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Table of Contents

THE RELATIONSHIP BETWEEN ORGANIZATIONAL CITIZENSHIP BEHAVIOR AND KNOWLEDGE MANAGEMENT

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ABSTRACT

This study investigates the relationship between organizational citizenship behavior (OCB) and knowledge management (KM). OCB has typically served to describe the behavior of employees in organizations. In particular OCB focuses on the fact that intrinsic employee rewards are attributed to those actions above and beyond formal role requirements.

It is interesting that OCB has a correlation with the concept of knowledge management. KM has typically been thought of as the collection of technological assets and managerial policies that compensate for information failures in organizations. The popularity of KM stems from the fact that organizations have become too big for personal information sharing to take place. Throughout the past several decades, information systems practices have become sufficiently developed to accomplish production of information, but problems arise when key individuals will not share information with those who stand to benefit from its discovery.

Thus, the principle of OCB, or lack thereof, governs the success of KM. This study serves to investigate this phenomenon in a variety of organizational settings.

FACTORS INFLUENCING THE USAGE OF GROUPWARE

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ABSTRACT

Groupware applications such as e-mail, electronic bulletin boards, instant messaging, and computer conferencing are important tools for increasing office communication and productivity, but relatively little is known about the factors involved in choosing to employ this technology. Selected variables from the Technology Acceptance Model were used to form a questionnaire administered to 409 individual employees in Fortune 500 companies in S. Korea, and results showed that subject norms and individual, task, and organizational factors can be used to predict the use of groupware.

Although the results of this study show that subject norm has a negative relationship with users' perceived ease of use on groupware use, this relationship is meaningful and significant. When skills and ability to manage groupware applications are not present, users are willing to listen to others, get help from others, and appreciate pressure from management and colleagues. However, when they know how to use and manage groupware applications better, or think learning groupware is easy, then social pressure affects them negatively. Thus, companies should be careful when they use groupware by choosing proper strategies and tactics for different levels of users, because mandating technology use against the explicit will of an individual may result in negative consequences. Managers should promote voluntary acceptance of information technologies (Agarwal, 2000). Users who are novices at groupware should be encouraged by management and supported by highly skilled technical staffs. Finally, high level users should be classified and managed carefully to promote their use of groupware applications. Both task equivocality and task interdependence to the perceived ease of use on groupware are not supported. This implies that the intensity of ambiguity, misunderstanding, or information and resource sharing in their tasks are not significantly related to users' perception of ease of use. Again, task equivocality and task interdependence do not make groupware easier to use. Groupware users are encouraged partially by task characteristics, by organizational support, and their own previous experience with similar information technology. Both the task equivocality and the task interdependence to perceived usefulness show that whenever users are confused with their tasks, they think groupware is useful. That is, they perceive that groupware can be used to help them remove task equivocality and to enhance collaboration in their workplace. They would use groupware to enhance the clearance of communication and better understanding within their workplace, for perceived usefulness is significantly and positively related to the actual usage of groupware applications. When users work closely with other members in their workplace by sharing information and resources, they would also use groupware to enrich their collaboration. The greater the ambiguity and interdependence of users' tasks, the higher the perceptions of users to think groupware is useful for their tasks. This result supports the findings of the Dishaw and Strong (1999) study.

The findings from this study have important implications for researchers and practitioners who are using groupware or are considering using the technology. In terms of research, this paper provides further evidence of the appropriateness of using individual factors, task-related factors, organizational support, and subject norm that have been used in prior studies of IT acceptance. When considering use of the technology, companies should carefully examine external factors that are significantly related to users' perceptions of groupware. For example, in promoting groupware usage, companies can provide users with more experience in similar applications on the Web and provide better technical support.

Although results of such a survey might not be completely generalizable to organizations in the United States and elsewhere in the world, at least one study (Kim, 1997) has shown that there is a reasonable level of agreement between executives in the United States and S. Korea on the importance of many key information technology issues. Conclusively, this study shows that the intention to use groupware can be predicted by individual, task-related, and organizational factors, as well as subject norm.

ESPIONAGE VIA MALWARE

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ABSTRACT

Can viruses, worms and other malware be used for espionage? The idea to do this has been around for a long time and now it is even easier to do than in the past. There is evidence that worms and other malware are increasing being used in corporate and governmental espionage. This article starts by describing malware. Examples of espionage malware are given next. Finally, conclusions are given. Although the conclusions may be anticipated, this relatively new threat must be addressed.

INTRODUCTION

Magruder and Lewis (1992) wrote that it might be possible to use viruses to perform espionage activities. It is much easier to do this in today's world. In 1992, a potential hacker had only viruses to work with. Today, a potential hacker has viruses, worms, email and web pages. All of these may be used to cause malware to be used for espionage as well as other activities.

MALWARE

Wikipedia (2006) defines malware as:

> ***Malware*** *(a portmanteau of 'malicious software') is software designed to infiltrate or damage a computer system, without the owner's consent. The term describes the intent of the creator, rather than any particular features. Malware is commonly taken to include computer viruses, Trojan horses, and spyware. (Wikipedia,2006)*

This definition would include email messages that have software attached that is meant to infiltrate or damage the user's computer system. Worms would also be included.

The term infiltrate would mean to gain access to the user's computer and leave a "presence" which would allow later contact from the original perpetrator (hacker). The software "presence" could wait for an event to occur (a command from the hacker) or look for information on the computer it is on, or the network connected to this computer. The damage caused could be many things, but in this paper, the stealing of information is the main focus. This may be part of the infiltration or the damage caused by the malware. In either case, the user will rarely know they have been victimized.

Pescatore states:

> *This story (www.washingtonpost.com, 2006) points out one of the biggest problems in how many enterprises reacted to worms and phishing attacks: they focused on patch management and the elusive "user education" and did not follow-up to see if any malicious payloads had been installed. Checking to see if their computers are patched, and blocking access to known phishing URLs is just part of what has to happen. Looking for dangerous software on internal machines needs to be part of continuous vulnerability management. There are plenty of scanning and network behavior analysis tools that provide this capability.*

Xterminator briefly describes Multipartite Virii which have more than one way of infecting a program. The malware of today can have multiple parts as well. One part may be a "regular" virus. The other part may be the infiltrator or the part that searches for information to be stolen. The "regular" virus portion may be detected. The other part may not be detected and may continue it's original purpose (find and steal a company's proprietary information) (Xterminator, 2005).

EXAMPLES

"The Israeli business community has been rocked recently by a scandal involving trojan horse software which sends out confidential company documents from an infected computer (Unknown, 2005). Chick states he sees a pattern, "…development from viruses that were nothing more than childish pranks to corporate and national espionage." (Chick). The Caligula Virus steals PGP (Pretty Good Privacy) keys and sends them to another site on the Internet (Unknown2).

China may be using worms to spy on the United States. A Trojan horse program has been discovered that may have come from a server located in China (Unknown3). The program, called Myfip, looks for CAD/CAM documents and other sensitive files (Vardi, 2005).

The latest form of malware, Spyware, may also be used for espionage. An author found parts of his unfinished book on the Internet even though he had not shared any part of the book with anyone else. When he found this out, "…he called the police and found out that it was stolen by his former son-in-law, who had use the 'Rona' Trojan horse program to swipe it." (Millard, 2005).

This tells us that much more of the malware being developed is looking for information. Consider the situation where a firm is in an industry where it makes bids for projects. These bids are based upon cost and profit information the firm has generated relative to the job. A worm could easily be developed that would search out this organization's computer network and search for this information. Once found, the information could be sent to a competitor (who may have hired the developer of the worm) or it could be changed. Either way, the competitor would gain an advantage. If the information is just stolen, the competitor can use the information in making their bids. If the information is changed, then the firm will make a bid on bad data. Their bid will either be too low (to make a profit) or too high (not in consideration).

IMPORTANCE AND WHAT CAN WE DO?

People using the Internet have sort of "gotten used to" the threats of the Internet. They have become almost complacent about them. They should be running updated anti-virus and anti-spyware software, but they often put it off to a later time. They don't make backups as often as they should. This needs to change. These threats are real and becoming more dangerous.

In the past, these forms of malware have spread throughout the world, and the damage they have done has been minimal compared to what these new targeted programs can do. Corporate secrets, military plans and much more information may be stolen and used by competitors and countries.

An increased diligence must become our new attitude. Since these new threats are coming along with malware we are already familiar with, we must re-double our efforts to defeat them. It may sound trite, but users must update their scanners often, and run them very often. Patches to operating systems and applications must be applied as son as they become available. This is the same advise experts have been giving users for years. It is now more important that they heed the advice.

CONCLUSION

New threats are coming into our computers using old methods. The payloads of these threats are much worse than they have been before. All users of the Internet must be aware of them and do their part in preventing them from wreaking havoc on our information system. Can viruses, worms and other malware be used for espionage? The answer is an unequivocal yes. Users of the Internet must prepare themselves for this new onslaught or suffer greater losses than before.

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A SIMPLE TOOL TO DETECT AND ILLUSTRATE BUFFER OVERFLOWS IN CGI PROGRAMS

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ABSTRACT

Buffer Overflows are explained. The specific case of overflowing a predefined area of memory (a buffer) in CGI programs is examined. A general description of buffer overflows is given. This is then extended to CGI programs. A simple tool is described which can be used to detect if and where the overflow occurs (required number of characters typed into the buffer to cause the program to crash). This tool can also be used to illustrate the concept in a classroom.

BUFFER OVERFLOWS

A buffer overflow occurs in a program when: (1) a specified amount of memory is allocated (say 20 characters); (2) no checking on the amount of characters to be placed into the buffer is performed; (3) the number of characters put into the buffer is greater than the allocated amount (say 40 characters). This results in the buffer being full and characters being written to memory next to the buffer, overwriting what was previously there. The area of memory after the buffer may contain data or program commands. If these are overwritten, then the program will crash or not work correctly.

There are two main reasons for exploiting a buffer overflow: (1) just cause the program to crash; and (2) cause the program to crash but execute additional commands that may give the hacker additional access to the exploited computer. In order for the latter to occur, there must be commands and/or variables used in commands after the buffer. If these commands and/or variables are overwritten correctly, then arbitrary commands may be executed by the hacker.

Donaldson (2002) gives steps necessary for a buffer overflow attack:

1. A buffer overflow vulnerability must be found discovered, or identified.
2. The size of the buffer must be determined.
3. The attacker must be able to control the data written into the buffer.
4. There must be security sensitive variables or executable program instructions stored below the buffer in memory.
5. Targeted executable program instructions must be replaced with other executable instructions." (Donaldson, 2002, p. 12).

Hurley, indicates that this problem of buffer overflows will be with us perhaps until 2012 (Hurley, 2002). There is just so much code out there already with buffer overflows hidden in the programs.

SIMPLE EXAMPLE

This simple C code (written for Linux) illustrates the above concepts very well (this code is adapted from code one of the authors had on their Linux system for several years. It is used for in-class demonstration purposes. The original author is unknown):

```
#include <stdlib.h>
#include <stdio.h>
main()
{
  char command[100]="w";
  char name[20];
  printf("Please enter your name: ");
  gets(name);
  printf("Hello, %s, This is what is happening on the system: \n",name);
  fflush(stdout);
  system(command);

}
```

This simple program allocates a 100-character buffer and puts the character "w" into the buffer. This is the Linux command that shows who is on the system and what they are doing. The command in this buffer will be executed by the system command at the end of the program. Next, the program allocates a 20-character buffer which will hold the user input, which they will type in as a result of the "Please enter your name: " prompt. The gets command receives the user input and places it in the name buffer.

The problem is that "gets" does not perform any automatic checking as to the length of input. It will accept any number of characters as input and place the contents in the name buffer. If the number of characters inputted are more than the size of the buffer, then the buffer overflow occurs. Notice that the command buffer is allocated before the name buffer. One would think this would be the order in memory. However, this is not true. The command buffer is allocated first in memory and then the name buffer. Thus, if the name buffer is overflowed, the extra characters are written in the command buffer. This example assumes the hacker does not have access to the source code.

Executing the program with appropriate input, produces the output:

```
v2:~/c$ ./testoverflow
Please enter your name: user2
Hello, user2, This is what is happening on the system:
 11:55am  up 151 days,  3:11,  1 user,  load average: 0.00, 0.00, 0.00
User     tty      From              login@  idle   JCPU   PCPU  what
user2    ttyp0    c-68-63-221-144. 10:56am             1        ./testoverflow
v2:~/c$
```

The program worked correctly. It requested the user's name, printed out the "Hello" string and then executed what was in the command buffer, "w" in this case. User2 is on the system, executing the testoverflow program.

Now suppose the user types in more than 25 characters:

```
v2:~/c$ ./testoverflow
Please enter your name: 1234567890123456789012345
Hello, 1234567890123456789012345, This is what is happening on the system:
sh: 12345: command not found
v2:~/c$
```

The user has typed in 25 characters (plus the return key). Notice, the program gladly accepts the input and prints it in the "Hello" string. However, the system command did not operate

correctly. The w command has been overwritten by "12345" which the interpreter, sh, does not know how to execute. The program crashed. However, the hacker has not gained any advantage, yet. The hacker knows how long the buffer is. The extra 5 characters that sh tried to execute indicates where the buffer ends and the overflowing starts.

Next the hacker would try to overflow the buffer, but add a command at the end of the overflow characters. Here is the result:

```
virus2:~/c$ ./testoverflow
Please enter your name: 1234567890123456789bash
Hello, 1234567890123456789bash, This is what is happening on the system:
bash-2.04$
```

The program executed, printed the "Hello" string, and then executed what was in the command buffer (bash) in this case. In Linux, bash is the most used shell (interface between the user and the operating system).

The hacker now has a different shell than the one in which the original program was executed. In this example, the new shell does not provide the hacker any elevated privileges, but it illustrates the process.

CGI PROGRAMS

Common Gateway Interface (CGI) programs allow execution of programs over the Internet. Typically, a user retrieves a web page that has textboxes, etc., where the user can type in information. When completed, the user clicks on a submit button and the information is sent to a program residing on the server that processes the information (updates a database, updates a shopping cart, etc). The user may have to log in or not. If the user does not have to log in, then it is possible they may be able to execute the program and exploit a buffer overflow anonymously. This is very similar to the above example. However, there are differences.

The administrator puts most web pages that are to be made available to the public in the proper directory. The same is true for any CGI programs. The administrator should check these programs to ensure they work properly. Under some configurations, web serves allow regular users to publish web pages and use CGI programs. The administrator is responsible for these programs as well.

The authors are developing a tool (called WebBuf) which would automate the process of testing a CGI program to see if it has a buffer overflow problem. This assumes that the tester does not have the source code for the program to be tested. It will allow the tester to incrementally add characters to the input supplied to the CGI program. Thus, the point where a buffer is "overflowed" (even by one character) is easily determined. WebBuf can be used to determine whether or not any additional privileges may be gained (by adding commands to the buffer overflow input).

WebBuf can also be used in the classroom to illustrate the concept of buffer overflow in CGI programs. Students understand the concept better if they have a concrete example.

WebBuf is written in Perl and uses the LWP module. The tool operates by "posting" the test information to the CGI program. The LWP module allows the perl program to "act" as if it is a form on a web page, which a user has filled out. Since, the form is inside of the program, the characters to be sent to the CGI program are easily generated. The above example was a very simple one and crashed with only a few characters. WebBuf can be told to use thousands of characters if necessary. In addition, characters representing commands to be executed after the buffer is overflowed are easily inserted.

CONCLUSION

Buffer overflows occur when too much information is given to a program. This applies to a "regular" program and a CGI program. CGI programs may be more of a problem as they are more available to the public (available on a public web server). A tool used to test for buffer overflows in CGI programs may prove very helpful to administrators who are responsible for all web content (including CGI programs) that are available on their web servers. The source code for this simple tool is available from the authors.

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WORK, SCHOOL, AND COMPUTER OWNERSHIP

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ABSTRACT

Diffusion of computer ownership and use was a controversial topic in the latter half of the 1990s. Concerns were expressed that the increasing role of computers was creating a "digital divide" in which wealthier and better educated households would have full access to the opportunities provided by computers while the poor, the less educated, and particularly minority households would not have access to these opportunities. More recently, the penetration of computers in lower income households and the penetration of computer use into the vast majority of elementary and high schools has lead some to suggest that the "digital divide" was merely a temporary stage in the normal pattern of adoption of new products (Compaine, 2001). Because of this controversy there is good reason to examine the factors determining computer ownership patterns among households and the ways in which these patterns are changing.

This paper examines the factors influencing household computer ownership in the United States with particular emphasis on the impacts of computer use at work and computer use by K-12 students at school on the household computer ownership decision. We find that both computer use at work and student use of computers at school have strong positive impacts on the rate of household computer ownership.

EXPECTED DETERMINANTS OF COMPUTER OWNERSHIP

The computer ownership decision can be viewed as an example of product diffusion. Studies of product diffusion suggest that high income households are generally first to adopt new technology. In addition, those with higher educational attainment are generally viewed as more willing to try new products and accept innovation (Ironmonger, et. al. 2000). In the case of adoption of computer technology in organizations, studies have shown that familiarity with similar technology tends to be an important factor in determining which organizations will adopt a new technology first (Caselli and Coleman, 2001). It is well known that there is some degree of computer presence in virtually all K-12 schools in the U.S. today. However, many question the extent and effectiveness of computer use in the typical school (Attewell, 2001). Arguably, extensive computer use at school should translate into both comfort with computer technology and understanding of the usefulness of computers and this should positively influence household computer ownership decision. In addition, basic statistics on home computer ownership indicate that the rate of ownership in minority households trails that of white households and this has raised concerns of a "racial digital divide" (Mack, 2001).

DATA

This study is based upon a sample from the October, 2003 survey of computer use conducted jointly by the US Department of Labor Statistics and the Census Bureau as a special supplement to the Current Population Survey. For the purposes of this study a sample of 9 percent of the usable responses was randomly selected.

The dependent variable for this analysis is a dichotomous variable whose value is one if a household owns a computer and zero otherwise. Independent variables include common demographic characteristics such as household income, geographic region of the household,

education level and race/ethnicity. Measurement of the last two variables is complicated by the fact that these are characteristics of individuals and not households. For purposes of our analysis, the highest level of educational attainment by any household member is used as the measure of education level. In the race/ethnicity categories, households with members reporting differing race/ethnicity values are recorded as households of mixed race. Due to limited observations in some ethnic categories, only the categories of White, African American, White Hispanic, and Other or Mixed Races are used. Income is reported in a set of ranges in this data set (see Table 1). Based upon the discussion above, we would expect *higher income and higher educational attainment to be associated with greater computer ownership and would expect minority households to have lower computer ownership levels than white households.* Other demographic variables modeled include household size and whether there is a telephone in the home. Since the lack of a telephone is likely to preclude the use of the internet, we would expect *the presence of a phone to have a positive effect on the rate of computer ownership.*

Our target independent variables relate to computer use at work, and computer use at school by K-12 students in the household. The survey recorded, at the individual level, whether each worker used a computer at work. For our analysis, any household with at least one individual using a computer at work is listed as a household with computer use at work. Even if an individual does not use a computer herself, the extensive use of computers in her workplace might contribute to more familiarity with computers or a greater perception of their value. To measure this effect, rates of computer use by industry and by occupation were calculated. For each household, the highest computer use rate of any industry in which a household member works is reported as the Industry Computer Use Rate and a similar statistic is generated for the occupations. As noted above, studies of diffusion of technology would suggest that individuals who use a computer at work, or who observe the use and usefulness of computers in their work environment, are more likely to purchase computers for their homes. Thus, we expect *computer use at work and working in an industry or occupation with extensive computer use all will have a positive effect on the rate of computer ownership.*

The survey recorded, at the individual level, whether a student used a computer at school. We separate households into three groups, those with no K-12 students, those with one or more students but with no students using a computer at school, and those with at least one student who uses a computer at school. Based upon the diffusion literature and past studies of computer use, *we expect the presence of students to positively influence computer ownership and the presence of students who use a computer at school to cause a still higher rate of computer ownership*.

Summary statistics for the set of data are presented in the last three columns of Table 1. For dichotomous and categorical variables the frequency of each category and percent of the sample it represents are shown. For the interval variables, mean values are shown.

MODEL AND RESULTS

The target variable of our analysis is dichotomous and thus requires transformation to place it in a form that can be approximately normally distributed. A frequently used regression technique that produces maximum likelihood estimates for equations with dichotomous dependent variables is the logit function (Green, 1997). In essence, the logit function uses the log of the odds ratio (the ratio of the probabilities of the two values of a dichotomous variable) as the

Table 1
Determinants of Household Computer Ownership Descriptive Statistics and Model results

	Logistic Regression Model Results			Descriptive Statistics		
				Binary		Cardinal
	Coefficient	Ho Probability		Frequency	Percent	Mean
Intercept	-1.0755	<.001	*			
Houshold (HH) Work Characteristics						
Use Computer at Work	0.5964	<.001	*	2090	52.3%	
Industry Computer Use rate	0.7118	0.005	*			0.471
Occupation Computer Use rate	0.5601	0.021	*			0.483
Student Characteristics						
Students in HH - No School Use	-0.0737	0.750		162	4.1%	
Students in HH - With School Use	0.8712	<.001	*	1064	26.6%	
No Students in HH				2771	69.3%	
Household Income						
Greater than $100,000	0.7551	<.001	*	444	11.1%	
Between $50,000 and $100,000	0.4172	<.001	*	1164	29.1%	
Between $30,000 and $50,000				895	22.4%	
Between $15,000 and $30,000	-0.4481	<.001	*	805	20.1%	
Less than $15,000	-0.5892	<.001	*	689	17.2%	
Highest Education Level in HH						
Graduate Degree	0.5811	<.001	*	538	13.5%	
Undergraduate (4 Year) Degree	0.2101	0.095		892	22.1%	
Come College or 2 Year Degree				1164	29.1%	
High School	-0.6984	<.001	*	1058	26.5%	
Less than High School	-1.5083	<.001	*	355	8.9%	
Geogrphic Region						
Northeast	0.0949	0.429		847	21.2%	
Midwest	-0.0259	0.818		1005	25.1%	
South				1191	29.8%	
West	0.2862	0.016	*	954	23.9%	
Race						
White				3006	76.1%	
African American	-0.7564	<.001	*	353	8.8%	
White Hispanic	-1.0611	<.001	*	252	6.3%	
Other or Mixed Races	-0.1991	0.188		386	9.7%	
Other Demographic Characteristics						
Household Size	0.0727	0.105				2.53
Telephone in Home	0.9616	<.001	*	3820	95.6%	
Dependent Variable						
HH Owns a Computer				2611	65.3%	

* Ho rejected at .05 level based on Chi-Square test results.
NOTE: Model Likelihood Ratio Test Chi-Square = 1544 with 21 D. F. Significant at the .0001 level.
Model correctly predicts 84.7% of cases versus 65.3% with no model.

dependent variable. Standard regression is performed on this transformed value. For this study, the odds ratio is the probability of a household owning a computer divided by the probability of the household not owning a computer. Coefficients from logistic regression must be interpreted cautiously since the magnitude of their impact varies as the mean probability of an event varies.

Logistic regression produces a series of Chi-Square statistics which measure the overall fit of the model and the significance of coefficients on the individual independent variables. Another measure of overall fit is the improvement in correct predictions of computer ownership. With no information, we would guess that each household owns a computer and would be correct 65.3 percent of the time versus 84.7 percent correct classifications with the model.

Review of the model results in Table 1 indicates that virtually all of the variables in the model were of the expected sign and were statistically significant. Of the variables hypothesized to affect computer ownership, only the presence of students without any computer use at school had an unexpected impact, but this coefficient was not statistically significant.

Table 2
Estimated Impact of Factors Affecting Computer Ownership
(Percentage Change form Mean Level)

	Probability of Ownership	Difference from Mean Probability
BASE ESTIMATE	65.3%	0.0%
Effect of		
No Computer Use at Work & in Low Use Job	41.5%	-23.8%
Student Using computer at School	81.8%	16.5%
Household Income		-65.3%
Greater than $100,000	80.0%	14.7%
Between $50,000 and $100,000	74.1%	8.8%
Between $30,000 and $50,000	65.3%	0.0%
Between $15,000 and $30,000	54.6%	-10.7%
Less than $15,000	51.1%	-14.2%
Highest Education Level in HH		
Graduate Degree	77.1%	11.8%
Undergraduate (4 Year) Degree	69.9%	4.6%
Some College or 2 Year Degree	65.3%	0.0%
High School	48.4%	-16.9%
Less than High School	29.4%	-35.9%
Race		
White	65.3%	0.0%
African American	46.9%	-18.4%
White Hispanic	39.5%	-25.8%
Geographic Region		
West	71.5%	6.2%
Other Demographic variables		
No Telephone at Home	41.9%	-23.4%

To ease the interpretation of the impact of the various independent variables, Table 2 shows how each individual coefficient would affect the probability of a household owning a computer if that household were otherwise at the mean probability of ownership (65.3 percent). The results suggest that student computer use at school has a strong positive impact (over 15 percent) on the likelihood that a household will own a computer. Not using a computer at work and working at a low use workplace (defined as working in an industry and occupation where use is 30 percent below the mean value) had an even greater negative impact on computer ownership (nearly 24 percent). Income, education, and race/ethnicity also impact ownership in the expected fashion.

SUMMARY

This study has examined factors affecting household computer ownership. The presence of K-12 students who use a computer in school was found to have a significant positive impact on the likelihood of household computer ownership. In addition, the presence of an adult in a household who uses a computer at work is found to have a strong positive effect on the likelihood of the household owning a computer. Expected positive effects of household income and education level were also found. With respect to race and ethnicity, African American and Hispanic households were found to be less likely to own computers. In addition, African American and Hispanic workers are statistically substantially less likely to use computers at work or work in industries and occupations where computers are used extensively. These factors as well as lower mean income and education levels for these groups are aggravating factors contributing to the gross differentials that have been observed in computer use across race and ethnicity.

Overall, this study suggests that substantial progress is being made in bridging the "Digital Divide" through computer use in school. However, computer use at work is an important factor in the transfer of computer technology to the household. As the price of computers falls, experiences outside the home providing the technological comfort need to purchase and use computers are increasingly important factors in household computer ownership decisions.

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MOBILE TV BROADCASTING TO YOUR CELLULAR PHONE: TECHNOLOGY CHOICE AND USER PERCEPTION

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ABSTRACT

New multimedia service, mobile TV, will be introduced in the U.S. cellular market. Cellular phone users can enjoy watching TV through their cellular phone anytime and anywhere. There are currently three competing technology standards in the world: DMB in Korea, DVB-H in Europe, and MediaFLO in the U.S. While DMB has already launched in Korea with two platforms (satellite and terrestrial), DVB-H and MediaFLO are still in the experiment stage. There are two different ways to watch portable TV. One way is the 3G wireless video-clip service, and the other is podcasting with video iPod. In the first part of this paper, the authors explain these three mobile broadcasting technologies and their alternatives (3G videocasting and podcasting), and provide survey outcome about potential users' perception to those technologies at the end of the paper.

IMPROVING THE QUALITY OF INFORMATION SYSTEMS PROJECT TEAM DELIVERABLES: THE USE OF INCENTIVES AND RESULTS ACHIEVED

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ABSTRACT

During the past eight years, interventions to improve team process adapted from the Software Engineering Institute's quality measures and incentives to increase the effectiveness of the interventions have been applied. The quality of deliverables and perceived effectiveness of the interventions has been assessed both through a questionnaire and evaluation of project deliverables. The project team environment is an academic one, but senior IS majors in this capstone course work with local companies to specify a systems solution to a real business problem. The quality of the projects and the team process experience has proved valuable during job searches and according to alumni, valuable in their subsequent careers.

Teams formulate contracts specifying conduct and performance expectations. They must also specify conditions under which a member must be terminated. Teams must hold a formal project status review meeting weekly and the agenda and minutes of the meeting are graded. During each formal meeting, each student must submit an individual time log to be approved by the team. The individual time logs are posted automatically to the work plan, using a multiple worksheet spreadsheet. Team process accounts for a third of the project grade. The contract, weekly meeting, and time logs minimize "free loading" in the academic environment in the same way these techniques insure contribution in professional environments. Students are aware that their peers will score their contribution at the end of the quarter and that this peer score will be considered in their individual project grade.

Prior to a deliverable being submitted for grading, each team member must review the deliverable using a prepared peer review checklist. A deliverable is graded in version 1 but may be resubmitted for grading when all needed revisions are made, thus providing an incentive to understand deliverable flaws and be able to correct them. The version 1 score is averaged with the final version score. Further, peer reviews are taken seriously because they graded on thoroughness and accuracy. The grade received is not a group grade but an individual grade. This grade provides an incentive to review carefully. The peer review process minimizes the number of revisions required for an acceptable quality deliverable.

Project teams maintain a web site, and this web site becomes the team's "legacy." The web site is a powerful incentive to take pride in the project. It is often used on resumes and is referenced by subsequent project teams. The most recent incentive is a project complexity level. A level of complexity is assigned to the systems request. Only projects with a level of 3, on a scale of 1 to 3, may receive an A. The highest grade for a complexity of 2 is a B; for a 1, C.

Project team web sites will be highlighted to assess the quality of project deliverables. Quantitative results from team surveys will also be presented.

THE SHIFTING ROLE OF A UTILITY COMPANY CHIEF INFORMATION OFFICER: A FIFTEEN YEAR LONGITUDINAL STUDY OF LOSING BATTLES

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ABSTRACT

In the early 1990s, the utilities industry was facing deregulation. The Chief Information Officer (CIO) of the holding company for a utility company providing electricity for five states was a key member of the strategy team, and his office was in the executive suite. Named as CIO because, in his words, he was the user who complained the most, this CIO had consolidated data centers and worked to consolidate Information Resource Organizations (IROs). Despite this CIO's proven negotiating skills, that battle was lost, with regional utility company Presidents retaining control over their Information Resource Organizations and appointing their own CIOs. The CIO of the holding company for these regional utility companies is observed during the week in which the proposal to consolidate IROs is proposed to the Management Council. Five years later, he is interviewed. Five years after the interview and three CIOs later, the current CIO is observed. This CIO is just returning from an assignment in England involving mergers and acquisitions, has few ties to the current IRO, and is not located in the executive suite. His predecessor retired early because he so strongly disagreed with personnel cuts in the IROs. This CIO's main task is personnel evaluations. He is clearly seeking to down size the holding company IRO.

Not only is the environment very different ten years after the original study, but the utility company strategy is also quite different. Deregulation and being competitive in a free market has become a non-issue. Post 9/11, the consolidated data center, which saved billions, is guarded by helicopters and an army of private security guards. Five years from this observation and fifteen years from the original study, a former public relations executive is named as CIO. Her job is to "sell" the services of the IRO to the client and to administer a charge back system for the twenty-five percent of services which are not "common" services, thus containing costs. Currently, the charge back system allows clients to compare in-house costs with outsourcing. Managing expectations is a key component of her job.

Comparisons in work schedules, office locations, contacts and contact media along with secondary research on the organization portray a role which has shifted with the strategy of the organization and power plays among regional Presidents. While the IROs have continued to perform admirably, providing significant benefits to the company, clients never seem to be satisfied. This finding is similar to Hirscheims' longitudinal study of the information systems group at a major oil company. Not only has the utility company placed five people in the CIO role in fifteen years, but the company has also continually redefined the role itself, never really seeming to understand the CIO role or the requirements for managing technology effectively.

THE IMPACT OF USING NONESTIMABLE CONSTRAINTS ON SIGNIFICANCE TESTS

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ABSTRACT

Nonestimable constraints are commonly used to transform an overparameterized (rank-deficient) ANOVA model into a full-rank ANOVA model. This study explains that nonestimable constraints modify the meaning of the model parameters. Furthermore, it discusses the common mistakes in interpreting significance tests under the full-rank model. Significance tests from the Type-III analysis of SPSS-GLM for a two-factor ANOVA model are used for illustration.

INTRODUCTION

In the literature, ANOVA models are almost always presented as full-rank linear models. As a result, many researchers are not familiar with the overparameterized models. The full-rank models are developed by imposing nonestimable constraints on overparameterized models. Different constraints produce different full-rank models. Apparently, researches are not truly aware that the types of constraints change the meaning of the parameters. Furthermore, researchers typically use a computer program such as SAS or SPSS in analyzing ANOVA models. Many researchers do not know that these programs use overparameterized models in their algorithms (Green, 1999).

The purpose of the study is to enhance the understanding about overparameterized models and full-rank models in the context of significance tests. We start the discussion by reviewing the theoretical background of an overparameterized model. Next, we define the parametric forms of the significance tests for the main effect and interactions effect. Afterwards, we talk about reparameterization and its impact on significance tests. Finally, we present a conclusion.

OVERPARAMETERIZED MODEL

Let us start by looking at the two-factor ANOVA model with interaction:

$$y_{ijr} = \mu + a_i + c_j + ac_{ij} + e_{ijr}, \quad (1)$$

where factor A has two levels and factor C also has two levels. Model (1) can also be expressed in matrix notation as

$$\mathbf{y} = \mathbf{XB} + \mathbf{e}. \quad (2)$$

In model (2), **y** is an n by 1 observable vector, model matrix **X** is a known n by p matrix with rank k, **B** is a p by 1 vector of unknown parameters, and **e** is an n by 1 vector of unobservable random errors. Moreover, the error **e** is assumed to be independent and identically normally distributed with a mean of 0 and an unknown constant variance. This assumption implies that **y** is normally distributed with mean **XB** and variance-covariance

$$\sigma^2\mathbf{I}. \quad (3)$$

In the first step of the analysis of model (2), we need to have the estimates of **B** by solving the normal equations

$$\mathbf{X'XB}=\mathbf{X'y}. \quad (4)$$

The rank of matrix **X,** say k, is less than the number of unknown parameters p. This is why model (2) is called *overparameterized*. Consequently, **B** is not *estimable*, that is, the individual elements of **B** cannot be estimated uniquely. There are many solutions of the normal equations. However, any solution of the normal equations (4) can be expressed in the form of

$$\hat{\mathbf{B}}=(\mathbf{X'X})^{-}\mathbf{X'y}+\left(\mathbf{I_n}-(\mathbf{X'X})(\mathbf{X'X})^{-}\right)\mathbf{u} \quad (5)$$

for any *generalized inverse* of **X'X** matrix and some vector **u**. There are many estimate of **B** of the form of (5) because there are many choices of generalized inverse. However, whatever estimate of **B** we take, the expected value of every observation,

$$E(\mathbf{y})=\mathbf{X}\hat{\mathbf{B}} \quad (6)$$

is unique. Consequently, any linear function of cell means are always estimable.

In the process of finding a particular solution of the normal equations, computer program (e.g. SAS or SPSS) reparameterizes model (2) by imposing a set of linearly independent constraints, which is usually called *nonestimable constraints*. The reparameterized model can be written as

$$\mathbf{y}=\mathbf{X}^*\mathbf{B}^*+\mathbf{e} \quad (7)$$

where asterisks are appended to **B** and **X** to distinguish model (7) from the original unconstrained model (2). After reparameterization, matrix **B*** is of full rank. As a result, solving the normal equations corresponding to model (7) will give a unique estimate of **B***.

It is essential to recognize that, the estimate of **B*** is not the best linear unbiased estimate of **B** in model (2)**.** However, the estimate of **B*** is actually estimating certain estimable functions of **B**. There is no linear function of estimate of **B*** can provide unbiased estimates of nonestimable functions of **B** in model (2). In fact, there is no reparameterization that will provide estimates of nonestimable functions of **B** in model (2). However, any estimable function of **B** can always be estimated by an appropriate linear function of estimate of **B***. Although the solution to the normal equations of model (7) appears to change with different types of nonestimable constraints, all solutions give identical estimates for every estimable function of **B**.

Having a working knowledge about overparameterized models is critical because standard computer program use them extensively (Green, et al., 1999). Although the theory behind estimable functions is complex, but researchers should remember that every linear combination of cell means is always estimable.

DEFINITIONS OF FACTOR EFFECTS

In model (2), researchers usually want to measure the main and interaction-effects of the two factors on the response variable. The most popular hypotheses are probably the hypotheses used in the Type III analysis of SAS-GLM or SPSS-GLM. The Type-III hypothesis for testing the interaction-effect is as follows:

$$H_0: \mu_{11} - \mu_{21} - \mu_{12} + \mu_{22} = 0 \quad (8)$$

or equivalently,

$$H_0: \alpha\gamma_{11} - \alpha\gamma_{21} - \alpha\gamma_{12} + \alpha\gamma_{22} = 0 \quad (9)$$

The existence of interaction effect between factors A and C implies that the effect of factor A on the response is different at different level of factor C. It is intuitive to understand that hypothesis (8) and (9) are appropriate for the significance test of interaction effect.

The Type-III hypothesis for testing the significance of the main effect of factor A in model (2) is as follows:

$$H_0: 0.5(\mu_{11} + \mu_{12}) - 0.5(\mu_{21} + \mu_{22}) = 0 \quad (10)$$

Rewriting hypothesis (10) in terms of the model parameters of model (2), we have the following equivalent hypothesis

$$H_0: \alpha_1 - \alpha_2 + 0.5(\alpha\gamma_{11} + \alpha\gamma_{12} - \alpha\gamma_{21} - \alpha\gamma_{22}) = 0 \quad (11)$$

Hypothesis (11) is testable under model (2), but it includes not only the main-effect parameters of factor A but also the interaction-effect parameters. Intuition would lead us to think that the most appropriate main-effect hypothesis should be

$$H_0: \alpha_2 - \alpha_1 = 0 \quad (12)$$

Unfortunately, hypothesis (12) is *nontestable*. If interaction is present, there are no estimable functions involving only parameters *a*'s alone or parameters *b*'s alone. (Rencher, 2000). This fact reminds us that, in models with interactions, we cannot separate main effects from interaction effects. Many authors recommend that hypothesis (9) should be tested first, and if it is found to be significant, the main effect hypothesis (11) should not be tested. Others argue that hypothesis (11) measures the main effect of factor A averaged over the levels of factor C and it can be tested even if interaction effect is significant.

REPARAMETERIZED FULL-RANK MODEL

Any overparameterized model can always be transformed into a full-rank model by redefining the model. This transformation process, which is called *reparameterization*, can be accomplished by imposing nonestimable constraints. For illustration, let use impose the "sum-to-zero" nonestimable constraints:

$$\sum a_i^* = 0,\ \sum c_j^* = 0,\ \sum ac_{ij}^* = 0 \text{ for all } j,\ \sum ac_{ij}^* = 0 \text{ for all } i, \quad (13)$$

to model (2). In this case, we will have the a full-rank model

$$y_{ijr} = \beta_0^* + \beta_1^* X_1^* + \beta_2^* X_2^* + \beta_3^* X_1^* X_2^* + e_{ijr} \quad (14)$$

where

$$X_1^* = \begin{cases} -1 & \text{if first level of A} \\ 1 & \text{if second level of A} \end{cases} \quad \text{and} \quad X_2^* = \begin{cases} -1 & \text{if first level of C} \\ 1 & \text{if second level of C} \end{cases}$$

Model (14) is probably the most familiar one among researchers. In fact, the Type-III analysis of SAS-GLM and SPSS-GLM also uses the "sum-to-zero" constraints in their algorithms (Searle, 1987).

We may also reparameterize model (2) as

$$y_{ijr} = \beta_0^{**} + \beta_1^{**} X_1^{**} + \beta_2^{**} X_2^{**} + \beta_3^{**} X_1^{**} X_2^{**} + e_{ijr} \quad (15)$$

where

$$X_1^{**} = \begin{cases} 0 & \text{if first level of A} \\ 1 & \text{if second level of A} \end{cases} \quad \text{and} \quad X_2^{**} = \begin{cases} 0 & \text{if first level of C} \\ 1 & \text{if second level of C} \end{cases}$$

if we use the "set-to-zero" constraints,

$$a_1^{**} = 0,\ c_1^{**} = 0,\ ac_{11}^{**} = 0,\ ac_{12}^{**} = 0,\ ac_{21}^{**} = 0. \quad (16)$$

Following hypothesis (8), the main-effect hypothesis in the constrained model (14) is

$$H_0 : \beta_1^* = 0 \quad (17)$$

while the main-effect hypothesis in model (15) is

$$H_0 : \beta_1^{**} + 0.5\beta_3^{**} = 0 \quad (18)$$

It is clear that testing hypothesis (17) in model (14) is different from testing

$$H_0: \beta_1^{**} = 0 \quad (19)$$

in model (15). It is essential to know that "beta-sub-1-asterisk" in model (14) designates the change in the mean response if factor A is changed from its second level to its first level, when factor C is at the middle of its first and second levels. On the other hand, "beta-sub-1-double-asterisks" in model (15) denotes the change in the mean response if factor A is changed from its second level to its first level when factor C is at its first level. Briefly speaking, the two slopes are not measuring the same thing. Consequently, it may happen that we can reject (17) but we cannot reject (19), or vice versa, for the same level of significance.

The above illustration reveals a consequence of using nonestimable constraints. The types of constraints changes the meaning of the model parameters. Researchers may interpret that hypothesis (17) is really measuring the effect of factor A after taking account the effect of factor C and the interaction effect (e.g., Lomax, 2001, page 168-169; Maxwell and Delaney, 2004, page 331). Hypothesis (17) is not identical to the nontestable hypothesis (12). Whatever nonestimable constraints we take, we cannot make hypothesis (12) testable. Such a confusion can be avoided if researchers remember the overparameterized hypothesis (11) and the concept of testable hypothesis. Note that interaction-effect is the "highest order" effect in model (2). The types of nonestimable constraints will not modify the meaning of the significance test of the highest order effect in the model. Therefore, testing

$$H_0: \beta_3^{*} = 0 \quad (20)$$

in model (14) and testing

$$H_0: \beta_3^{**} = 0 \quad (21)$$

in model (15), respectively, are equivalent to testing hypothesis (9) in model (2). These hypotheses really measure the interaction effect after adjusting for the main-effects of factor A and C.

It is clear that, in models with interaction, the main-effect hypotheses do not really measure the main effect alone, but also measure the interaction effect. Some researchers suggested that hypotheses should be expressed using the cell-means notation because they are more intuitive. But, we have shown that overparameterized formulated hypotheses give more details about the factor effects being tested.

CONCLUSION

This study has shown that nonestimable constraints change the meaning of parameters and, of course, the meaning of some significance tests. Hypotheses involving main effects that are nontestable under an overparameterized model may appear to be testable under the constrained full-rank model. Obviously, the results of testing such hypotheses are not really interesting and are potentially misleading.

This study also suggests that, in order to avoid misinterpretation, hypotheses should not be written only using the cell means notation, but also using the overparameterized notation to avoid

misinterpretation. It has been shown that the cell-mean notation is intuitive but it does not reveal the factor effects measured in a significance test.

Moreover, the results of the study can be extended to models involving more than two factors. For example, in a three-factor ANOVA model with interaction, nonestimable constraints will modify the meaning of significance tests involving two-factor interaction effects and main-effects. The discussion is also valid for both balanced and unbalanced data.

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MIDDLE MANAGERS AND THE IT ENVIRONMENT IN PUBLIC SERVICE ORGANIZATIONS

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ABSTRACT

This paper examines the automation environment of public service organizations (PSO) in two different periods to suggest that the introduction of information technology (IT) into public organizations continues to be more pragmatic than strategic. Findings suggest that triggers, such as organizational problems and technological availability for introducing IT are not sufficient to produce substantial organizational change.

THE ENVIRONMENT FOR IT ADOPTION IN PUBLIC SERVICE ORGANIZATIONS

This paper examines the automation environment of public service organizations (PSO) in a period of twelve years to support the claim that the introduction of IT into public organizations has been more pragmatic than strategic. The results coincide with reports in the general literature stating that managers invest in information technologies (IT) to achieve pragmatic ends, such as lowering the cost and time needed in producing and delivering the goods and services for which they are responsible (Pinnsoneault & Kraemer, 2002; Richter, 1996; Brudney & Selden, 1995; Grady & Chi, 1994; Browning, 1990; ICMA, 1989; Danziger & Kraemer, 1988), and to respond to external political forces that dictate IT adoption practices (Tarafdar & Vaidya, 2005; Heintze & Bretschneider, 2000).

An analysis of managers' perception of the organizational problems they intend to solve with the introduction of IT provides insights as to why IT is introduced in the first place. The first phase of this study was conducted at a time when organizations were entering a second wave of IT-enabled organizational change, in which they were moving from data processing to data production and application (Scwartz & Brock, 1998). The second phase took place twelve years after the first phase was concluded, in a time when most IT adoption processes were mediated by strategic considerations, and by a need to support organizational learning.

The first phase of the study used a field survey to collect data and was based on a total of 140 IT projects that were introduced in agencies delivering services in the New York metropolitan area, such as social, law enforcement, community development, and capital project services. Here, data were collected during 1992 and 1993. Although the sample size was large enough, it doesn't represent the entire spectrum of IT projects in the public sector.

The follow-up phase of the study used 30 semi-structured interviews with middle managers from various organizations. All managers interviewed have been involved with IT efforts for more than ten years. This research design represents a common form of ex-post facto analysis that seeks to explore relationships between variables. The questionnaire used in the first phase was self-administered in a report format, in which managers were asked to describe the objectives, the problems they intended to solve, and the technological solutions they adopted. For each project, managers described: the organizational context and problems; the intervention or managers' response to the problems; the benefits that resulted from the introduction of IT; and, the potential for marketing the project to other PSO. The follow-up interviews used an abridged version of the

survey, focusing on the same four themes, and asked managers to discuss and comment on the same set of factors.

OBJECTIVES BEHIND THE INTRODUCTION OF IT: MANAGERIAL JUSTIFICATIONS

In deciding on new IT initiatives, organizations follow distinct trajectories and use different criteria sets (Nidumolu et al, 1996). When IT is introduced to improve the timeliness of information flows and to reduce process cycles times, the organization uses a functional approach. Cost-benefit analyses are at the heart of these processes. On the other hand, when the adoption of IT is framed by a political/symbolic approach, decisions are dictated by political, rather than economic considerations. Finally, in a social information processing approach, the adoption of IT is influenced by the perceptions, values, and behaviors of the referential group (Nidumolu et al, 1996).

Albeit organizations introduce IT for a multitude of reasons, a primary purpose deals with the expectation that IT will streamline information processing, thereby improving organizational performance (Heintze & Bretschneider, 2000; Korac & Kouzmin, 1996; Kraut, et al., 1989; Rice & Contractor, 1990; Drucker, 1988). The ultimate goal is to leverage the strategic impact of the existing IT with the potential benefits of the IT portfolio.

Table 1
Reasons to Introduce IT

"To automate and to replace old technology"; "to improve the existing system"; "to improve accuracy in analysis"; "to reduce repetitive efforts".
"To improve management and allocation of resources, to share resources"; "to improve quality of products and services".
"To deliver services effectively"; "to improve responsiveness"; "to provide timely information"; "to improve safety".
"To track status of transactions, and monitor activities"; "to enhance compliance, and improve control over tasks and operations";
"To redesign processes"; "to eliminate stages in the operation"; "to improve work flow". "To improve communication", "to standardize responses", "to coordinate processes", "to decentralize operations", "to centralize responsibility".
“To improve data analysis";" to develop flexible systems that enhance functionality and the capacity for ad-hoc report generation"; "to improve access to and facilitate links with information sources, and to improve flexibility in providing information".
"To improve information management"; "to develop historical databases and improve the organizational ability to collect and manage information"; "to monitor large amounts of data"; "to develop a comprehensive system to integrate data".

This study attempts to provide answers to the following questions: what are the reasons and objectives managers indicate act as triggers for the introduction of IT; and, what are the organizational problems that managers seek to solve through the introduction of IT. Table 1 includes a sample of managers' statements describing the intentions behind their decisions. These statements provide insight into the goals managers tried to attain by introducing IT in their units. Apparently, the introduction of IT did not respond directly to specific organizational problems, but was instead guided by a motivation to seize technology-enabled opportunities.

An organizational outcomes taxonomy can be mapped on top of these categories of intentions (Watad, 2000). While the first three clusters are associated to outcome factors such as productivity, competitive advantages, responsiveness, and accountability, the fourth is linked to a task-execution and control factor. The fifth cluster corresponds to structural issues and re-

engineering efforts. The final two clusters relate to analytical skills, knowledge management, and organizational memory factors, all indicators of managerial efforts to enhance organizational learning.

PROBLEMS SOLVED WITH THE INTRODUCTION OF IT: MANAGERIAL POST-FACTO RATIONALIZATION:

In identifying organizational problems managers attempted to solve by introducing IT, a deductive process was used. It included four steps, namely: (i) identifying and listing problem statements in the written reports, (ii) clustering statements into meaningful categories based on the literature, (iii) constructing final categories, and (iv) classifying projects according to these categories. Sixty different problem statements from 140 projects were identified. They were carefully reviewed and then clustered into seven mutually exclusive categories. Table 2 in appendix 1 displays these categories as well as their frequencies.

Assuming that the above mentioned seven categories of triggers for IT adoption are post-rationalizations of actions taken (Knights & Maurray, 1994), one can argue that they represent what managers say they did rather than what they actually did. Being this so, there seems to be a gap between actual objectives and perceived problems, as well as between plans and actions (Goodman and Burke, 1982). Regardless of whether the triggers were deemed as objectives, problems, or post-rationalizations, they determined the attention structure of public managers regarding the use of IT. In addition to reflecting what managers perceive can be achieved or can be solved with the introduction of IT, this classification of triggers provides an insight into the automation environment and the prevalent IT culture in PSO. Managers' perceptions (Weick, 1969) are important because they affect managers' decision-making and actions regarding the introduction of IT into their organizations (Heintze & Bretschneider, 2000).

THE CURRENT IT ENVIRONMENT OF IT ADOPTION

The second phase of the study was conducted in 2004. At this time, IT adoptions were mainly framed using strategic considerations that are in terms of providing competitive advantage or making possible for the organization to "catch up", not to be left behind. In addition to providing a competitive edge, IT is being introduced to support e-business at all levels of organizations. The study expected to find a shift in the approach PSO used to introduce new IT. Although the sample size was smaller in the second phase, it was sufficient to provide an understanding of whether changes have taken place in recent years in PSO.

The data collected in this phase suggested that there was a slight change in the structure of the portfolio of problems managers attempted to solve with the introduction of IT. Although *Manual Processing* problems were still a substantial portion of their portfolio, they were not as prevalent as in the first phase. Their frequency dropped from 74% to 50% (see Table 3). On the other hand, *Information Access and Management* problems emerged as the most prevalent set of triggers for IT adoption, and were the main focus of managers' attention and efforts. Their frequency grew from 16% up to 60%.

Table 3
Phase II - IT Adoption Triggers: Categories of Problems

Category of Problems	Frequency
Manual Processing	50%
Capacity	23%

Control	21%
Information Access and Management	60%
Operational	14%
Service Quality and Responsiveness	13%
Other	11%

An in-depth analysis of the sets of triggers may provide support for a claim stating that the introduction and use of IT in these PSO occurred as a result of the interaction of two opposing forces, which intertwined in the context of technological availability and managerial actions (Markus and Robey, 1988). They are the technological push and the organizational pull. The technological push is characterized by managers' desire to take advantage of IT capabilities to improve information access and management processes, enhance resource allocation, and simplify operations. The organizational pull, on the other hand, is characterized by a desire to solve structural problems and boost organizational performance and control. Improving the quality of products and services, for instance, can be interpreted as a technology-led project, whereas reducing delay in delivering services can be interpreted as an organization-led project. Albeit IT is the driving force in the former case, organizational variables are the catalyst in the latter

CONCLUSIONS

This research examined the automation environment in PSO in two different eras. The main conclusion of the study is that, in spite of the prevalent shift in focus, from a productivity emphasis to a more strategic outlook, the introduction and use of IT in PSOs takes place mainly at the operational level. Public managers are still more concerned with automating the operating core functions, than advancing the strategy of their organizations. It appears that middle managers are still spearheading the IT initiatives in their units, and that their focus remains unaffected. Middle managers seem to have different IT priorities than those of senior executives. In addition, it seems that where middle managers have more control over the use of IT, they select the type of IT that is akin to their roles and priorities.

These findings lead to questions such as to why PSO managers use this approach: is it because they want to protect their jobs and are not willing to take risks; or because organizational constraints prevent effective introduction of IT into public organizations; or, because they lack knowledge to radically change the organization? One direct proposition or explanation could be that middle managers do not see IT as a strategic asset but only as an operational and role-reinforcement tool. Another proposition is that these organizations don’t apply systems thinking to decide on IT-led innovation.

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APPENDIX 1:

Table 2
IT Adoption Triggers: Categories of Problems

Category	Types of Problems	Frequency
Manual Processing	*Accuracy problems:* data errors, redundancy or double record keeping, and inaccurate transactions. *Speed problems:* delays in processing and report generation, time consuming operations, slow production line, and inefficient transactions. *Cost problems:* time-intensive operations, labor-intensive operations, and costly operations.	74%
Capacity	Large volumes, increases in demand, increase in workload and backlog, use of large amounts of paper work and manpower, and increasing scope of work and/or decrease in resources.	23%
Control	Limited ability to track work (e.g., tracking violations), fragmentation of control, poor enforcement of regulations, lack of coordination, limited ability to control work, and lack of centralized control.	21%
Information Access and Management	*Access problems:* information that is not readily available to users, lack of access to data stored in either mainframe systems or external databases, and lack of compatibility. *Information processing problems:* lack of information, out-dated information, and inability to handle extensive use of information, limited reporting capabilities, and fragmentation in related information, poorly organized data, and the unavailability of information in an easily understood format.	16%
Operational	Complex processes, fragmented organizational operations, and difficult tasks.	14%
Service Quality and Responsiveness	Limited ability to deliver services or to reach out; poor responsiveness, or lack of a standard response; regulation; poor enforcement, lack of accountability, lack of security, lack of compliance, and fragmented responsibility.	13%
Other	Lack of time, misuse of time, old equipment, lack of skilled staff, misuse of space, and lack of vendor support; existing systems that are inflexible, not user friendly, still required manual work, and produce rigid output.	11%

INVESTIGATION INTO THE HOME PAGE OF THE TOP 100 LIBERAL ARTS COLLEGE WEBSITES

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ABSTRACT

Almost all Liberal Arts Colleges provide their information through websites. The key to the successful utilization of the College website is to retain users' good impression. We evaluated the top 100 Liberal Arts College Websites and determined whether or not they employ selected principles of good website design. Twenty evaluation criteria (i.e., critical features of an ideal website) for websites have been selected through literature reviews on website design. We will evaluate the websites with respect to each criterion for the implementation of selected principles of good design.

INTRODUCTION

Nowadays it is probably impossible to find a single college that doesn't have a website. To search the internet is a common thing. If one needs to find information on a certain college the first thought that comes to mind is, "to check the internet." So, the home page of the college website is the first impression or "the face" of any college. Thus, it is a good idea to have some understanding of what is good or what is bad for the website's homepage. Of course, in many cases the opinion on the website is relative, and depends on a certain person, i.e. everybody has a different taste. Nevertheless, we can agree that some of the criteria and features of the website appeal to most of us. To identify these features, we picked common criteria mentioned in most of the books on website design. Thus, we have done research on top 100 liberal arts colleges, based on the following twenty criteria: image size, number of images per page, number of background colors, are those colors white, gray, black, light blue, background and text crash, number of colors used for fonts, emphasis indication, javascript, page loading sequence, search box, email, news, content layout, descriptive links, horizontal line usage, multiple fonts, capital letters, page length, and white space usage.

The purpose of the paper is to identify certain criteria to use when designing an attractive and professional looking website for colleges and universities. The current work is based on the previous research done on the top 100 university websites. We reconsidered and extended the number of criteria and changed the set of universities. The data collected from the top 100 liberal arts colleges showed that a significant number of the criteria are not considered when websites are being designed. Unfortunately, the importance of the appearance of the website is underestimated by many colleges. Everybody knows by experience, that if the website doesn't look nice and professional, we have corresponding feelings about the university itself. Thus, we can see the value that our research can bring to colleges in general. The rest of the paper will guide the reader through the steps of our research. We begin by reviewing literature and criteria used for the research. Then we analyzed the data collected from investigating of the top 100 liberal arts colleges. Based on that data we will draw a conclusion.

DATA ANALYSES

MATLAB is used to analyze collected data. For most of the criteria we decided to use "yes" and "no" answers. The results of our analyses are displayed in the following tables.

Table 1: Results of the analysis on the image criteria.

Criteria	*Comply with criteria*	*Do not Comply*	*No data*
Image size is 600*400 pixels or smaller	78%	13%	9%
Use no more than 3 images per page	14%	84%	2%

For some pages, it was impossible to determine the size of the largest image since Macromedia Flash was used. Out of 100 colleges, 78% comply with the image criteria, while 13% do not. However, the low compliance percentage is the number of images per page. In most cases, it far exceeds three images per page.

Table 2. Results of the analysis on the background criteria.

Criteria	*Mean*	*StdDev*	*Comply with criteria*	*Do not Comply*
Number of Colors	1.86	0.97	81%	19%
Use light blue, white, gray			81%	19%
Do not use black			88%	12%
Do not use background & text crash			75%	25%

Most colleges follow the guidelines for background. It is worth mentioning that in some cases, the number of background colors per page is very difficult to determine, since the design of the page is not uniformly organized.

Table 3. Results of the analysis on the text criteria.

Criteria	*Comply with criteria*	*Do not Comply*
Do not use more then 4 colors	98%	2%
Indicate emphasis with bright color	15%	85%
Do not use Java script	12%	88%

The reader can see from the data above, that emphasis and JavaScript criteria, are mostly not complied with (i.e. drop down menus and highlighting buttons are very popular features nowadays). In terms of the emphasis with bright colors, this feature is not followed, since most homepages do not contain extensive text information. In many cases, the text information includes brief news with links to subtopics.

Table 4. Results of the analysis on the content criteria.				
Criteria	***Mean***	***StdDev***	***Comply with criteria***	***Do not Comply***
Display text on the page first while the graphics is loading			79%	21%
Search Box			59%	41%
What's news			90%	10%
Web mail			2%	98%
Break up content with topics & subtopics, headings, or horizontal lines, or use headers in segmented order			73%	27%
Make links within a document descriptive			58%	42%
Use horizontal line at the bottom of page			34%	66%
Avoid using multiple fonts			96%	4%
Do not use all capital letters			97%	3%
Use of the white space effectively			86%	14%
Length (1, 2 .. pages)	1.83	0.6825	30%	70%

The reader can examine the data above and get a clear picture of compliance with the content criteria. We would like to make a couple of comments on some of the criteria. Search boxes are getting very popular, but still almost half of the colleges researched does not use this feature. In some cases, it is due to simplicity of the website. 98% percent of the colleges do not provide access to the school's email, (i.e. there is no login and password input boxes on the page). And still most of them have links to the email login page. 66% of the colleges do not use the horizontal line at the bottom of the page. This feature is mostly used to complete the structure of the page. Some pages use background color to provide the same feeling of completeness. Finally, having a one screen home page is not a very popular feature among the colleges. We can easily calculate that average of the length in the front page is 1.83 or almost two screens. This implies that a significant part of the information on the page, is not reached by the users.

CONCLUSION

We have investigated and evaluated home pages of the top 100 Liberal Arts Websites selected by U.S News and World Reports magazine. In order to evaluate the home pages, twenty evaluation criteria (i.e., critical features of an ideal home page) are selected through literature reviews on the website design. We found that most colleges use news (90%), multiple fonts (96%), and white space (86%). They do not use more than four colors per screen (98%) and do not use all capital letter (97%). The other critical features of an ideal home page are used relatively frequently but in less degree. But not a single college's website satisfies all twenty evaluation criteria.

Reference will be available upon request.

ENHANCING PROJECT MANAGEMENT WITH KNOWLEDGE MANAGEMENT PRINCIPLES

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ABSTRACT

In many organizations, projects are unique endeavors that require special functions. Project managers, who are filling the void of middle management, often do not possess the advantages of a learning curve in performing individual project analyses. This is where project managers have the potential to benefit greatly from well-defined knowledge management (KM) practices. KM is the concept of combining the expertise, wisdom and insights of those individuals who have come to their wisdom the hard way. This research proposal addresses the issues that have been barriers to the integration of KM practices for project mangers. In particular, it discusses both explicit and tacit benefits of KM for project managers as well as motivating factors for its adoption.

INTRODUCTION

Today, almost every organization gets involved in many projects, leading several business executives and experts to declare that "Project management is the wave of the future." Stewart (1996) proclaims that the corporate jungle has a new species, the *project manager*, who will fill the void created by the extinction of middle management. More and more firms are realizing that managing projects can be a vital part of everyone's job.

The concept of knowledge management (KM) has been around for decades, but most organizations accept it only as theory and have not put it into practice. It has been difficult for many firms to evolve their organizational thinking from an information focus to a knowledge focus. Throughout the past several decades, information systems practices were sufficiently developed to accomplish efficient production of information. Problems arose when information was in abundance, but key individuals possessing that information did not or would not share it with others who stand to benefit from its discovery.

This research focuses on the partnership of project management practices and KM principles. Together, their contributions can bring project management to a new frontier for application.

PROJECT MANAGEMENT

Project management has long been associated with operations management, and is an important topic in the Operations Management curriculum. By definition, a project is a complex, non-routine, one-time effort limited by time, budget, resources, and performance specifications designed to meet customer needs (Gray & Larson, 2003).

In many organizations projects are unique endeavors that require special functions where the advantages of a learning curve are not available. Thus, organizations often seek project managers with experience as a replacement for their shortcomings. The term "experienced project manager" does not necessarily imply that a project manager has the exact skills required to do the task at hand, but

generally means that he/she has completed similar tasks which he/she can draw upon to complete the task at hand.

KNOWLEDGE MANAGEMENT (KM)

Dunn and Neumeister (2002) define KM as a systematic approach to managing and leveraging an organization's knowledge assets, which may include knowledge of the organization's customers, products, market, processes, finances and personal services. The Gartner Group, an international technology consulting group, defines and offers KM as a discipline that encourages a mutually supported method to create, capture, organize, and use information (Duffy, 2000).

Koskinen (2004) categorizes KM into two components to support project management communication and implementation. First, *explicit knowledge* is knowledge that can be embodied in a code or a language, and, as consequence, it can be communicated easily. The code may be words, numbers, or symbols like grammatical statements, mathematical expressions, specifications, manuals, and so forth. In addition, *tacit knowledge* presents knowledge based on the experience of individuals. It expresses itself in human actions in the form of evaluations, attitudes, points of view, commitments, motivation, etc. Polanyi (1966) summarizes the essence of tacit knowledge in the phrase, "We know more than we can tell." To distinguish between the two, explicit knowledge is about *why* things work, and tacit knowledge is about *what* things work.

ISSUES IN PROJECT MANAGEMENT

In general, any project can be assessed in three dimensions: time, cost and quality. Olson (2004) argues that most projects will meet any two of the dimensions, but very few meet all three. Issues identified for missing one of the dimensions include:

1. Non-Reporting of unplanned events.
2. Change orders.
3. Late completion of tasks.
4. Poor quality.
5. Lack of project tracking skills.
6. General project variances.

CURRENT METHODS TO MANAGE THE ISSUES

Below are three of the most currently recognized methods for mitigating many of the issues in the midst of a project. Positive and negative arguments of each are addressed.

Critical Chain Buffers

Goldratt (1997) offers critical chain project management (CCPM) to mitigate issues, where a project's focus is not only on critical activities, but on activities that might become critical. He suggests eliminating dues dates, which themselves become reasons for delay. His primary means of insuring that critical activities are completed on time is to use buffers, which are added time in the schedule to protect against unanticipated delays, and to allow for the early start of tasks. It is not slack time, but blocks of time that are not expected to be used as work time. These blocks of time are dedicated to covering highly probable contingencies, and are closely watched so that if they are not needed, subsequent activities can proceed at the earliest time possible.

Many dismiss this method, arguing that experienced project managers have known the principles behind CCPM for a long time, and its uniqueness is in its terminology rather than in its substance. Raz et. al. (2003) begin their argument by accepting the CCPM assumption that all task

owners overestimate task duration by a certain safety factor, and that the time duration of the actual execution of each task will expand to fill the time allotted. Raz et. al. (2003) also argues that if a method exists for portioning tasks into completion times and safety factor times, then it should have been used in the first place.

Risk Management

Every project manager understands risks are inherent in projects. Gray and Larson (2003) define *risk* in the context of projects as *the chance that an undesirable event will occur along with all of its possible consequences*. Risk management attempts to recognize, manage and possibly remedy potential and unforeseen trouble spots that may occur when a project is implemented. Risk management, as part of the project planning process, attempts to identify as many risk events as possible (what can go wrong), minimize their impact (what can be done about the event before the project begins), manage responses to those events that do materialize (containment plans), provide remedies for the event or events (previously determined solutions), and provide contingency funds to cover risk events that actually materialize.

Disappointingly, risk management is not generally performed well in most organizations. Unplanned events are more often than not missing from the risk management portfolio. In addition, informal interviews with project managers indicate that risk management is performed more as a reactive measure than a proactive one.

Project Assessment and Evaluation

The general accepted method of project assessment and evaluation is the Earned Value (EV) system (Gray & Larson, 2003). The usefulness of the EV system depends on data from the work breakdown structure (resources, time and cost estimates, and a time phased budget for each task) and new estimates of percent complete work that are realistic and as accurate as possible.

Similar to risk management, project assessment and evaluation are not generally performed well by most organizations, and are considered one of the most neglected areas of project management. It holds people accountable and allows for traceability. Thus, it has negative connotations for many and is frequently resisted.

In several cases, modifying a project's scope creates change orders that produce significant status report variances. Such occurrences are often subject to creative baseline revisions leaving many to question the results of this self-assessment technique.

APPLYING KM TO THE ISSUES

The most profound aspect of KM is that, ultimately, an organization's only sustainable competitive advantage lies in what its employees know and how they apply that knowledge to business problems. The addition of KM repositories to project management enhances an organization's ability to:

1. Think in broad terms.
2. Capture issues for study/observation.
3. Take independent remedies and address issues in an interdependent fashion.
4. Catch issues that have traditionally "slipped through the cracks."

KM BENEFITS

KM is a practice that makes sense for improving project management. It is the concept of combining the expertise, wisdom and insights of those individuals who have come to their wisdom the

hard way. If the wisdom could be captured and shared within the project management community, it would make sense that organizations would benefit infinitely. Such benefits occur in both explicit and tacit forms.

Explicit KM Benefits

1. Past data on completed projects, milestones, and work packages are obtained.
2. Interdependencies among tasks due to shared resources are addressed.
3. Identification of real risks and the methods used to alleviate them are known.

Tacit KM Benefits

1. Can conduct interviews to determine what processes/methods were successful.
2. Interviews to determine what actions didn't work can also be conducted.
3. Allows for quicker movement down a task's learning curve.

BARRIERS TO KM

Having explored the nature of KM as an important tool for organizations, our research must also address barriers that inhibit its effectiveness. The question is: "How can project managers be motivated to share the knowledge gained from their experiences?" The typical culture shared by many project managers is not one that rewards the sharing of ideas and wisdom. Promotion and job security are functions of a project manager's ability to generate original ideas, and apply them in unique ways. In such a case, knowledge can be thought of as a belief that is justified and then internalized. Therefore, it can be lost, shared, or hoarded. A simple remedy might be to provide financial motivation for documenting projects at completion.

CONCLUDING REMARKS

Peter Novins (2002), a vice president at Cap Gemini Ernst & Young, summarized the characteristics of KM in an e-Business presentation. His remarks were that good KM should have three characteristics. First, it needs to address a real business problem that everybody agrees is a problem. Second, an organization cannot sustain a KM system without some kind of community interest or practice that provides content and accepts responsibility for continuing to build and share the content. Third, KM systems have to make it very, very easy for people to get the content they need.

In the current complex business environment, projects are viewed as critical building blocks for organizational success. As projects are continuously combined with new information, we conclude that it is necessary to continue to make contributions to research in project management in cooperation with research in KM.

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