a distance of approximately 143 miles to work. A consultant located in Champaign must now travel 123 miles and 135 miles, respectively, to service the Chicago and West Chicago offices. A consultant located in Edwardsville, a distance of 92 miles away, serves the Marion region.

Because of the size of each region, the distance between the offices, and the amount of travel required to service a region, more than 80% of the DOH staff time is consumed simply by traveling and meetings (Jenssen, 1998). The DOH staff would prefer to spend their time doing the tasks they were trained and hired to perform such as providing oral health technical assistance to the local agencies, and providing oral health education and training, rather than in traveling extensive distances to and in coordinating meetings. While the private sector has embraced the use of asynchronous tools similar to the CyberCollaboratory (described below), governmental agencies have lagged behind, often due to lack of funding.

Groupware such as the CyberCollaboratory in the form of Group Decision Support Systems (GDSS) and Distributed Group Support Systems (DGSS), as mentioned above, are thought of as possible tools for the improvement of group processes and decision-making (Desanctis and Gallupe, 1985, 1987; Stasser, 1992; Stasser and Titus, 1985; Hiltz et al., 1991; Dufner, Hiltz and Turoff, 1994) and for improvement in group productivity (Hiltz, 1988).

Some examples of enhanced outcomes include subjective satisfaction (Watson, 1987), more effective problem solving (DeSanctis and Gallupe, 1985), productivity gains which translates into hard dollar savings for an organization (Hiltz, 1988), better decision analysis via facilitated group communication (Turoff and Hiltz, 1982), and model building to facilitate planning and policy making (Nunamaker, Applegate and Konsynski, 1988). In addition, according to Rice et al. (1984), there seems to be greater equality of influence and participation among group members using GDSS for group decision-making.

## DEVELOPMENT HISTORY

Work on the Group Decision Support System (GDSS) environment, the preliminary step in the development of the CyberCollaboratory, was begun in 1993. As has been true at most other institutions, the GDSS was initially designed for a face-to-face (same time and same place) decision room meeting environment. The Phase I system functionality is shown in Table 1. The four types of collaborative interaction are also shown in Table 2. The first GDSS, developed over a period of two years, included five tools: Session Manager, Electronic Brainstorming, Idea Organizer, Voting, and Alternatives Evaluator. The software was tested and operated in a computer lab on campus.

Because of the high costs of building a decision room, we moved to the second phase, distributed, as shown in Table 2. The necessary modifications to make the software capable of handling the distributed, synchronous mode of communication were made in 1995. During Phase II using the campus LAN and WAN connections, group members no longer were required to meet

in the same place, although they were required to be logged on at the same time for their distributed meeting. The meeting agenda could be distributed via e-mail and members could log in to the system from their computers or from the computer laboratory. Facilitation and meeting coordination were still required.

| Table 1. Development History and Future Direction | |
|---|---|
| Phase I(1993-1995) | Face-to-Face (Same Time & Same Place) Meeting Environment<br>Level 1 GDSS<br>Decision Room<br>GDSS, E-mail |
| Phase II(1995-1996) | Distributed Synchronous (Same Time but Different Place)<br>Level 1 GDSS<br>LAN-based<br>GDSS, E-mail |
| Phase III(1996-present) | Distributed Asynchronous (Different Time & Different Place)<br>Level 2 GDSS<br>Web-based<br>CyberCollaboratory including GDSS, E-mail, Discussion Group, Project Management, ASADE |
| Phase IV<br>(Future Direction) | Intelligent Distributed Asynchronous<br>Level 3 GDSS<br>Web-based<br>Intelligent Facilitation Agent (Self-Facilitation) |

| Table 2. Four types of collaborative interaction (Hsu & Hockwood, 1993) | | |
|---|---|---|
| Place of Access | Modes of Communication | |
| | Same Time (Synchronous) | Different Time (Asynchronous) |
| Same Place | Face-to-Face<br>Occurs at the same time and place<br>Decision Room | Asynchronous<br>Occurs at different times but at the same place<br>Shared offices, Working in shifts |
| Different Place | Distributed Synchronous<br>Occurs at the same time but at different places<br>Audio/Video conferencing, LAN based GDSS | Distributed Asynchronous<br>Occurs at different times and at different places<br>E-mail, Discussion Groups Web-based GDSS |

In 1996, when the design work for the CyberCollaboratory as it exists today was begun, the GDSS was included as an important component of the asynchronous tool kit for group coordination and process control. Integration of the GDSS into the Notes platform provided decision groups with asynchronous GDSS and with the full functionality of a robust CMC (Hiltz and Turoff, 1978)

system. The three levels of GDSS shown in Table 1 are presented and discussed in detail in DeSanctis and Gallupe (1987).

## THE VIRTUAL MEETING SYSTEM: A CYBERCOLLABORATORY

The term "Collaboratory," defined by William Wulf (1993), is as follows:

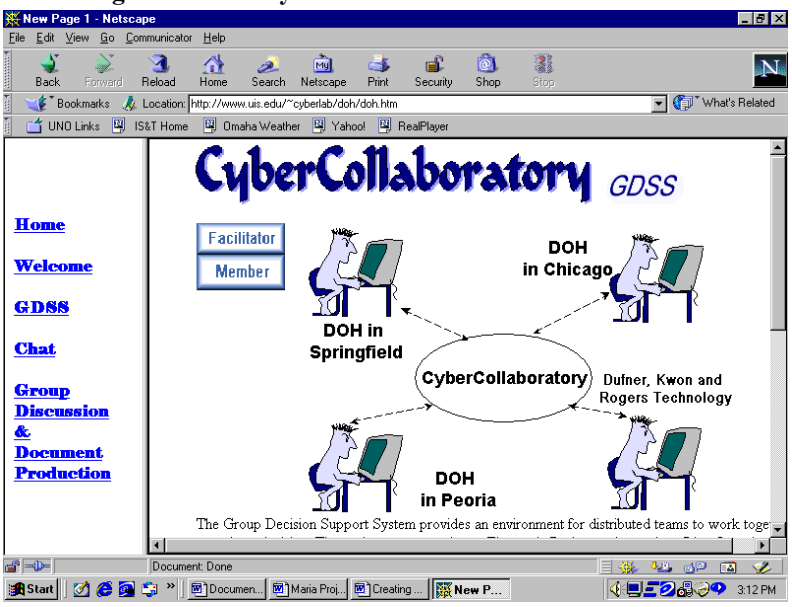
> *'" ...center without walls, in which the nation's researchers can perform their research without regard to geographical location-interacting with colleagues, accessing instrumentation, sharing data and computational resource, and accessing information in digital libraries.'" (Kouzes, Meyers, and Wulf, 1996).*

For our CyberCollaboratory, we have extended Wulf's definition to include centers without walls specifically designed and built to support team work for practitioners such as the staff of the DOH can experiment with the usefulness of asynchronous team technologies such as group decision-making in the asynchronous mode of communication. The CyberCollaboratory interface is shown in Figure 2.

**Figure 2: The Cybercollaboratory Interface for the DOH**


Members do not need to attend frequent face-to-face meetings because the CyberCollaboratory is designed to be used in the asynchronous mode of communication as shown in Figure 3 and is accessible using a standard Web browser and a PC or workstation. A group member may login to participate in a "virtual" meeting from the location of his/her choice at the time of the day or night he/she prefers.

**Figure 3: The Asynchronous Mode of Communication**




Given the need for group coordination for successful and satisfying group collaboration the CyberCollaboratory needed:

> tools (artifacts)
> process structures (e.g. agenda)
> process support (e.g. group memory, anonymity)
> task structure and task support (e.g. GDSS tools, collaborative document editing tools, project management software, etc.)

Hiltz et al. (1991) discusses three primary methods for coordination of asynchronous groups. These are:

> an agenda or some set of directions or instructions
> a facilitator or leader
> GDSS tools such as those embedded within existing group systems such a following commercially available systems: GroupSystems, Electronic Information and Exchange System 2 (EIES2) or Software Aided Meeting Management (SAMM)

Asynchronous groups can also be coordinated through facilitation and through additional software tools such as collaborative document editing. The CyberCollaboratory contains the following software environments:

Group Discussion (Computer mediated conferencing)
Collaborative Document Editing
Chat
Group Decision Support including Electronic Brainstorming, Idea Organizing and Voting
Intelligent Project Management (Project Management Advisor)

## TRADITIONAL MEETINGS PRESENT MANY PROBLEMS FOR GROUP MEMBERS:

Traditional meetings pose many problems for group members, especially if the groups are spread as thinly as are the DOH staff. The limitations of a traditional meeting are listed in Table 3.

**Table 3. Limitations of a Traditional Meeting (Palmer and Palmer, 1983)**

| | |
|---|---|
| 1. | Subject and purpose are not clearly defined |
| 2. | The meeting is held at a bad time for those who are expected to attend |
| 3. | Physical meeting facilities are poor |
| 4. | Participants are not prepared with ideas or materials |
| 5. | The meeting does not start on time |
| 6. | The wrong people are in attendance; the right people are not |
| 7. | Participants are allowed to get off track |
| 8. | The leader gets off track |
| 9. | One participant dominates |
| 10. | Participants argue uncontrollably among themselves or with the leader |
| 11. | Participants do not express their true feelings or opinions |
| 12. | Interruptions do not express their true feelings or opinions |
| 13. | Participants are ridiculed or embarrassed by the leader or others in attendance |
| 14. | Participants are unclear or confused about the issues or information under discussion or being presented |
| 15. | Audiovisual equipment does not work |
| 16. | Participants can not see, read, hear, or understand audiovisual aids |
| 17. | The meeting lasts longer than planned |
| 18. | When the meeting is concluded, participants are not sure what was accomplished nor do they know what is to happen next |
| 19. | Participants are dissatisfied and unmotivated |

Group support systems may provide the following benefits (Turban, 1998):

Bring more information, knowledge, and skills
Support parallel processing of idea generation
Provide instant anonymous voting results
Record all information automatically
Provide organization memory
Motivate members' participation
Give members more satisfaction

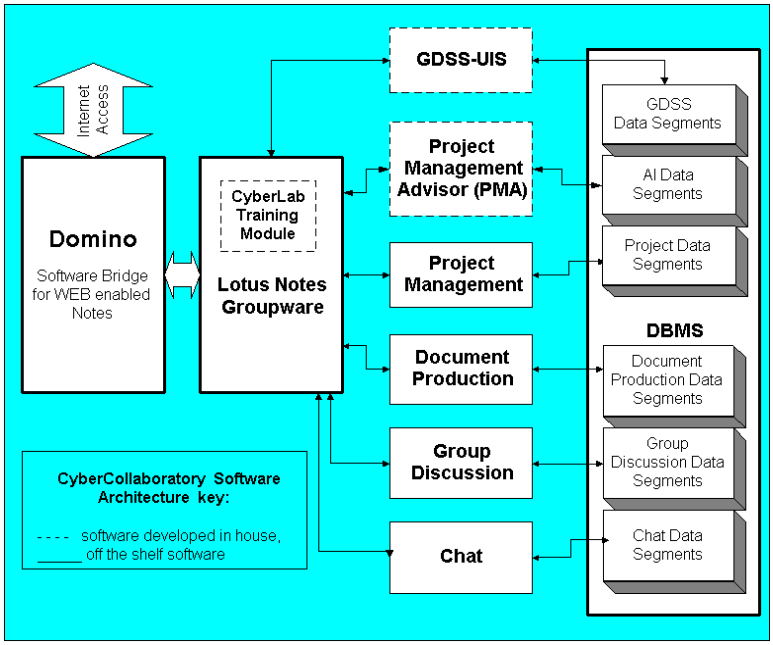
The CyberCollaboratory is expected to provide the following additional benefits:

Economic: save time and money by minimizing travel
Availability: does not require its own expensive telecommunication infrastructure. It is readily available through a phone line.
Scheduling: scheduling a meeting for a group or groups of people is a very difficult task. Through asynchronous communication and task control, we could eliminate this problem. Group members can participate in their meetings from anywhere at any time of their choice.

## THE CYBERCOLLABORATORY ARCHITECTURE

The CyberCollaboratory Architecture is shown in Figure 4. It is web enabled through the use of Domino and built upon the foundation of Lotus Notes, both of which are supported by IBM. This insures a secure and relatively trouble-free and maintenance-free environment.

**Figure 4: The CyberCollaboratory System Architecture**




## DEVELOPMENT OF THE MEASURES OF SATISFACTION AND PRODUCTIVITY FOR ASYNCHRONOUS TECHNOLOGIES

For this research, the survey instruments used to measure the efficiency and effectiveness of asynchronous technologies such as the CyberCollaboratory evolved and were validated over a ten year period through the research efforts of Hiltz and Turoff at the New Jersey Institute of

Technology (NJIT) and their graduate students, and the efforts of other researchers at the University of Minnesota (Watson, 1987). In 1998 Dufner and Kwon modified the survey instruments to fit this and other similar studies underway.

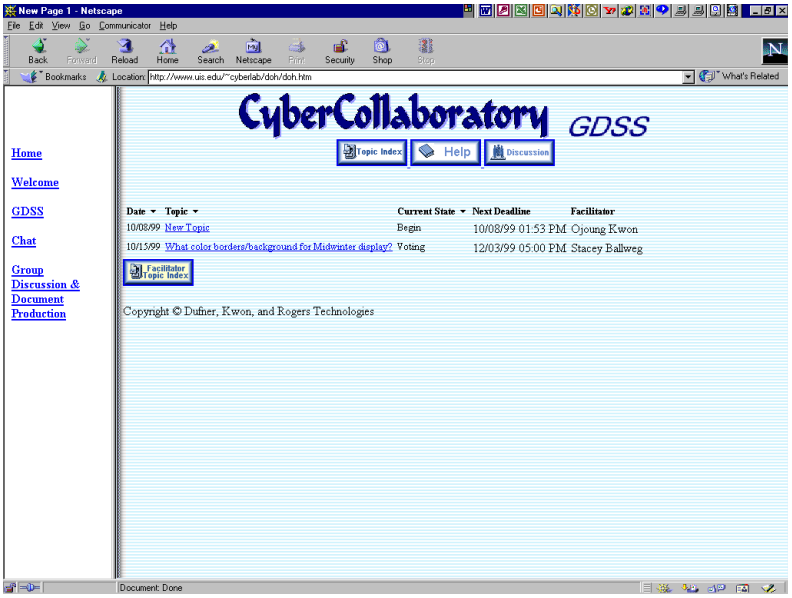
The instruments include a Consent Form, a Pre-test Questionnaire (to obtain demographic information), a Training Evaluation Questionnaire (to assess the participants experience of the training to use the environment), a Task Expectations Questionnaire (designed to measure the subjects expectations regarding performance of the forthcoming task), and a Post-test Questionnaire (administered after the task was completed).

## THE RESEARCH METHODOLOGY

The DOH group attended a face-to-face (synchronous) training session where the Consent Form and Pretest Questionnaire were administered, and then training was begun. The hands-on training in the use of the CyberCollaboratory followed. The Systems Expectations and Task Expectations questionnaires were administered directly following completion of the training session. The subjects were trained in the use of the entire CyberCollaboratory and were given a paper copy of the user's guide. This user's guide was also emailed to all group members because in its electronic form, the table of contents, and the figures were hyper-linked for easy reference.

The group member with the greatest technical skill and experience was selected to serve as the group's facilitator for performance of the asynchronous task. The facilitator establishes the task within the CyberCollaboratory as a TOPIC, shown in Figure 5, and moves the group through the various stages of the decision-making process by using the tools and agents (such as Brainstorming and Idea Organizing) that are available within the CyberCollaboratory environment.

**Figure 5: Setting Up the Task**



After the training session was completed, the subjects were instructed to decide on a suitable task over the next week to ten-day period for performance in the asynchronous mode of communication (distributed in time and place), using the CyberCollaboratory.

After the group had decided on an appropriate task, the subjects using the asynchronous mode of communication as shown in Figure 3 began performance of the task. The Post-Test Questionnaire was administered immediately following completion of performance of the real-world task by the subjects. Analysis of the CyberCollaboratory transcripts and questionnaire data followed collection of the Post-tests. The entire process spanned approximately two years, from January 1998 through November 1999, and included the initial presentation of the ideas to the administration of the DOH, coordination, obtaining appropriate equipment, training, and administration of the questionnaires, and performance of the task by the DOH team. One of the problems that caused to take the entire process so long was obtaining appropriate computers for DOH employees. Even though the CyberCollaboratory can be accessed using a PC with any standard Web browser and Internet access, the DOH had many computers (386) that would have been very slow when using the Web and thus might have served as an intervening variable in the study. Upgrades for these machines were deemed necessary before the study began.

## THE TASK

The staff members of the DOH chose to select a color for their midwinter display, and this task was identified within the VMS system as, "What color borders/background for midwinter display?" The facilitator set up the task as a TOPIC within the CyberCollaboratory as shown in Figure 5.

This task worked very well for the group's pilot project. Indeed, responses from the group members indicated that (1) the task was neither too simple nor too difficult; (2) the task required somewhat tightly integrated action from the group to complete; and (3) the task was an important and urgent task but not too critical to the group. The task seemed to be an excellent choice as the first CyberCollaboratory effort because a task of very high urgency or one that was critical to the group might have caused the group to abandon the CyberCollaboratory and use alternative methods of communication. Also, a task that required low integration from the group might have been performed by one individual for the group.

## FINDINGS

The sample size (N = 7) is small due to the small size of the agency staff, as discussed above in the introduction. The Pre-test responses reveals that 100% of the participants reported they are "White" and 86% reported that English is their native language. The group consists of six females and one male. This group is mature (no teens or twenties), with a mean age of 45.3 years. All of the subjects have many years of full-time employment experience with a mean of 23.3 years. Their decision-making experience is distributed from "low" to "very high."

The mean responses to the "Communications Medium," the CyberCollaboratory were generally more positive or neutral than negative. The high standard deviations for the variables

presented shown in Table 4 is probably based on the relatively wide variance in the group members' previous training and experience with computers, even though all participants reported having good computer access, frequently using various types of computer software, and having easy access to the Internet from their office.

**Table 4. Reactions to the CyberCollaboratory**
**Means and Standard Deviations for Participants' Reactions to the Communications Medium**

| Semantic Differential Scale 1 through 7 for all items N= 7 | | Mean | SD |
|---|---|---|---|
| Dependable | Not dependable | 3.0 | 1.4 |
| Technical | Non-technical | 3.4 | 1.1 |
| Delayed feedback | Immediate feedback | 4.0 | 0.8 |
| Simple | Complex | 3.1 | 0.9 |
| Urgent | Not urgent | 4.3 | 1.5 |
| Inconvenient | Convenient | 4.1 | 1.3 |
| Easy to use | Hard to use | 3.3 | 1.4 |
| Always available | Not always available | 3.1 | 1.2 |
| Flexible | Restricted | 3.6 | 1.3 |
| Confidential | Public | 3.4 | 1.1 |
| Ambiguous | Clear | 4.3 | 0.5 |
| Personal | Impersonal | 4.1 | 0.7 |
| Rich | Impoverished | 3.7 | 0.8 |
| Much feedback | Little feedback | 4.0 | 1.0 |
| Wide-ranging | Narrow-focused | 4.4 | 1.0 |
| Subjective | Objective | 4.0 | 0.6 |
| Sensitive | Not sensitive | 4.0 | 0.8 |

The respondents also reported that the overall system is more good than bad with a mean of 3.0 (scale 1-7, extremely good/extremely bad). On the pre-test, 57% of the participants reported feeling a bit tense when participating in group discussions. On the post-test questionnaire we see a shift away from feeling tense in the direction of feeling less tense with only 43% of the respondents reporting that they get frustrated or get nervous when participating in group meetings. The CyberCollaboratory might help shy people to feel more comfortable when participating in meetings. Table 5 indicates that respondents thought using the system is somewhat easy (the average of the mean numbers is 4.8). Table 6 indicates that the respondents perceived the GDSS tools (i.e. EBS, IO, Voting, etc.) are as somewhat easy to use (the average of the mean numbers is 2.9) and somewhat valuable (the average of the mean numbers is 4.9).

**Table 5. User Perceptions of the System**
Semantic differential scale variables (differential scale range: 1 - 7), N = 7

| Perceptions of the System | | Mean |
|---|---|---|
| Hard to learn | Easy to learn | 4.9 |
| Impersonal | Friendly | 5.0 |
| Frustrating | Not frustrating | 4.3 |
| Time wasting | Time Saving | 5.1 |
| Unproductive | Productive | 4.9 |

**Table 6. User Perceptions of the GDSS Tools**
Semantic differential scale variables N = 7

| GDSS Tool | User Perception of the GDSS Tools | | Mean |
|---|---|---|---|
| EBS | Easy | Hard | 3.1 |
| EBS | Useless | Valuable | 4.9 |
| IO | Easy | Hard | 2.9 |
| IO | Useless | Valuable | 4.8 |
| Voting | Easy | Hard | 2.8 |
| Voting | Useless | Valuable | 5.1 |
| Chat | Easy | Hard | 2.9 |
| Chat | Useless | Valuable | 4.9 |
| GD & DP | Easy | Hard | 3.1 |
| GD & DP | Useless | Valuable | 4.9 |

The respondents reported that the time spent for traveling to actual meetings and coordinating meetings was less after having used the CyberCollaboratory. With the CyberCollaboratory, the group reported they gained more time for substantive preparation and for the meetings themselves.

Of the participants, 71% reported that use of the system helped the group save time. 80% of the people who reported that use of the system helped the group save time also indicated they saved between 1-2 hours per week, while 20% reported they saved between 5-10 hours per week.

Only 43% of the participants reported that the system helped reduce travel. This finding may simply reflect the fact that the secretaries in the group are not required to travel for their jobs, or that the task would not have required as much travel as a more critical task. 100% of the people who said

'Yes' to less travel as a result of using the CyberCollaboratory for this project indicated that they saved 1-2 trips per month. Overall they reported spending less time traveling.

## CONCLUSION

These very preliminary findings seem to indicate that the CyberCollaboratory is a useful tool for the DOH. Further studies would be needed to fully confirm these findings. However, the results of the pilot study are very encouraging and it is entirely possible that more savings in time and travel could be realized by the agency as members gain more familiarity and comfort with the VMS system.

Asynchronous Groupware such as the CyberCollaboratory seem to hold much promise for group work and decision-making because artificial pressures to closure are greatly reduced (Hoffman, 1976). These systems can support an on-going group decision process where the group's members are distributed both in time and geographically, as is the DOH staff. The Group members can research and analyze alternatives and explore ideas free from the pressures of having to coordinate and attend a face-to-face meetings or, conversely, from having to end meetings prematurely as a result of artificial constraints such as the end of the workday.

The group at the DOH used the CyberCollaboratory to perform a task asynchronously (distributed in space and time) rather than traveling to meet to perform the task as a face-to-face group. Even though the sample size was small (due to the small size of the department after positions were lost due to drastic budget cuts), we gained important insights and extremely encouraging results from the pilot study. Asynchronous technologies such as the CyberCollaboratory can be used to contribute to productivity by reducing the amount of time needed to coordinate and travel to meetings when staff are distributed over great distances.

## REFERENCES

Barua, A., R. Chellappa, & A.B. Whinston (1995) Creating a Collaboratory in Cyberspace: Theoretical Foundation and Implementation. *Journal of Organizational Computing, 5(4),* 417-442.

Biond, A. (1997) Implications that Downsizing Could Have for Public Sector Unions. *Journal of Collective Negotiations in the Public Sector, 26(4),* 295-301.

Bajjaly, S. (1999) Managing Emerging Information Systems in the Public Sector. *Public Productivity & Management Review, 23(1),* 40-47.

Boynton, A. C. & R.W. Zmud (1987) Information Technology Planning in the 1990's: Directions for Practice and Research. *MIS Quarterly*.

Champy, J. (1996) Better Government, Not Necessarily Smaller. *Government Executive Magazine, September,* 7A-10A.

DeSanctis, G. & R.B. Gallupe (1987) A foundation for the Study of Group Decision Support Systems. *Management Science, 33 (5),* 589-609.

Dufner, D., O. Kwon & R. Hadidi (1999) Web-CCAT: a Collaborative Learning Environment for Geographically Distributed Information Technology Students and Working Professionals. *Communications of The Association of Information Systems,* 1(12).

Faucett, A. & B.N. Kleiner (1994) Developments in Performance Measures of Public Programmes. *International Journal pf Public Sector Management, 7(3),* 63-70.

Fjermestad, J. & S. Hiltz (1998) An Assessment of Group Support Systems Research: Results. *Proceedings of the 32nd Annual Hawaii International Conference on System Science (HICSS-32), Los Alamitos, CA: IEEE Computer Society Press, January*.

Hammer, M. (1996) The Soul of The New Organization. *Government Executive Magazine, September,* 2A-6A.

Hiltz, S. (1988) Productivity Enhancement from Computer-Mediated Communication: a Systems Contingency Approach. *Communications of the ACM, December, Vol. 31,* 1438-1454.

Hiltz, S. & M. Turoff (1978) *The Network Nation: Human Communication via Computer*, Addison-Wesley.

Hoffman, L.R. (1979) Applying Experimental Research on Group Problem Solving to Organizations. *The Journal of Applied Behavioral Science, 15(3),* 375-390.

Hornestay, D. (1996) Downsizing Dilemma. *Government Executive Magazine, September,* 27-30.

Huang, W., K. Wei, B. Bostrom, L. Lim, & R. Watson (1998) Supporting Distributed Team-Building Using GSS: A Dialogue Theory-Based Framework. *Proceedings of the 31st Annual Hawaii International conference on System Sciences (HICSS 31), Los Alamitos, CA: IEEE Computer Society Press, January,* 98-107.

Illinois Department of Public Health: Division of Oral Health, P.O. #347019, January 1997.

Kouzes, R.T., J.D. Meyers & W.A. Wulf (1996) "Collaboratories: Doing Science on the Internet. *Computer 29(8), IEEE Computer Society Press, August,* 40-46.

Nunamaker, J.F., R. Briggs, D. Mittleman & P. Balthazard (1997) Lessons from a Dozen Years of Group Support Systems Research: A Discussion of Lab and Findings. *Journal of Management Information Systems, (Winter),* 163-207.

Nunamaker, J.F., A.R. Dennis, J.S. Valacich, D.R. Vogel, & J.F. George (1991) Electronic Meeting Systems to Support Group Work. *Communications of the ACM, 34 (7),* 40-61.

Popovich, M.G. (1998) Creating High-performance Government Organizations, (Editor). *Alliance for Redesigning Government,* Joeeey-Bass Publishers, San Francisco.

Roach, S.S. (1993) *A Special Economic Study: Making Technology Work,* New York, Morgan Stanley.

Roach, S.S. (1994) *A Special Economic Study: The Perils of America's Productivity-Led Recovery, January,* New York, Morgan Stanley.

State J. (1991) Edgar: Cut Budget $509 Million. *State Journal-Register, Mar 7,* 1-2.

State J. (1991) State Crisis Worse Than Expected. *State Journal-Register, Dec 18,* 1-6.

State J. (1992) Budget Cuts Elude Edgar Administration. *State Journal-Register, Jan 15,* 1-5.

Trimmer, J.J., C.V. Slyke & C. Conca (1997) Transforming Student Groups into Teams. *Proceedings of the Association for Information Systems (AIS) Americas Conference,* Indianapolis, Indiana, 971-973.

Tyran, C.K., A.R. Dennis, D.R. Vogel, & J.F. Nunamaker (1992) The Application of Electronic Meeting Technology to Support Strategic Management. *MIS Quarterly, September,* 313-334.

Wulf, W. & R. Kouzes (1996) Collaboraties: Doing Science on the Internet. *Computer, IEEE Computer Society Press, August,* 40-46.

# COMPONENT-ORIENTED MIDDLEWARE FOR E-BUSINESS: COM+ AND EJB APPLICATION SERVERS

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## ABSTRACT

*After critically examining the COM+ and EJB component models, this paper formulates seven criteria, such as application development, portability, interoperability, reliability and availability, scalability, security, and e-business application integration, and compares COM+ (Component object Model +) and EJB ( Enterprise JavaBeans) application servers on the basis of the above criteria. Questionnaires were sent to fifty IT professionals to evaluate COM+ and EJB application servers. This study investigates the results of the survey and offers a critical explanation of each criterion. From the survey, this research arrives at a conclusion that although both COM+ and EJB component models are beneficial for e-business, the COM+ based application server is ideal for moderate e-business applications in the Microsoft environment, and EJB based application servers are favorable for complex e-business enterprise applications.*


## INTRODUCTION

Corporations are involved in different types of e-business applications varying from a simple application, for selling one or a few products through the Internet, to complex applications, consisting of supply-chain management and purchasing of supplies from other businesses. In the complex e-business environment, they are facing new challenges, such as managing a high volume of transactions, rapid applications development and modifications up front, making use of existing resources, and application integration with business partners. The key to meet these challenges is to change business models. The corporations have turned to multi-tier client/server (c/s) systems using component model standards. Multi-tier c/s system in the e-business environment consists of physically, the web server, application server and data server, and logically, presentation logic, business logic and data logic. To glue together these tiers, a component-oriented middleware technology which supports enterprise application development is commonly used at present. There are three standards for implementing component-oriented middleware. They are Microsoft's COM+ (Component Object Model +), Sun's EJB (Enterprise JavaBeans) and Object Management Group's CCM (CORBA Component Model). Vendors build application servers according to the component model specifications. At present, there are no application servers available according to CCM specifications. Microsoft's Windows 2000 servers use COM+ standards. There are many EJB application servers, such as IBM's WebSphere, BEA's WebLogic, Oracle's application server, etc. Application servers, built according to the component model specification, enable developers to

concentrate on programming the business logic. They do not have to write the "plumbing code" (Suresh Raj, p. 3) for such features like security, resource pooling, persistence, transactional integrity, and database connections, which will be provided by the application servers. The objective of this study is to compare the effectiveness of COM+ and EJB application servers for complex e-business enterprise applications.

## RESEARCH METHOD

This research first critically examines COM+ and EJB component models. It formulates seven criteria for comparing application servers based on COM+ and EJB standards. The criteria are application development, portability, interoperability, reliability and availability, scalability, security, and application integration. Questionnaires were sent to fifty IT professionals to evaluate the application servers. This study examines the results of this survey in terms of each criterion with critical explanations. Finally, this research arrives at a conclusion about the effectiveness of COM+ and EJB application servers in terms of e-business applications.

## COM+ AND EJB COMPONENT MODELS

COM+ (Leinecker, pp. 10-45) is Microsoft's component model. It is not a product, but a specification for creating server-side, scalable, multi-user, transactional and secure enterprise applications in the Microsoft environment. COM+ is platform dependent. In this model, Microsoft integrates its three previous component models, such as COM, DCOM and MTS. It also integrates with it the features of MSMQ for an asynchronous component, which allow the client to do some other work while the method request is in queue. COM+ also provides the load balancing features. COM+ can be deployed on the top of existing transaction processing. It can be written in many languages, such as C++, Visual Basic, Java, etc. However, it is not portable. COM+ is closely tied to Windows 2000. Both, COM+ and Windows 2000, together provide a strong and flexible platform for e-business in the Microsoft environment.

EJB is the Java component model. It is a specification, which defines a component architecture for creating server-side, scalable, transactional, secure and portable enterprise applications. It also specifies requirements of infrastructure services for interfacing between EJB servers and components in multi-tier environment. EJB components are independent of a platform and also middleware. EJB components can be written only in Java programming language and contain only business logic. The component model specifies three entities, such as servers, containers and objects that participate in the execution of components. There are more than forty EJB servers commercially available. The main function of servers is to allocate the resources to containers, which reside within the servers. It is the responsibility of the containers to make secure and persistent the server component. There are three types of objects, such as session beans, entity beans and message oriented-beans (Cattel, pp.14-24). Each of them has a specific role to play in the application development. EJB is one of the widely adopted component models.

## THE SURVEY RESULT AND ITS EXPLANATIONS

Twenty-one IT professionals responded to the questionnaire. Currently, eleven of them are using COM+ with Windows 2000 Server/ Advanced Server, six of them EJB with BEA's WebLogic, and four of them EJB with IBM's WebSphere. All are satisfied with the application servers they are using currently. All of the companies, which use COM+ and Windows 2000, are medium sized, except one. All of the companies, which use EJB, are comparatively large in size.

Although all of the twenty-one IT professionals have some knowledge about both COM+ and EJB, four have worked with both. Out of these four, three are currently using COM+ and the other one is currently using EJB. These four favor EJB for portability and scalability, and COM+ for application development as is implicitly evident in Table 1.

As there are eleven responses which are currently using COM+ as opposed to ten using EJB, this study leaves out one COM+ response so that both might be equally weighted. Table 1 shows the distribution of responses according to each criterion out of twenty responses. Five points are assigned to each response in each criterion. COM+ application servers received 310 points, and EJB received 390 points.

**Table 1: Distribution of responses according to Criterion**

| Criterion | COM+ | | EJB | |
|---|---|---|---|---|
| | # of Responses | Percentage | # of Responses | Percentage |
| Application Development | 11 | 55% | 9 | 45% |
| Portability | 7 | 35% | 13 | 65% |
| Reliability and Availability | 10 | 50% | 10 | 50% |
| Interoperability | 9 | 45% | 11 | 55% |
| Scalability | 7 | 35% | 13 | 65% |
| Security | 10 | 50% | 10 | 50% |
| Application Integration | 9 | 45% | 11 | 55% |

### Each Criteria Result Explanation

**Application Development**: The important things to be considered with respect to application development are programming language, bridges to other development tools, and ease of use (Boucher, pp.213-223). The most important advantage of COM+ is its language neutrality (Sessions, p.2). It can be written and implemented in a variety of languages, such as C++, Java, Visual Basic, etc. Microsoft provides tools, such as Visual Studio .NET, to support cross-language inheritance. EJB can be written and implemented only in Java, though there are indirect bridges to other languages from Java. EJB application servers may have application development tools, such as IBM's VisualAge For Java, which support ease of use. EJB has features, such as entity beans,

which enable the developers to write applications with less codes. 55% of respondents favor COM+ for application development.

**Portability**: enables one to develop systems in a variety of operating systems. It makes applications platform independent. Microsoft's COM+ is closely tied to Windows 2000. One cannot move the codes written in windows 2000 environment to another platform, unless the entire application is re-written. COM+ lacks portability. One of the most important advantages of EJB is its portability. Sun's J2EE platform allows a developer to write the code once according to EJB specification, and to run it anywhere in any machine. However, portability involves a overhead cost for porting the application from one vendor product to another. 65% of respondents in the survey favor EJB in regard to portability. This implies that all those who are familiar with both EJB and COM+ made EJB the winner.

**Interoperability:** In a company, a heterogeneous nature of the systems may result from many causes, such as combined projects, mergers and acquisitions. Interoperability with this heterogeneous system is essential in e-business. In the Microsoft environment, COM + has client-tier operability; for example, clients invoke COM+ components through DCOM. For HTTP communication, clients operate through XML, DHTML and HTML. Clients also communicate through COM-CORBA bridge. COM+ has interoperability with data-tier through Microsoft's MSMQ. However, COM+ does not have as much interoperability with heterogeneous systems as EJB does. EJB components can be easily deployed in heterogeneous systems. They are inter-operable both in system-level and application-level between products from different vendors. EJB is written in a cross-platform language, which enables the application to be deployed on any machine. EJB clients inter-operate with web pages through HTML, DHTML, JSP and Java servlets. EJB components inter-operate with objects written in other languages through IIOP and XML. They can communicate with COM+ through COM-CORBA bridge. 55% of respondents in the survey favor EJB on this criterion.

**Reliability and Availability**: require that the server-side service must be available to customers around the clock. Server down time can incur big losses to a company. Reliability is all the more critical in enterprise e-business because e-business performs transactions all the time around the world. Most robust operating systems can be running 99.999% of the time, meaning only five minutes down time over a period of a year. Windows 2000 had a problem of down time in the beginning, but reliability is improved in Windows 2000 Advanced Server and Windows Datacenter Server through improved architectural features (Microsoft, pp. 1-25). Besides, clustering and load-balancing features can increase reliability. EJB applications can be deployed in most robust operating systems with very little server down time (Brown, pp.1-8). For example, BEA's WebLogic supports many robust platforms, such as Solaris, AIX, UNIX etc., and IBM's WebSphere supports OS/390, AIX, Solaris etc. Both COM+ and EJB received 50% of votes from the survey respondents.

**Scalability:** involves the capability of the server increasing or decreasing its capacity to meet the workloads. In e-business scalability is essential as corporations get new customers and have to handle a high volume of transactions. Microsoft's most scalable server, Window 2000 Datacenter Server, scales to 16 - 32 processors; but it is also possible to scale hundreds of processors through clustering Windows 2000 and load balancing. Some Corporations prefer this kind of

clustering, as they can add new servers as needed, though it is not without additional problems and risks. For example, Commonwealth of Securities, Australia's largest online broker (Microsoft Corporation, pp. 1-6), chose Windows 2000 Advanced Servers, when they have to opt between Sun's "Big Box" system and Microsoft's distributed system. They are clustering eighty-five servers now, and have ordered an additional forty servers. EJB applications on J2EE platform can be deployed into UNIX and mainframe systems, which support 256 processors (Roman, pp.8-9). J2EE platform provides many load balancing strategies, which support thousands of processors resulting a highly scalable system. In the survey, 65% of respondents favor EJB in regard to scalability.

**Security:** evaluation includes security standards provided by the product, and ease of administration of security features. Security of COM+ is integrated with that of Windows 2000. COM+ provides (Kiely, pp. 1-7) declarative role-based security and programmatically role-based security. It allows an administrator to set the component's security features. In the multi-tier environment, Microsoft recommends to implement security on the middle-tier for a secure database. EJB application servers support CORBA security or SSL. They provide security features, such as authentication, authorization and access control following the Java security model. The security of each EJB component will be declaratively defined in deployment descriptors at the assembling time. In the survey, both COM+ and EJB received 50% vote each.

**Application Integration**: Enterprise Application Integration (EAI) and B2B integration are critical for e-business success. In the COM+/Windows 2000 environment, a developer can give ODBC and SQL connections to the database access. Microsoft allows COM Transaction Integrator (COM TI) for CICS and IMS. MSMQ can be used for asynchronous object invocation. In the COM+ environment, Object Linking and Embedding (OLE) automation facilitates B2B application integration. EJB supports the JDBC connection to the database. In J2EE framework legacy applications, ERP, CRM etc. can be packaged as EJB components, and can be integrated with enterprise applications through Integration Broker. EJB in J2EE platform provides Java Connector Architecture for EAI and B2B integration. Peoplesoft and SAP are providing support for J2EE connector architecture. EJB components provides interface for B2B transactions through B2B integrator using XML. MQ Series also supports B2B integration. In the survey, 55% of respondents favored EJB for application integration.

In addition to these seven criteria, cost-efficiency is to be evaluated. Although the initial cost of EJB servers will be higher, their maintenance cost will be lower than COM+ servers. On the basis of the total ownership cost at the time this study was conducted, if COM+ servers are used for moderate e-business and EJB servers are used for complex e-business, both will benefit from the cost-efficiency.

## CONCLUSION

Both COM+ and EJB have their own advantages and disadvantages. If a company has already locked into a Microsoft platform, COM+ is its choice. If the company does not have application developers trained in Java and wants to keep its language neutrality, it may look into Microsoft's COM+. If a company wants to have portability and a choice of operating system , it has to select EJB. Although both COM+ and EJB component models are beneficial for e-business, the

COM+ based application server is ideal for moderate e-business applications in the Microsoft environment, and EJB based application servers are favorable for complex e-business applications.

## REFERENCES

Boucher, K. & Katz, F. (1999). *Essential Guide to Object Monitors*. Wiley & Sons, NY.

Brown, K. & Cook, L. (May 2000). *What's it going to get you to go with EJB component?*. IBM: Developer Works: Components: Library - Papers, 1-8.

Cattell, R., Incore, J., & Enterprise Partners (2001). *J2EE™ Technology in Practice*. Addison-Wesley, NY.

Fischer, P. & Reckford, S. (May 2001). EJBs to the Rescue. *ADT Magazine*, 1-11.

Kiely, D. (2201). Component Security in COM+. *Earthweb*, 1-7.

Leinecker, R.C. (July 2000). *COM+*. Sams Publishing, IN.

Microsoft Corporation (2000). *Increasing System Reliability and Availability with windows 2000.* White Paper, 1-25.

Microsoft Corporation (July 2001). *Commonwealth Securities chooses a windows 2000 distributed Architecture, Case Study*, Microsoft corporation, 1-6

Roman, E. & Oberg, R. (December 1999). The Business Benefits of EJB and J2EE Technologies over COM+ and Windows DNA. *The Middleware Company*, 1-14.

Sessions, R. (November 2000). EJB vs. COM+. *Software Magazine*, 1-6.

Suresh Raj, G. (May 1999). A Detailed Comparison of Enterprise JavaBeans & The Microsoft Transaction Server (MTS) Models. *Tripod,* 1-24.

# A REVIEW OF THE INTERRLATIONSHIP AMONG MANAGEMENT, INFORMATION TECHNOLOGY, AND IN-HOUSE END-USER: EMPIRICAL PROPOSITIONS

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## ABSTRACT

*The introduction of new technology is the responsibility of general management and information systems personnel. The complementary relationship between end-users and IT is viewed here as two sides of a coin (the organization) in which the role of management is to maintain a balance within this relationship. Viewing the employees as the core entity of the business and recognizing that all other aspects of the organization, including IT, are built around people will help management to maintain such balance. The analysis of the end-users' personalities, attitudes, and reactions to the new IT provides management with a tool that will minimize the end users' resistance to change. This paper presents a comprehensive review of the relationship among management, information technology (IT), and end-user. It introduces a set of propositions that aim to help realize productive relationships among management, IT, and the end-users.*


## BACKGROUND

Information Technology is one of the most powerful innovations in history that affects our way of life, thus any investigation shedding light on such an important issue is worthwhile (Montealagre, 1999). In addition to that, IT has radically altered the way many industries conduct their business (Ansel & Dyer, 1999). Moreover, IT represents about half of all capital investment on a global basis (Martinsons & Chong, 1999). IT is one of the top industries worldwide. More importantly, it is helping countries and companies of all sizes reach their strategic goals (World Information Technology and Services Alliance (WITSA 1998)). IT represents the business of the future and communities realize that the most vital economies of the 21st Century will be predominately led by IT businesses (World Information Technology and Services Alliance (WITSA 1998)). As a result, many studies have focused on examining different aspects of IT. For example, few of those studies have examined the determinants of IT adoption and usage by employees (Mathieson, 1991, Moore & Benbasat, 1991). Other studies have investigated the relationship between end-users' attitude and perceptions and the actual use of IT (Ajzen & Madden, 1986, Al-Khaldi & Wallace, 1999, Davis, 1989, Lin & Shao, 2000, Ozer, 2001). On the other hand, a few studies have discussed the process that influences the acceptance of IT (Agarwal & Prasal, 1999, Rogers, 1995).

In a business community, it is observed that the interaction between humans and machines influence the future of a business. Among the most important aspects of a business is the use of information technology (IT) and its effect on human behavior, which ultimately directs the

productivity of employees. The use of IT has definitely changed people's lives. The changes extend to almost every segment of one's daily life, especially human behavior, which can have a significant impact on the business environment. Implementing any type of IT definitely has an effect on employees; thus, management should study it and adjust the various parameters involved. There is also a need for continuous monitoring of the implications of the social impacts of IT. New technology can be successfully implemented only if it is acceptable to end-users.

The effect of IT on end-user productivity has been investigated in depth by many researchers. These types of studies have been known in the literature as "productivity paradox" (Brynjolfsson 1993, McCune 1998, Strassmann, 1999). A major new study of the world's information communication technology (ICT) spending reveals that the global high tech industry surged to over $2.1 trillion in 1999, and it is expected to surpass $3 trillion in 2003 (WITSA, 2000). North America as a region continues to lead the world in overall ICT spending, which reached $796 billion in 1999 (WITSA, 2000). Businesses in America spent more than $2 billion a year on information technology (McCune 1998). Yet the question that still remains unanswered is does this spending of information technology payoff in the form of increased productivity? The answer might vary because it depends on many factors such as the type of industry that has been investigated, the method in which productivity is measured, and model specifications. Many of these studies have concluded that the reward from IT investments is inadequate due to the following: (1) there is too much "technology for technology's sake," (2) relations between IT users and IT specialists are poor, and (3) system designers do not consider users' preference and work habits (Bensaou & Earl 1998, Mallalieu, Harvey, & Hardy 1999, Strassmann, 1997). On the other hand, other researchers have reached a different conclusion that IT has a positive impact on productivity (Brynjolfsson & Hitt 1998).

The implication of the above discussion is that a company should think twice before purchasing the latest in technology (McCune 1998). Since investment in IT usually requires a large amount of capital, it should be appropriately utilized by end-users so it might increase their productivity and effectiveness in decision making and other areas. However, motivation of end-users to utilize IT remains a significant problem for organizational managers (Bhattacherjee, 1998). Since IT adoption and usage are critical prerequisites for obtaining the productivity benefits that have been promised by IT, management should be aware of end-users' perception of new IT prior to adoption and post-adoption (Karahanna, Detmar & Chervany 1999). A review of IT implementation research indicates that end-users' utilization of IT depends not only on their beliefs, attitudes, and intentions, but also on management strategies, policies, and actions (Back & Moreau 2001, Bloodgood & Salisbury 2001, Ives & Olson 1984, Leonard-Barton & Deschamps 1988). Despite the fact that many studies have examined the effects of individual variables (e.g., beliefs, attitudes) and managerial variable (e.g., management support), very little attention has been devoted to the interaction among management, IT, and end-users.

A complete understanding of IT implementation requires an integration of management, IT, and end-users' perspectives with a common framework. This paper addresses this issue by studying the relationship among the three components. The general research question that guided this paper is "what is the framework that can help keeping the relationship among management, information technology, and end-users in balance?" Even though, the paper does not have an empirical data to support its propositions, it identifies many "problems" for general management attention. These

identified problems were based on both personal interviews with managers and existing literature. Moreover, the research presented here also has practical implications, through the proposed propositions, for managers responsible for making decisions regarding the implementation of a new IT by providing the HOW component (the solutions). Moreover, normative guidelines are provided after the discussion of each set of the proposed propositions.

The paper is organized as follows: Section 2 provides a discussion of preparing end-users for a successful implementation of a new IT. Section 3 presents the social effects of IT on the end-users' behavior in the workplace. Section 4 explains the relationship between end-users and IT. Conclusions and suggestions for future work are discussed in Section 5.

## PREPARING END-USERS FOR A SUCCESSFUL IMPLEMENTATION OF A NEW IT

The organization is an open system that interacts with its environment. End-users, as part of the organization body, interact with their internal and external environment. IT usage typically requires end-users to spend effort in overcoming usage barriers, such as learning curves and social inertia and may therefore be resisted by end-users. The field of human engineering has suggested that ease of use is the primary factor for end-users' acceptance of IT (Bradley 1998, Karahanna & Straub 1999). However, one of the key factors that may influence the acceptance of new IT is organizational climate (culture) (Fink 1998, Prager & Overholt 1994, Shadur, Kienzle & Rodwell 1999). Moreover, organizational culture is found to be the most significant factor in the adoption of IT (Hasan & Ditsa 1999, Tolsby 1998). It is worth mentioning that the factors that influence IT adoption are the same for both developed and developing countries (Dasgupta et al., 1999). Management' awareness of end-users' attitudes to new technology can help in predicting and controlling end users' resistance to change. A successful organization knows how to make a positive impact on end-user attitude. For example, this can be accomplished by providing them either with incentives (e.g., recognition, praise, and monetary reward) for IT use or penalties (demotion) for non-use (Bhattacherjee 1998).

Major barriers to rapid implementation of IT seems to be end-users' acceptance of the new IT and managerial ability to overcome technological complexities (Mahmoud & Rice 1998). The adoption of new technology takes place gradually but progressively through a given course of management actions (Montealagre 1999). The process of IT adoption and use is a vital factor in realizing the benefits of IT. Karahanna, Detmar, and Chervany (1999) pointed out the importance of evaluating the sequence of activities that lead to the initial adoption of IT and the consequence that follows that adoption. The authors provided the answers for the following questions regarding the usage of IT: "Do employees change their attitudes and beliefs over time?" and "Is there any difference between employees who adopt and employees who actually use IT?" It is found that potential adopters' intention to adopt is determined by normative pressure (perceptions of usefulness and ease of use), whereas users' intention is determined by attitudes (belief of usefulness and perceptions of image enhancement (Karahanna, Detmar, & Chervany 1999).

Humans have the capability to adapt to any kind of change if it comes in a proper way. The need for changing any type of activity is always a strong reason for its adoption. Once a person realizes the importance of a new tool, he or she will work harder to acquire it. For example, if a

company uses e-mail for memos and disseminating information, then every employee will learn how to use e-mail. The fact that this type of IT is important for improving employee performance will create the desire to change. Thus, introduction of any change should come from a personal point of view: why and "what is in it for me?" A successful organization anticipates changes rather than reacts to them. Generally speaking, if employees have the opportunity to anticipate the way in which their work will change, they will alter their behavior to match the new realities (Crabb 1993). The personality traits of employees, which are shaped by genetic and experience factors, affect the employees' behavior in an organization. Management's acknowledgment of some dimensions of the personality traits, such as psychological needs, cognitive abilities, and interpersonal styles, will enable it to influence and predict employees' behavior (Myers et al., 1993). The dimensions of personality traits provide management with valuable information about end-users, such as open-versus-closed minds or risk-taker-versus-risk-avoider; so management might have a better understanding of employees' psychological needs. In general, people change their attitude by learning. Adequate training and gradual integration of necessary knowledge make a hard job easier. These two concepts, change and learning, are essential for management to make a smooth transition from an old to a new technology. Any new IT creates a new set of behaviors between the users and the system, on one side, and between the individuals themselves, on the other side. Therefore, it is management's responsibility to identify what new behaviors are required as a result of new technology (Crabb 1993).

A notable study by Bhattacherjee (1998) addresses the questions of why and how management can influence its employees to use new IT. In that study, the author examines managerial incentives and controls that are linked to IT usage using a Principal Agent Model (PAM). The Principal-Agent-Model (PAM) describes the behavior of two parties involved in a business relationship in which the payoffs of one party (the principal) depend on the actions of the other (the agent). The agent (end-users) may act in a manner that is inconsistent with principal's (management) interest, resulting in an agency problem. The existence of such a problem might be for different reasons, such as management's inability to accurately predict end-users behaviors or management and end-users' differences in attitudes toward new IT. For example, management acquires IT to achieve organizational benefits (e.g., profits, productivity) and wants end-users to use the IT appropriately so that their goals are achieved (Leonard-Barton & Deschamps 1988). On the other hand, end-users value their individual benefits (e.g., career achievement, leisure) over management goals (Francik et al., 1991). As a result, the conflict of interests exist. One solution to this problem is that management could have a mechanism of incentives that would minimize the costs of motivating, monitoring and ensuring the end-users commitment.

Managers should be aware of end-users' perception of the new technology before the implementation process occurs and during the IT development process. Moreover, a successful management tracks the changes in end-user behavior after the implementation of a new IT. If the end-users feel comfortable with the new technology, they will use it in an effective manner. Management can influence end-users' attitude regarding new technology by establishing values and norms in the organization. The organization's culture plays a major role in unifying end-users' behavior, so in the long run, management can anticipate end-users' reaction to new technology. To

evaluate and predict end-users' behavior, management could examine end-users' past behavior in similar situations to understand patterns. The above ideas rise to the following propositions:

| | |
|---|---|
| P1: | Developing a positive attitude toward any new IT is negatively associated with end-users' resistance to change |
| P2: | Tracing the changes in end-user behavior is positively associated with acceptance and a successful implementation of new IT. |
| P3: | Management's recognition of end-user personality and behavior is positively associated with accommodation of any changes due to implementation of new IT. |
| P4: | There is a positive correlation between monitoring the end users' behavior during the IT development life cycle and the success of implementation of new IT. |

A positive attitude by the end-users toward a new IT could be materialized by establishing incentives and training programs, acknowledging the end-users personality traits, studying the past history of the end-users regarding their attitude toward a new IT and creating a profile for each end-user for future assignments. Moreover, a supportive management style, a clear expectation statement for the end-users, a unified culture tradition, acknowledging personal traits, studying the past experiences of the end-users, and examining the end-users behavior before and after the implementation process could help management in achieving the above premises. In addition to that, management might utilize both "use-case model" and prototyping techniques for studying the changes in the end-users behavior. For example, managers could utilize use-case model by making the end-users work under different situations or scenarios and then record their reactions and behaviors. Management can affect the end-users behavior toward a new IT in many ways. For example, training the end-users to be open minded and risk takers to accept new challenges. The use of "use-case model" through workshops also enables management to prepare the end-users for a new IT. The end-user involvement in the process of implementing IT through effective communication systems could gradually lead to make the necessary changes in the end-users behavior (Schwalbe, 2002). In addition to that, a good technical support system helps and encourages the end-users to make the necessary changes in their behavior.

## THE SOCIAL EFFECTS OF IT ON END-USERS' BEHAVIOR IN THE WORKPLACE

IT has extended its effect to every aspect of the employees' lives. The area most affected by IT is communication. New channels are established for fast, less-expensive, and more-inclusive communication. As a result, when employees have a better understanding of their responsibility, they might be more cooperative. There is an assumption held by many academia and managers that if employees are adequately informed about matters that concern them (e.g., using new IT) and they are allowed to make decisions relevant to their work, then there will be benefits for both managers and employees. On the other hand, if employees are not given sufficient information, then it is most likely that employees would not be able to carry out their responsibilities efficiently (Shadur, Kienzle & Rodwell 1999). Moreover, an effective management style takes into account the way

end-users receive its messages, because individual employees interpret messages differently. The failure or the misuse of IT occurs when managers are unclear about the expectations they have of their employees. They either narrow their focus and expect too little from employees, or they fail to define the new behaviors they expect once IT is implemented.

With the new IT communication, privacy becomes a concern for each participant. In many cases people have to pay a social price for new technology, that is, to sacrifice simplicity and sense of community. The privacy issue becomes the cornerstone not only for American people but also for the world at large. IT could be used to monitor and track what people are doing. Examples include how many keystrokes to enter per minute, how many calls they handle per hour, and whether their time online is spent at financial figures or bar figures (Greengard 1999). There is strong evidence that links electronic performance monitoring (EPM) with increased stress for employees. In their study, Aiello and Kolb (1995) found that monitored workers felt electronic observation made their jobs more stressful. This could lead to a reduction of job satisfaction, an increase of social isolation, and an increase in the perception that generating quantity is more important than producing quality work. Continuous monitoring may also reduce the opportunity for employees to socialize at work. This leads to the question of what happens when employees become physically and socially isolated from one another. However, management should be aware that if the workplace is full of such activity, then it is not only that the productivity of the employees might be negatively affected but also it might cause employees to leave the company. Privacy in the workplace is a very complex issue which includes management, end-users, IT, and legal issues, among others. However, a clear written privacy policy is a good start (Greengard 1999).

The workplace will not be restricted to any geographic constraint. According to International Telework Association & Council (ITAC) statistics, there were approximately 19.6 million teleworkers in the U.S. in 1999 and the number is growing at the rate of about 10% per year (Baffour & Betsey 2000). Moreover, the number of companies who offer telework options is growing in that as many as 64% of American companies allow employees to participate in some form of telework (Van Horn & Storen 2000). People can live anywhere, manage their jobs from home, and have more time to share with their families. Telework indeed might provide parents with more time to spend with their children, but is it focused time? Galinsky and Kim (2000) reported that the children whose fathers telework are more likely to report that their fathers have hard time focusing on them when they are together than children whose fathers do not telework. These children are also more likely to feel that their fathers work too much and place greater importance on their jobs than family life. In addition to that, they are more likely to feel that their fathers' work interferes with how they parent.

Telecommuting "virtual work" has brought new challenges that need to be managed, such as the challenge of trust between management and employees and the issue of loss of control from management's perspective. To address such concerns, management may need to change its style of operation in order to accommodate new methods of communication and interaction with employees. For example, management needs to have more trust and encouragement of employees so they can perform their tasks more efficiently (Harrington & Ruppel 1999, Venkatraman, Tanriverdi & Stokke 1999). As a result, management's role has evolved from that of "enforcement" to that of "coaching" or "facilitating" (Pratt 2000). Another concern for management in the teleworking environment is

the compensation package and the productivity measurement. One option could be that management might determine workload in terms of results or outcomes rather than number of hours (Baffour & Betsey 2000).

IT in the workplace allows employees more time to communicate with each other using tools such as e-mail and voice mail. Teleworking has made the role of the offices as places for people to communicate and socialize with their colleagues. However, a satellite network enables employees to feel a sense of community with their peers. In a sense, they have the feeling that they are in the same room. Such an effect strengthens the relationship between management and subordinates due to ease of communication access (Malone 1994). IT largely affects the workplace design in such a way that employees change the way in which they work. They have more autonomy, less dependency, but more interdependency. IT makes it easy to communicate with people from different cultures, since there is no need for personal interaction. IT eliminates some cultural barriers, such as gestures. Today, it is not necessary to interact with customers to conduct business; there is no need for face-to-face communication (electronic-commerce and mobile-commerce).

IT gives more freedom to employees in the sense that they can do the job easier, faster, and more efficiently. For example, written correspondence requires a supervisor's approval but electronic notes do not (Fulk & Boyd 1991). On the other hand, IT often overloads employees with information because it produces a large volume, which can exceed the employees' capability to handle. It is worthy to mention that the problems inherent in any information systems, such as navigation and cognitive overload, are multiplied on the Internet (Brandt 1997). The consequences of information overload might be job stress, tension, and low performance. However, when employees know how to use IT, they can reduce information overload by scanning, filtering, maintaining, and disseminating the information. In summing the following propositions are suggested:

| | |
|---|---|
| P5: | An effective communication environment positively affects the relationship between management and end-users. |
| P6: | Understanding the social effect of IT is positively associated with end-users' performance. |

An effective communication system might include internal newsletters, formal and informal meetings, social parties, and a reliable and open feedback system. Management might design a matrix that relates the message type to the appropriate communication media for each end-user to enhance the communication system in the organization. A real involvement of the end-users in the decision-making process leads to a strong and healthy relationship between management and the end-users. One can achieve the above premises by studying the use of IT by the end-users through surveys or observations. Management might collect data regarding the end-users' utilization of the IT in their social practices, in their communication with others, and in teleworking activities, among others. A clear policy regarding the usage of IT at the workplace for other than business activities could help in establishing a health relationship between management and end-users.

## END-USERS VERUS IT IN THE INFORMATION AGE

Generally speaking, IT is implemented within a social context that includes economic, political, cultural, and behavioral factors which differ greatly from one society to another and from one company to another. One reason for rejecting new IT by employees might be the lack of consideration of such differences (Harris & Davidson 1999, Rose & Straub 1998, Winston & Dologite 1999). For example, in Western countries, system developers tend to focus more on the technical side of the "system design" than on the human side. On the other hand, Japanese developers focus on the principle of "human design" (Bensaou & Earl 1998). In Japan, the aim of developing a system is to enhance the contribution of the users, not to replace them. The persons who are in charge of implementing IT must take the human side of the equation into consideration in every step of system development if their plans are to be successful. It is hard to understand the impact of human emotion on the success or failure of IT in the workplace; therefore, the human side of the IT equation should not be underestimated. IT will succeed if it meets the real needs of people.

Society has changed from industrial-to information-oriented. As a result, today's organizations deal with more people and information in the workplace rather than just technology. IT cannot do the job by itself; the other side of the equation must be there to complete the task. At the present time, IT does not know the term "judgement" because it lacks a true understanding of knowledge. On the other hand, people do have the ability to understand, reason, and create. This fact raises the question of whether IT improves the human ability to create, reason, and understand or simply helps employees perform computational tasks and manage information. Even though artificial intelligence (AI) is advanced, IT lacks the capability of interpretation and response to ambiguity. It does not go beyond its performance design. On the other hand, end-users have the capability of interpreting and responding to ambiguity.

Most of IT architecture only addresses the technology component, not the human aspect. Many IT projects fail because of human factors, not technological factors (Bradley 1998, Martinsons & Chong 1999, Raheb 1992, Schwalbe 2002). Organizations sometimes forget that end-users constitute and give meaning to technologies. Most managers get information from verbal discussions; therefore, the emphasis should be on information rather than on technology. One can not be an effective manager without caring about information, but one can be a fairly effective manager without caring a whole lot about Information Technology (Maglitta 1994). The employees' fear of IT replacing them forces employees to work harder to keep their job; however, this could cause "workaholism" (work to death), a phenomenon which affects the employee's attitude (Haas 1991). Some companies have tried to develop systems which focus on ergonomics, but they treat their employees only as users of systems and do not value them as complements or alternatives to the systems (Bensaou & Earl 1998). IT can help employees to perform their job in a better way. However, IT applications, in many cases, are misused or underutilized due the lack of understanding of the interdependency between IT and employees. A successful implementation of IT includes the right IT application to help the right end-users perform the right process (Martinsons & Chong 1999).

IT has a significant impact on organizational communication channels; yet, the human element will continue to play a crucial role. Naisbitt (1984) used the term "high tech/high touch"

in proposing that whenever a new technology is introduced into a society, there must be a counterbalancing human response or the technology will be rejected. He even believes that as the use of IT increases, the role of human interaction to insure the acceptance and successful implementation of the technology increases as well. Interpersonal communication skills are very essential for the success of IT. Person-to-person interaction will continue to be the most effective communication media, because managers want to see their employees and want to watch them work. The following propositions are suggested:

| | |
|---|---|
| P7: | The concept of "human design", that is to make use of the explicit knowledge of end-users, is positively associated with the success of IT. |
| P8: | The right combination of the end-users and IT is positively associated with the task success. |

Management could make use of the knowledge of its end-users by continuously monitoring the end-users progress in acquiring knowledge through surveys and qualified tests. Managers might create task/end-users' knowledge matrix that matches the right end-user who has the knowledge and the skills for the right task.

## CONCLUSIONS AND SUGGESTIONS FOR FUTURE WORK

The importance of this paper is that it provides normative guidelines that managers can use to establish a healthy and productive relationship between IT and the end-users. IT has positive and negative effects on end-users' behavior. It is management's responsibility to be aware of such implications. A need for establishment of a neutral party to foster a healthy relationship among management, IT, and end-user is a challenge and an opportunity for new specialists to advance in the 21st Century. More work regarding the effect of IT on human behavior, in general, and on end-users' behavior, in particular, is needed. For example, further studies of the effect of IT on end-user's personal life, privacy, and cognitive processes are needed. An extension to this paper would be to develop an empirical study to validate the stated propositions.

## REFERENCES

Agarwal, R., & Prasal, J. (1999). Are individual differences germane to the acceptance of new information technologies? *Decision Sciences*. 30 (2), 361-391.

Aiello, J., & Kolb, K. (1995). Electronic Performance Monitoring and Social Context: Impact on productivity and Stress. *Journal of Applied Psychology* . 80 (3), 339-353.

Ajzen, I. & Madden, T. (1986). Predicting of goal directed behaviors: Attitude, intentions, and perceived behavior control. *Journal of Experimental Social Psychology*. 22, 453-474.

Al-Khaldi, M. and Wallace, R (1999). The influence of attitudes on personal computer utilization among knowledge workers: The case of Saudi Arabia. *Information & Management*; Amsterdam; 36(4), pp. 185-204.

Ansel, D., & Dyer, C. (1999). A framework for restaurant information technology. *Cornell Hotel and Restaurant Administration Quarterly*. 40(3), 74-84.

Back, W. and Moreau, K. (2001). Information management strategies for project management" *Project Management Journal*; 32(1), pp. 10-19.

Baffour, G. & Betsey, C. (2000). Human Resources Management and Development in the Telework Environment. *U.S. Department of Labor Symposium on Telework and New Workplace of the 21st Century*. Xavier University, New Orleans, Louisiana. October 16, pp.17-21.

Bensaou, M. & Earl, M. (1998).The Right Mind-Set for Managing IT : Japanese and American Methods. *Harvard Business Review*. 76(5), 119.

Bhattacherjee, A. (1998). Managerial influences on interorganizational information technology use: A principal agent model. *Decision Sciences*. 29 (1), 139-162.

Bloodgood, J. and Salisbury, W. (2001). Understanding the influence of organizational change strategies on information technology and knowledge management strategies. *Decision Support Systems*; Amsterdam; 31 (1), pp. 55-69.

Bradley, J. (1998). Human computer interaction and the growing role of social context. *American Society for Information Science*. 24(3), 18-19.

Brandt, S. (1997). Constructivism: Teaching for Understanding of the Internet. *Communications of the ACM*. 40(10), 112-117.

Brynjolfsson, E. & Hitt, L. (1998). Beyond the productivity Paradox. *Communications of The ACM.*

Brynjolfsson, E. (1993). The Productivity Paradox of Information Technology. *Communications of the ACM*.

Crabb, S. (1993). Building a Better Workplace by Design. *Personnel Management*. 25(8), 20-25.

Davis, F. (1989). Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information technology. *MIS Quarterly* 13(3), 319-340.

Dasgupta, S., Agarwal, D., Ioannidis, A., & Gopalakrishman, S. (1999). Determinants of information technology adoption: An extension of existing models to firms in a developing country. *Journal of Global Information Management*. 7(3), 30-40.

Fink, D. (1998). Guidelines for the successful adoption of information technology in small and medium enterprises. *International Journal of Information Management*. 18 (4), 243-253.

Francik, E., Rudman, S., Cooper, D., & Levine, S. (1991). Putting innovation to work: Adoption strategies for multimedia communication systems. *Communications of the ACM*. 35(12), 52-63.

Fulk, J., & Boyd, B. (1991). Emerging Theories of Communication of Organizations. *Journal of Management*. 17 (2), 407-446.

Galinsky, E. & Kim, S. (2000). Navigating Work and Parenting by working at Home: Perspectives of Workers and Children whose Parents Work at Home. *U.S. Department of Labor Symposium on Telework and New Workplace of the 21st Century*. Xavier University, New Orleans, Louisiana. October 16, pp.37-38.

Greengard, S. (1999). Privacy: An increasingly public matter. *Workforce*. 78(10),120- 122.

Haas, R. (1991). Strategies to Cope with a Cultural Phenomenon-Workaholism.*Supervisory Management*. 36 (11), 4.

Harrington, S., & Ruppel, C. (1999). Telecommuting: A test of trust, competing values, and relative advantage. *IEEE Transactions on Professional Communication*. 42(4), 223-239.

Harris, R. & Davidson, R. (1999). Anxiety and involvement: Cultural dimensions of attitudes toward computers in developing societies. *Journal of Global Information Management*. 7(1), 26-38.

Hasan, H., & Ditsa, G. (1999). The impact of culture on the adoption of IT: An interpretive study. *Journal of Global Information Management*. 7(1), 5-15.

Ives, B., and Olson, M. (1984). User involvement and MIS success: A review of research. *Management Science*. 30 (2), 586-603.

Karahanna, E., Detmar, S. & Chervany, N. (1999). Information technology adoption across time: A cross sectional comparison of pre-adoption and post adoption beliefs. *MIS Quarterly*. 23(3), 183-213.

Karahanna, E. & Straub, D. (1999). The psychological origins of perceived usefulness and ease-of-use. *Information & Management*. 35(4), 237-250.

Leonard-Barton, D., & Deschamps, I. (1988). Managerial influence in the implementation of new technology. *Management Science*. 34(10), 1252-1265.

Lin, W. and Shao, B. (2000). The relationship between user participation and system success: A simultaneous contingency approach. *Information & Management*; Amsterdam; 37(6), 283-295.

Maglitta, J. (1994). Information ... Please. *ComputerWorld*. January 10. 25-27.

Mahmoud, E., & Rice, G. (1998). Information systems technology and healthcare quality improvement. *Review of Business*. 19(3), 8-12.

Mallalieu, G., Harvey, C., & Hardy, C. (1999). The wicked relationship between organizations and information technology. *Journal of End User Computing*. 11(4), 40-50.

Malone, R. (1994). Wireless Communications with a Human Face. *Communication News*. 36.

Martinsons, M., & Chong, P.K. (1999). The influence of human factors and specialist involvement on information systems success. *Human Relations*. 52(1), January 123-152.

Mathieson, K. (1991). Predicting User Intentions: Comparing the Technology Acceptance Model with the Theory of Planned Behavior. *Information Systems Research*. 2(3), 173-191.

McCune, J. (1998). The productivity paradox. *Management Review*. 87(3) 38-40.

Montealagre, R. (1999). A temporal model of institutional interventions for information technology adoption in Less-developed countries. *Journal of Management Information Systems*. 16(1) 207-232.

Moore, G. & Benbasat, I. (1991). Developing of an Instrument to Measure the Perception of Adoption an Information Technology Innovation. *Information Systems Research*. 2(3), 192-222.

Myers, D., Mitchell, T., Larson, J., & Luthans, F. (1993). *Human Behavior in Organizations*. New York, NY. McGraw-Hill, Inc.

Naisbitt, J., (1984). *Megatrends : Ten New Directions Transforming Our Lives*. New York, NY. Warner Books, Inc.

Ozer, M. (2001). User segmentation of online music services using fuzzy clustering. *Omega*; Oxford; Apr 2001, 29(2), pp. 193-206.

Prager, K., & Overholt, M. (1994). How to Create a Changed Organization: Successful Implementations. *Information Systems Management.* 64-70.

Pratt, J. (2000). Telework and Society- Implication for Corporate and Societal Cultures. *U.S. Department of Labor Symposium on Telework and New Workplace of the 21st Century*. Xavier University, New Orleans, Louisiana. October 16, pp.30-36.

Raheb, S. (1992). There's no excuse for failure. *Canadian Manager*. 17(3), 18-19.

Rogers, E. (1995). *Diffusion of innovations*. 4th ed. New York, The Free Press.

Rose, G., & Straub, D. (1998). Predicting general IT uses: Applying TAM to the Arabic world. *Journal of Global Information Management*. 6(3), 39-46.

Schwalbe, K. (2002). *Information Technology Project Management*. 2nd ed. Course Technology

Shadur, M., Kienzle, R., & Rodwell, J. (1999). The relationship between organizational climate and employee perceptions of involvement. *Group and Organization Management*. 24(4), 479-503.

Strassmann, P. (1999). The Productivity paradox. Paul Strassmann@buttler Group Journal No. 2., October. http://www.strassmann.com

Strassmann, P. (1997). Has Business Squandered the IT Payoff? Computer Finance.

Tolsby, J. (1998). Effects of organization culture on a large scale IT introduction effort: A case study of the Norwegian army's EDBLF project. *European Journal of Information Systems.* 7(2),108-114.

Van Horn, C. & Storen, D. (2000). Telework: Coming of Age? Evaluating the Potential Benefits of Telework. *U.S. Department of Labor Symposium on Telework and New Workplace of the 21st Century.* Xavier University, New Orleans, Louisiana. October 16, pp.2-5.

Venkatraman, N., Tanriverdi, H., & Stokke, P. (1999). Is it working? Working from home at Statoil, Norway. *European Management Journal*. 17(5), 513-531.

Winston, E., & Dologite, D. (1999). Achieving IT infusion: A conceptual model for small businesses. *Information Resources Management Journal*. 12(1), 26-38.

World Information Technology and Services Alliance (WITSA) Report. (2000). Digital Planet. The Global Information Economy. 2, Executive Summary. http://www.witsa.org/

World Information Technology and Services Alliance (WITSA) Report. (1998). Digital Planet. The Global Information Economy. 1, Executive Summary. http://www.witsa.org