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ASSIGNING RATIO CODING TO NOMINAL OR ORDINAL DATA: INFERRING ATTRIBUTES FROM ONE TO THE OTHER

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ABSTRACT

One of the first things to be done in analyzing data is a determination of data type; that is, what type of numeric scale is being used. This determination drives the kind of description and analyses to be used. The strength of the numbers being used limit the appropriate measures of description. Nominal values preclude the most basic of arithmetic actions, the numbers are in fact void of information within themselves. Ordinal values allow scaling, but differences between categories are meaningless. Numerical scales (interval and ratio), however, are the highest levels of measurement, contain the most information, and allow the full hierarchy of arithmetic functions. Thus, one would not calculate the arithmetic mean or standard deviation of nominal or ordinal data, but such measures would most certainly be considered for interval or ratio data.

Variants of the Likert scale are widely used in marketing and attitudinal research. Such scales are generally coded with a counting variable (1, 2, 3, etc.) which is ratio in type. Perhaps, in part, because counting variables themselves have equal intervals, Likert scales are often treated as if they were interval data. Assuming the distances between answer alternatives are equal, one often sees arithmetic means being used as a descriptive measure for such.

An example of such an application is the student evaluation of faculty performance currently being used at a large Southeastern State University. The "Minimum Academic Currency Standard for Tenured Faculty" includes a minimum requirement for a 2.0 arithmetic mean for student responses to the question:

> *Considering all factors (Questions 11-12 below, and others you think are relevant), how do you rate the overall performance of this instructor in this course*
> *A= outstanding; B= above average; C= average; D=- below average; E = poor*

The coding for these answers are: A=4, B=3, C=2, D=1, E=0, a counting scale, generally considered to be of ratio type. Although we would know that student X with a response of A ("outstanding") thought the instructor to be better than respondent Y with a response of B ("above average "), we have no idea how much better nor can we even be sure that both respondents have the same understanding of what constitutes "overall performance" and therefore, whether they really differ in their opinion about its quality. The only way one could appropriately use the arithmetic mean would be an assumption that the ordinal data in the students' responses have the same characteristics as the numbers used to code the data, that is, equal intervals between the alternative answers. This paper discusses the potential consequences of such assumptions.

APPRECIATIVE INQUIRY AS A MODEL FOR POSITIVE CHANGE IN AN UNDERGRADUATE INFORMATION TECHNOLOGY DEGREE PROGRAM

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ABSTRACT

Over the past two years faculty in this department (in a University setting) have updated the curriculum for its undergraduate information technology degree program, aligning it with needs of employers in the region where university resides, students, and the IS 2002 Curriculum Guide. Previous change initiatives resulted in minor improvements to the program as the developers of the program rejected the traditional process for change for a more holistic approach to encourage positive long-term and continuous change. The potential to improve program quality, student services, retention, and other themes is critical to the long-term health of the information technology (IT) degree program. We used appreciative inquiry as a model for positive and continuous change to improve the undergraduate program. Results have been encouraging and energizing with success in advancing change in an undergraduate program while incorporating stakeholders from around the university to effect change. The model is in continuous process improvement and it has made significant progress.

INTRODUCTION

The purpose of this study is to report how faculty reengineered the undergraduate Bachelor of Science in Information Technology (BSIT) program to increase marketability to non-traditional and transfer students at this University. That desire spawned several initiatives to align the BSIT degree program with the needs of the university, the college, local business and industry, and the IS 2002 Curriculum Guide. Like many organizations, BSIT was stuck in an organizational development approach. This approach can and often does ignore the human aspect of change (Passmore, 2003). What was missing was an environment of collaboration, appreciation, and excitement that built upon great efforts of previous members or positive efforts of those currently working in the program. We used appreciative inquiry (AI) as a model for positive and continuous change for BSIT reengineering. Appreciative inquiry (AI) "is an organizational tool that focuses on learning from success" (Johnson & Leavitt, 2001, p. 130). AI offers a sustainable model for change and growth in organizations connected to learning, sustainable development, and growth of the organization (Eijnatten, 2002).

Appreciative inquiry, a method of evaluation, has set the stage for a new way of envisioning the future of groups and organizations. The idea seemed clear and simple: Rather than viewing

organizations as having problems, the researchers challenged managers and leaders to approach organizations as containing mysteries. Universities have continued to contribute to the problem-solving mindset versus the human system—the mystery to be embraced. The BSIT degree program was no different. Since its creation it has taken a more technology-centric approach to dealing with organizational issues, focusing on solving problems. This study includes an evaluation of the effectiveness of appreciative inquiry as an intervention methodology to assist in defining and capitalizing on strengths and past successes the undergraduate degree program; in developing a compelling vision and mission to guide future strategic decisions and actions; and in re-branding the program to increase student and faculty recruitment, retention, graduation rates, and program quality.

APPRECIATIVE INQUIRY MODEL

When one understanding the foundations upon which appreciative inquiry is built, one is able to shift to a more positive change paradigm and plan a positive intervention. By embracing the constructionist principle organizations are free to create what they seek to create. The power of AI rests in the unconditional positive question where the "notion that organizations are open books, which are continuously in the process of being co-authored and re-authored over time" (Ludema, Cooperrider, & Barrett, 2001, p. 189). The first and most critical step in deciding upon the focus of the inquiry is asking:

1. What topics should be studied?
2. What would the organization like to know more about?
3. What areas of discussion will potentially generate intriguing possibilities toward which the organization can work? (Cooperrider, et al., 2003; Ludema, Whitney, Mohr, & Griffin, 2003)

Topics can encompass anything that affects or influences organization effectiveness. Although one person or the management team of an organization can choose focus areas, topic generation is best accomplished through discussions with selected stakeholders at different levels of an organization. Outcomes are very strong when different individual perspectives of the organization's current state and potential are incorporated into the selection process. The size of the pre-selected stakeholder group is a matter of preference, although an opportunity for more diverse viewpoints exists within a larger group.

Topics selected for inquiry will provide a starting point for development of formalized questions and will ultimately lead subsequent discussions and resulting growth in those directions. "AI has demonstrated that human systems grow in the direction of their persistent inquiries, and this propensity is strongest and most sustainable when the means and ends of inquiry are positively correlated" (Cooperrider et al., 2003, p. 30). Once identified, questions are carefully crafted to elicit free-flowing discussion from interviewees regarding particular topic areas. In addition to being topic-focused, questions should be affirmatively constructed and posed in open-ended format whereby the interviewee is asked to "remember a time when…(Cooperrider et al., 2003)." Curran & Work (1998) describe it this way:

> As we were all familiar with traditional interviewing methods, we knew that for this nontraditional process, it would be essential to free interviewees from a state of mind of "answering" our questions; instead, we would encourage them to tell their own stories. The interview structure was meant to serve as a doorway into the person's meaningful recollections, not just to provide a means of gathering focused data (p. 247).

Effective questions should engage the interviewee on both a personal and organizational level, thus defining a parallel between the reasons an individual has joined and continues with the group and clarifying the participant's social identity.

Discovery: What Gives Life?

The interview process is commonly referred to as the *discovery* phase—the first of a *4-D* cycle. Its purpose is to find out what works in an organization, rather than to focus on what is ailing. Rediscovering peak experiences, individual values, and strengths upon which to identify future opportunities and potentials are goals of the discovery phase. Questioning may take place in large or small group situations or in one-on-one conversations. Regardless of the forum, the interviewer should systematically ask prescribed questions, provide prompts and/or request clarification as needed, and withhold judgment and opinions that would sway interviewee responses (Cooperrider & Srivastva, 1987; Cooperrider, et al., 2003). The interview takes copious notes keyed to each question.

Dream: What Might Be?

The larger group is convened for the second step in the AI process, the *dream* phase. In this phase, the project leader presents results of the interviews and allows the group to identify themes or recurrent ideas revealed during the discovery phase (Cooperrider, et al., 2003; Whitney & Trosten-Bloom, 2003). The project leader asks questions to initiate discussion based on the inquiry tool. Questions may include:

1. What were the most humorous or surprising things you remember from the interview?
2. What one word best describes your feelings after the interview was completed?
3. What do you believe is the life-giving force of BSIT degree program? (Whitney & Trosten-Bloom, 2003).

A particularly effective way of helping to identify themes and simultaneously create enthusiasm for future visioning is to ask willing participants to recount some of the more compelling success stories. Once identified, common themes of organizational strength are used as the basis for collective discussion. Questions that would further spur a group discussion might include:

1. How can we capitalize on our strengths?

2. We have identified remarkable success when partnering with other organizations, how might we expand our pool of partners, and with which organizations do we think we would we be most compatible? Why?
3. Where do we want to see the organization in five years? (Whitney & Trosten-Bloom, 2003).

"The dream phase is practical, in that it is grounded in the organization's history. It is also generative, in that it seeks to expand the organization's potential" (Cooperrider et al., 2003, p. 112). The Dream phase provides an overall strategic focus for the organization.

Design: How Can it Be?

The third *d* in the 4-D cycle stands for *design*. This phase builds on the dream phase and provides tangible results in the form of provocative propositions, sometimes called possibility statements, which are "an ideal state of circumstances that will foster the climate that creates the possibilities to do more of what works" (Hammond, 1998, p. 39). Provocative propositions challenge the status quo. They are goal statements which bridge the best of what is with what could be possible. Although challenging and inspiring, these hard and provocative propositions are attainable because they are developed from the program's successful past and identify its current strengths. These discussions should initiate action steps that translate intention into reality, what some have called creating the social architecture of the organization (Whitney & Trosten-Bloom, 2003). Through this design of an improved social architecture the organization has the blueprint it needed so that leaders begin to realize the destiny that is within reach.

Destiny: What Will Be?

The fourth and final phase of the AI process is the *destiny* phase. Based on a shared vision for the future, participants decide together upon a plan and commitments to implement the dreams that were refined in the design phase (Johnson & Leavitt, 2001).

> It is a time of continuous learning, adjustment, and improvisation—all in the service of shared ideals. The momentum and potential for innovation are extremely high by this stage in the process. Because of the shared positive image of the future, everyone is invited to align his or her interactions in co-creating the future (Cooperrider et al., 2003, p. 176).

A VARIATION

A variation on AI is the *best team* approach. Bushe (1998) describes this simplified process, based on the principles of AI, as a means to help teams—groups smaller than the entire organization—to conduct conversations that generate new, affirming, and generative images for the opportunities they identify. The objective is to create an appreciative space where everyone in the group feels comfortable and connects with other members of the group. This appreciative space is often all a group needs to produce its own positive images (Bushe, 1998), while clearing the way for members to establish their identities within the group. This initial state helps minimize the need

for *storming*, allowing the group to move more efficiently from *forming* to *norming* (skipping over storming) in the group development process.

Bushe's (1998) simple model works well as a pre-4D cycle set of activities to form or gel the group quickly:

> Through their best team stories, individuals establish their identity in the group and indirectly indicate what role they are willing to play within the group. The group identifies qualities from which it will operate, making these qualities explicit. When generated through an appreciative inquiry initiative individuals within the group internalize these qualities more effectively.

Throughout the life of the group it is important to recognize and appreciate the contributions of individual members. Team building retreats should be conducted with a focus on increasing effective relationships throughout team members' time together. As described earlier the group begins to explore *the best of what is* through (Cooperrider et al., 2003):

1. Discovering who the stakeholders are;
2. Crafting an appreciative question;
3. Developing their interview guide;
4. Collecting and organizing data;
5. Conducting interviews; and
6. Making sense of data from the inquiry.

With this information the group presses forward with data in hand to explore *what might be* of the organization during the dream activity. The success of this activity, Cooperrider et al. (2003) indicate, is that many dream activities share common components: They build upon the discovery process by bringing in original inquiry in very personal and creative ways and they begin with energizing activity, using a focal question that starts the rich and creative dream dialogues and encourages individuals to create personal dream reflections. Like architects, member of organizations must consider the many elements that emerge through the discovery and dream phases of the process when designing *how it can be* for the organization (Cooperrider & Whitney, 1999). The design stage takes into account four additional steps (Cooperrider et al., 2003):

1. Select design elements.
2. Identify internal and external relationships.
3. Identify themes and engage in dialogue.
4. Write provocative propositions.

The above steps develop the bridge between *what is* and *what might be*. They are designed to challenge the status quo and suggest possibilities for an organization's future.

The fourth *D*, destiny, is to ensure that the dream can be realized. "The destiny phase represents both the conclusion of the discovery, dream, and design phases and the beginning of an ongoing creation of an "appreciative learning culture" (Cooperrider et al., 2003, p. 177). This phase

outlines implementation and rebirth of the process, an iterative process of continuous change and renewal.

RESULTS

Using the best teams variation of AI, the program implementers have been able to react quickly and decisively to adjust curriculum to meet changes in information technology while maintaining close alignment with the needs of industry, students, and the IS 2002 curriculum guide. For this program AI has proven to be a very powerful tool for organizational change. Although the process is far from complete the program developers continue to explore new ways of recruiting students and identify new markets for those efforts, reshaping the program flow to clarify for students the requirements of the degree; improving the quality of advising and student/customer services; and collaborating with faculty and adjuncts to improve the delivery and quality of individual courses. Those involved in the change process view AI not as a closed system with a beginning and an end, but one that represents multiple levels of the 4-D cycle where growth and rediscovery can take place continuously.

CONCLUSIONS AND FURTHER RESEARCH

The positive impact on morale, motivation, perception of team members, and results of the efforts of the team contribute to addressing change with enthusiasm and energy. AI sets the stage for a winning outcome for organizational or program change. Through this study, the investigators used appreciative inquiry as a model for positive and continuous change to reengineer an existing undergraduate program. The results have been encouraging and energizing with success in advancing change in an undergraduate program while incorporating stakeholders from around the university to effect that change. Further research could include continuing to evaluate the results of the program and make improvements.

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MANAGING THE TOTAL COST OF SPAM

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ABSTRACT

Business press has indicated that spam is a major threat to organizations. The amount of spam has increased dramatically, and has resulted in clogging employees' email boxes and organizations' networks. Organizations without appropriate spam-fighting measures are faced with lost productivity from employees and slower network processing.

The authors conduct interviews with representatives from several non-profit organizations and review literature to determine the extent of the threat. They then propose a formal process to help organizations determine how to best address the spam threat. Comments on the process are also collected during the interviews.

The conclusions reached by the authors suggest that the claims of the business press about the extent of the spam threat have not been accurate for non-profits. Thus, the formal process may not be valuable for organizations. However, additional research is necessary to determine whether for-profit organizations and other non-profit organizations are represented by results collected from the initial round of interview.

INTRODUCTION

Spam (unsolicited email) costs businesses and other organizations lost employee productivity for time spent to delete spam, additional information technology (IT) costs to fight it, and increased expenses to manage its effects. Current estimates of the cost of spam include:

1. Ten percent of IT staff time in large companies could be diverted from other priorities to contain the effects of spam. (Kontzer, p.20)
2. By 2007 a 10,000-employee firm without proper spam protection could spend up to $257 per employee on computing resources to handle spam. (Kontzer, p. 20)

Supporters of spam claim that it is a legitimate business practice. Because of the support spam still receives, it is unlikely that spam will go away any time soon. Therefore, organizations have to find ways to manage spam and any costs it adds to the organizations' operations.

This paper discusses the effects of spam on organizational operations and how to effectively and efficiently manage them. Structured interviews were conducted with managers at several non-profit organizations to identify the spam costs, the measures currently in place to address spam, and the standards used to assess the effectiveness of the spam-fighting measures. These interviews and a review of literature are used to establish a standard process by which organizations can evaluate the total cost of spam, identify and analyze alternatives for addressing spam, and decide which spam-fighting measures have the most merit for their operations.

EFFECTS OF SPAM

According to Ferris Research, 15-20 percent of all incoming email for US computer users is estimated to be spam and the number is steadily growing. Other sources estimate this figure to be as high as 55 percent. ("Spam Wars') A CTO Network Survey, conducted in June 2003, found that only 3.3% of email, on average, is NOT spam. That means the remaining 96.7 percent, on average, includes some spamming. (Udell, 2003)

Jupiter Research predicts that the amount of spam received by the average consumer will increase from 2300 emails per year in 2003 to 3600 per year in 2007. ("Still Choking on Spam) For organizations, the increase could be felt at much greater rates.

For one of the organizations the authors interviewed, the amount of spam received in August 2004 represented 43.43% of the monthly email volume.

Even when organizations have implemented measures to address the effects of spam, they still incur costs. (Harbaugh, 2004)

The organizations the authors interviewed suggested that once spam-fighting techniques were implemented, the benefits outweighed the costs. The filters, however, did identify some legitimate email as spam. But the costs to correct those problems were not large.

RESPONSES TO SPAM

The articles in the business press indicate that organizations have responded to the effects of spam by installing software and hardware, hiring additional employees in IT and other areas, and educating employees about how to minimize spam. Based on the literature, spam-fighting software is one of the most popular measures taken by organizations and individuals. Software filters are used to place email identified as spam in separate files. This can be done at the server gateway or at the desktop. (Harbaugh and Dennis) Challenge/response software prevents email from unrecognized email addresses from being delivered unless the sender correctly responds to a challenge email. (Harbaugh and Dennis) A more recent development involves tracing the spam to its origins. If spammers can be readily traced, they may be less likely to continue their spamming activities. ("Who sent the Spam?")

The organizations the authors interviewed are primarily using filters at the email server level. Another organization that the authors interviewed uses a filter at the email server, but passes on the spam emails after they are identified as spam. They plan to use the employees' feedback to help them move to a filter that will prevent the spam from going any further than the email server.

One of the organizations the authors interviewed had tried Bayesian methods for fighting spam. The literature suggests that Bayesian filters can be very effective in eliminating spam and helpful in identifying and blocking new spam technologies. (SpamAssassin Documentation)

MANAGEMENT OF SPAM

According to the body of literature, spam is costly and will continue to affect organizations. Thus, the authors suggest that spam and its effects must be effectively and efficiently managed. To

do this, organizations must not only recognize how spam affects their operations, but also must weigh the costs and benefits associated with available alternatives for fighting the effects of spam.

Following these concepts and using the tools discussed below, could help organizations minimize the effects of spam and the costs of fighting it, while maximizing the benefits to the organization. However, our preliminary interviews have indicated that the need for such a process might not exist—i.e., the non-profit organizations included in our sample did not experience the significant effects of spam that the business literature has proclaimed.

IDENTIFYING AND MEASURING THE EFFECTS OF SPAM

The body of literature suggests that many of the effects of spam are easily recognized, such as lost productivity and slower network speed. However, some effects of spam may not be readily apparent. Less recognized losses resulting from spam might include the following: (Marsh, 2003)

1. Spam containing explicit sexual messages offends an employee. If this occurs frequently, the employee might have a legitimate lawsuit concerning sexual harassment.
2. Spam sent to a list of email addresses that are supposed to be private or otherwise protected by an organization might result in a privacy violation lawsuit against the organization maintaining the list.
3. A large volume of spam might result in the organization's website crashing or the network becoming clogged and preventing business from being conducted. .
4. The organizations the authors interviewed identified the following effects spam had on their operations:
5. Servers crashed.
6. Employees complained. .

The organizations did not recognize any additional problems associated with the volume of spam they received. While the literature suggests that spam is costly and affects organizations in the ways mentioned above, means for measuring the costs of spam to an organization are not readily available. A metric for identifying and measuring the effects of spam might follow a general risk management survey instrument and contain some of the following components: Networking processing speed reduced, amount of processing time increased, cost of reductions and increases; hardware cost increases; personnel cost changes; productivity and downtime cost estimates.

However, the organizations the authors interviewed did not have explicit methods for measuring the effects and costs of spam. One organization counts the spam emails it receives, but does not convert that to a cost to the organization. Further, they were not sure such analysis would be worth the time and effort. They could easily address the spam issue by implementing low-cost or no-cost techniques without explicitly measuring the effects and costs of spam.

IDENTIFYING AND MEASURING THE COSTS AND BENEFITS OF ALTERNATIVES

The most common means of treating spam, as evidenced in the literature and by the organizations the authors interviewed, is spam filtering software. As mentioned above, these filters can be applied at the server or desk-top level.

While software to filter out spam is often the primary treatment used, it may be supplemented by other spam-fighting techniques These include training the employees to reduce their exposure (and thereby the organization's exposure) to spam and changing the way in which email addresses are released on web pages and other areas where spammers can harvest them.

Additional spam-fighting alternatives include: White lists, Black lists, Challenge/response, and Secure messaging.

The organizations the authors interviewed are using spam filters that are part of a more comprehensive package of antivirus and security software. The costs and benefits of the responses to spam can be measured using a metric similar to the one suggested above for analyzing the effects and costs of spam. For example, an expanded list of the solutions used by the organizations discussed above would help analyze the benefits and costs of techniques available for addressing spam. This list of metrics would include the costs of software alternatives (e.g., filtering), hardware (e.g., routers), and changes to networking capacity.

For the organizations the authors interviewed, a formal process for evaluating spam-fighting alternatives was not in place. The spam filters implemented were included in the antivirus and security packages that had been installed on the email servers. Furthermore, the cost of the spam filter was minimal (or free, as for one organization). It was included in the cost of the package that was being used for antivirus and security protection. The updates for the packages include updates for filtering spam. For the organization automatically receiving those updates specifically for the spam filter component of the package, the updates are free.

DETERMINING THE PACKAGE OF MEASURES TO USE

According to the proposed process, once the available alternatives for fighting spam have been analyzed for costs and benefits, other tools can be used to determine the combination of alternatives that would best meet the organization's needs. A cost-benefit portfolio technique could be used for this purpose. Combinations of alternatives could be analyzed for their total costs and benefits, with the selected combination being the one that minimizes the costs while maximizing the benefits.

The organizations the authors interviewed did not have a formal process for analyzing the combination of alternatives they implemented. One organization was using only the spam filter. Another organization was providing informal training about how employees could reduce the amount of spam they received in addition to using the spam filter.

MONITORING THE RESULTS

The monitoring step in the proposed process involves ensuring that the needs of the organization are being met by the implemented alternatives. The results of the alternatives should be compared to the expected benefits and costs identified in previous steps of the process.

In general, the organizations the authors interviewed were using informal monitoring processes.

SUMMARY

For the last few years, the business press has suggested that spam is a major problem for organizations. It is clogging systems, causing problems with processing speed and employee productivity and increasing the IT costs of organizations as they try to address its effects. To help organizations address this threat, the authors proposed a formal process for responding to the effects and costs of spam. However, in the preliminary interviews the authors conducted with non-profit organizations, the authors found that some organizations did not experience these significant effects. One organization had experienced server crashes, but upon moving to a dedicated email server with a spam filter, the problem essentially disappeared. Therefore, the formal process would not be helpful for these organizations.

According to the literature, spam filters are an effective and popular way for organizations to address the effects of spam. The literature has also suggested that in addition to spam filters, more robust spam fighting techniques, such as secure messaging and challenge/response, are needed to adequately address spam. The organizations the authors interviewed had addressed spam with spam filters because the filters were included in the antivirus and security software packages they were installing on their email servers. They were not using any additional software to fight spam.

CONCLUSIONS AND FUTURE ISSUES

The data gathered in the initial interviews with non-profit organizations do not support the claims of the business press that spam is a major threat to organizations. Thus, while the authors propose a formal process for analyzing the effects of spam and the alternatives for addressing spam, the preliminary results suggest that such a process is not necessary. Further data must be collected to determine whether the initial interviews are representative of for-profit organizations and other non-profit organizations. Additional interviews and surveys of organizations will be conducted by the authors.

Additional research should also be conducted to determine whether the proposed process would be valuable to organizations if it was generalized to include additional threats, such as pop-ups, instant messaging, viruses, worms, and other security issues. These threats have been identified in the literature and were mentioned by the organizations the authors interviewed. Expanding the process to include them might better help organizations maximize the benefits and minimize the costs of addressing these threats.

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WHAT THE MANUAL DIDN'T TELL YOU ABOUT POWERPOINT

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ABSTRACT

Ever since students entered into a formal learning arrangement with faculty, faculty have used a variety of tools to explain and to transmit concepts. These tools have included simple chalk boards to more sophisticated software packages much as IBM's Storyboard, Asymetrix's Compel, Harvard Graphics, and more recently Microsoft's PowerPoint.

Currently, Microsoft's PowerPoint has market dominance and is often considered the tool of choice for guiding class presentations. PowerPoint is, however, not free from criticism. Some of that criticism is directed at the software, specifically at its formulaic approach via templates and wizards to presentations that provide "cookie cutter" presentations to sometimes jaded audiences. Some critics have been bold enough to label this as "death by PowerPoint."

Users of PowerPoint are not without responsibility in the development of their presentations. The issue is not just the use of templates and wizards and cluttered slides, but also the presentation of three-dimensional data on a two-dimensional medium. Edward Tufte addresses many of these issues and makes several recommendations that are explored in this paper.

The paper describes in some detail the tricks and tools that have been, or could be, used to create both effective and ineffective PowerPoint presentations. The paper then concludes with a series of recommendations for effective presentations.

INTRODUCTION: A HISTORY OF PRESENTATION TOOLS

A variety of tools and technologies have been developed to assist in student learning and the organization of materials for presentation in professional, public, and educational settings. These include chalk boards, whiteboards, flipcharts, transparencies, smart boards, LCD panels, and software tools such as Microsoft's PowerPoint.

One of the earliest, widely-available, PC authoring tools was IBM's Storyboard. This product saw a number of evolutionary steps, but is no longer available. Storyboard appeared sometime in early 1985 or 1984 (Version 1.1 is dated 1985). The product lived up to its name since it used the concept of a storyboard long used by script writers and producers.

Storyboard lasted at least into 1993 as "Storyboard Live." One of the key characteristics (of later versions) was the "if-then-else" branching capability. One of its strengths adopted by other

software packages was color, on screen, presentations. These and similar capabilities were used in a well known theatre project, *Florimène at the Court of Charles I* (http://www.videoccasions-nw.com/history/florimene/flori1.html).

Harvard Graphics (Harvard Graphics, http://www.spco.com/about.asp) appeared on the market in 1986 in a DOS-based version. The Window's version appeared in 1991. Harvard Graphics claims that it was the "first presentation graphics program to include text, graphs and charts in one program." The early versions of Harvard Graphics were designed to generate printouts or transparencies for use with projectors. As computer technology advanced, Harvard Graphics released a version that would allow projection directly from the computer.

In 2001, Serif Incorporated purchased Harvard Graphics, and it now comes in a variety of flavors. The premier version includes the presentation software, a charting system with multiple effects and data analysis, Web publication, photo editing, animation, import options, and a viewer. The product has won a number of awards in its almost two-decades of use, but has fallen from its premier position in the market.

Asymetrix's Compel was an early product that had sophisticated tools very similar to tools now available in PowerPoint. Objects, both static and animated, could be moved along a line or between slides to give the true appearance of cartoon animation. Compel is no longer available and one of Asymetrix's other products, Toolbook, is now distributed by SumTotal (http://www.sumtotalsystems.com/). Compel is not mentioned on the SumTotal site.

PowerPoint by Microsoft now holds the market leader position and has incorporated many of the key features found in Storyboard (presentation on screen), Harvard Graphics (chart tools) and Compel (animation). While some of these products and others such as WordPerfect's Presentations and freeware/shareware provide some competition and innovation, it now appears that Microsoft must rely on itself for innovation. To a certain extent, they have lived up to the demands of the market place with the introduction of Office 2003.

FEATURES OF POWERPOINT

PowerPoint has incorporated, adopted, or modified and enhanced many of the successful features of its predecessors and competitors. These include the storyboard concept, the slide metaphor, and the ability to modify some graphics and to add graphs and charts based on dynamic data.

The slide metaphor uses the concept of 35mm slides to arrange a presentation. A presentation consists of a number of "slides" containing combinations of images, text, and charts. If the creator of the presentation wishes to make a "live" presentation, the slides are presented in sequence according to the order shown in the "slide sorter" view. In the slide-sorter view, the creator can rearrange, and hide slides. In addition, this view can be used to incorporate transition effects and build self-running shows.

Another view, the "Normal View," allows the designer to create slides, add speaker notes, and see the presentation in either outline or sorter view. This view also allows the user to rearrange slides either by using the outline or sorter. Outlines from Word documents can be ported into PowerPoint for rapid creation of a companion presentation. Conversely, an outline in PowerPoint can be used for the skeleton of a document in Word.

For those who need a presentation created for them, PowerPoint provides a number of wizards and templates. For example, the "AutoContent Wizard" provides eighteen options for creation of a presentation ranging from "generic" to "Product/Services Overview." Design templates provide a variety of colorful layout schemes. Other "useful" tools include grouping, and ungrouping.

Grouping objects is a time-saving strategy. Once the objects have been grouped, they can be treated as a single object, and attributes can be applied to all objects in the group at one time. Some PowerPoint objects, such as images, can be ungrouped and then used to form new images or special animation. A Windows Metafile (.wmf) can be converted into a drawing object, ungrouped and edited. Files in bitmap, .jpg, .gif, or .png format cannot be converted to drawing objects and then ungrouped.

Adding sound and special visual effects such as animation to a presentation can generate interest, but can take inordinate amounts of time. Time-saving steps include the use of preset animation schemes and preset motion paths for text, graphics, bullets, and other objects. Numbered tags, corresponding to the effect applied, are quick ways to review which animations are applied to which slides. It is always a good practice to preview or test the animation once it has been applied.

Animated graphics created using Macromedia Flash® and saved as a Shockwave® file can be played using a specific ActiveX control and the Macromedia Flash Player. You can address this in one of two ways: the ActiveX control can be added to the slide then a link can be created to the Flash file or you can embed the Flash file in the slide.

Sound files such as music add appeal to your presentation, but care should be taken with regard to accessing these files. Linked sound files must be stored in a separate source file then linked to the destination file, your presentation. Making changes to one file will cause changes in the other since the files are linked. Embedded sound files, on the other hand, are slightly different. Embedded sound files are also stored in a separate source file, but are inserted in the destination file as part of the slide or presentation. You must make changes in both files because changes in the source file will not be evident in your presentation. A rule-of-thumb is that sound files over 50 MB should be linked. If you are showing your presentation on another computer ensure that the source files that contain your linked source files and corresponding folder are saved on the computer you are using. If you are saving your source files to a CD-ROM, be certain that the software used to create the CD is compatible with the computer you will be using for the presentation. You may also use the Package for CD provided in PowerPoint.

Hyperlinks from a slide to a Web page or Web file can be in the form of text or an object such as a graphic. Hyperlink information for the destination page is either encoded as a URL or is contained in the Web browser.

DEATH BY POWERPOINT: LIES AND OTHER TRUTHS

With all the power and capabilities inherent in the PowerPoint program and with the great strides in making the program easier to use, how can anything go wrong? As with anything else, the power can be used for good or ill. Lying in PowerPoint, for example, occurs in ways similar to lies in other graphic-intensive media, except it might be easier to construct lies in PowerPoint because of the ready availability of clipart and photographic images. In the opinion of Edward Tufte, a lie occurs when graphics are not "directly proportional to the numerical quantities represented" (1983,

56). If gasoline prices have doubled within a certain time period, the naïve (or devious) presenter might consider using two gasoline pumps to show a comparison, one for before the price increase, one for after. The problem is, however, that while the price variable increases in only one dimension (height), the image of the pump increases in two dimensions (height, width). With the height and width of the pump doubling, the image actually increases fourfold (2 X 2). In addition, if the pump is given the appearance of having depth, it now has three dimensions (height, width, depth), so it increases eight-fold (2 X 2 X 2) in size.

Other ways to lie in PowerPoint are familiar to anyone who uses charts to depict numerical data. One method is to present visual representations of data out of context to "emphasize" trends or imply cause-and-effect relationships that might not otherwise be apparent. For example, let us assume that, after a certain vaccine has been given to a sample population in New Jersey, during the following year cases of the target disease have gone down considerably. Seems as if the vaccine worked. But what if a more complete presentation of the data shows that cases of the disease have over the last several years risen and fallen periodically, and the trend suggested for this year was probably going to be downward anyway? What if other states that did not introduce the vaccine also experienced a decline in the disease? The neat correlation that appeared to exist between the administering of the vaccine and the declining disease cases has suddenly become tenuous. The lie often becomes more difficult to sustain when additional context is supplied.

One might also adjust the scale of bar or column charts, such as adding more data points on the x axis or not starting with a zero point on the x axis, to create dramatic effects (Fink, 16-17). By making simple (and apparently innocuous) changes to the axis scales, the presenter can make the data appear to support different conclusions. Because the graphic images can be so large and dramatic in a PowerPoint presentation, it is particularly important for the presenter to be honest in their creation.

RECOMMENDATIONS FROM THE EXPERTS: REVIVING THE AUDIENCE

Regardless of the presenter's skill in creating sophisticated, technically dazzling performances, the two essential points of purpose and audience still must be addressed for the presentation to be successful. What is to be accomplished? What does the creator of the presentation expect the audience members to know or perhaps to do as a result of the presentation? Who are the audience members? What are their ages, and cultural, religious, and ethnic backgrounds? Mixed or same gender? Work experiences? What are they expecting from the presentation? If they are expecting an informal chat session in a small room with an expert, the 40-slide presentation with audio and video set up for a large auditorium is seriously overdone and out of place.

Once one has established that a PowerPoint (or similar) presentation is appropriate to the purpose, audience, and setting, several guidelines about the "construction" of the presentation can contribute to its success. Some of these include emphasizing important ideas by placing them at the beginning and end of your presentation, and "chunking" ideas by taking many topics and categorizing them into related "chunks" (Munter, 2002). Other decisions will involve the creation and use of visuals. Visuals enhance the persuasiveness of the material and the audience members' perception of the presenter. They also assist the audience members to pay attention and to recall information (Morrison and Vogel, 1988)

A caution about overdoing the visual gimmicks: Data can be obscured by "chartjunk" - data legends, cross-hatching, clipart – in short, almost all the visual elements amateurs use to create what they believe will contribute to a memorable visual experience. However, simplicity is almost always a better approach than complexity when it comes to using what Tufte calls "non-data ink." Whatever does not contribute to the data, or the clear presentation of the data, according to Tufte, should be eliminated.

In more specific criticisms about PowerPoint itself as a presentation medium, Tufte maintains that it suffers from "extremely low resolution." This low resolution leads to "impoverished space," which in turn leads to "over-generalizations, imprecise statements, slogans, lightweight evidence, abrupt and thinly-argued claims." Because each slide can provide so little information, many slides are needed. Audiences, says Tufte, "consequently endure an endless sequentiality, one damn slide after another." "The fans of PowerPoint," he continues, "are presenters, rarely audience members" (Tufte, 2003, p. 4).

Regarding color combinations: Often it is too late to change the color combinations of your slides after you have gotten to the presentation site. The best combinations of colors on the computer monitor, most presenters have discovered to their dismay, rarely look the same on the screen. Sometimes the templates and wizards can be helpful in making choices about which color combinations work best together. Black on a white background is usually a safe bet, as are dark red, dark green, or dark blue on a white background. (Sorenson, 2001). Still, however, a test run under actual conditions is the surest way to be confident that the presentation will be both visible and readable to an audience.

About point size and font families: While different font sizes and effects can effectively be used for emphasis (Sorenson, 2001), beware of the ransom note school of fonts and text effects. Resist the urge to bold everything, because if everything is bold nothing is bold. Resist also the urge to get in an arms race with yourself by italicizing, bolding, and underlining everything because that creates an unreadable mess. Less, as the saying goes, often is more. Take a cue from the television ad that had all grayscale images except for one spot of color on the screen. How distinct and dramatic that spot appeared!

In spite of the many well-founded criticisms of PowerPoint and its predecessors, the developer is the one finally responsible for its content. While PowerPoint literally does what the designer wishes (within the limits of the software), PowerPoint does facilitate a coherent presentation. The sequentiality of the product, though a potential problem, does require the designer to formally organize thoughts.

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TEACHING MULTIPLE DUMMY VARIABLES: STANDARD ERRORS FOR SHIFTED INTERPRETIVE FRAMEWORKS

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ABSTRACT

When teaching introductory statistics courses some facets of multiple regression are not covered. One such facet deals with statistical problems using multiple dummy variables. The conventional coding scheme involves the binary interpretative framework, i.e., the dummy variable will have a value of 1 or 0, depending on whether a given characteristic is present or absent. The recommendation is to delete a category from each of the qualitative variables. The interpretation for each dummy variable category coefficient is then made relative to the omitted category. The teaching of multiple dummy variables is usually "wrapped" at this point as the interpretations become more complex. Shifted interpretative frameworks, such as Suits and Sweeny-Ulveling, are available which allow the teaching of the interpretation of dummy variable coefficients relative to "an average" of the dependent variable The shifted frameworks also provide coefficients for the omitted categories. Another advantage of the shifted coefficients is the predicted value for the dependent variable can be estimated by simply determining to which categories the individual or groups belong, and then summing the coefficients (positive or negative) associated with these categories with an overall average. Since the coefficients show the extent to which a category deviates from the dependent variable average, the standard errors of the shifted frameworks coefficients allow for a significance test of each category's difference.

The purpose of this paper is to provide a procedure (macro) to generate the Suits and Sweeny- Ulveling shifted interpretative coefficients and standard errors. The procedure utilizes the binary coding framework output obtained from the statistical package, Minitab. The procedures' output will allow for an extension of coverage when teaching multiple dummy variables in the basic statistics courses.

NEW APPROACHES TO ONLINE PROCUREMENT

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ABSTRACT

The dramatic growth of the Internet and the rise of online commerce are providing new hope for changing many costly, time consuming, and inefficient procurement processes. In recent years, many major industries have begun using Internet technologies to improve negotiation tactics and re-engineer procurement processes in ways that reduce the cost of doing business. A key Internet technology used to improve negotiations is the electronic reverse auction. This paper outlines the potential of reverse auctions for procurement negotiations, evaluates the current use of reverse auctions by major companies, and reviews the advantages and disadvantages of reverse auctions. The paper concludes with some specific recommendations about when to use and when not to use reverse auctions in procurement negotiations.

PROCUREMENT ARRANGEMENTS

Buyers and sellers can develop a variety of different procurement arrangements (Heide, 1994). At one end of this spectrum of procurement arrangements is the transactional model in which buyers and sellers create contracts for specific transactions. The procurement negotiation process is focused on specific transactions. Each party to the transaction views the transaction negotiation of price and other terms in a win-lose framework

At the other end of the spectrum, buyers foster collaborative procurement arrangements in which the buyer and suppliers focus on identifying mutual benefits. By sharing knowledge and and creating implicit understandings in an environment of trust, buyers and sellers negotiate procurement activities and processes. These collaborative processes often involve more than one product or service and can develop into relationships that last for many years. Indeed, in strategic sourcing relationships, the parties make significant mutual financial investments and often search for business opportunities that they can exploit as partners.

Most purchasing relationships fall between these two extremes. For example, some transactional relationships involve long-term contracts that are reviewed every few years. In these cases, buyers can develop considerable experience with suppliers over the term of the relationship. The degree of the continuing relationship between buyers and suppliers can be an important factor in determining whether or not the use of reverse auctions is advisable.

REVERSE AUCTIONS

In a reverse auction (also called a seller-bid auction), multiple sellers submit price bids to an auctioneer that who represents a single buyer. The bids are for a given amount of a specific item

that the buyer wants to purchase. The prices go down as the bidding continues until no seller is willing to bid lower. Reverse auctions are sometimes used in business-to-consumer (B2C) transactions, but the vast majority of these auctions (and by far the largest portion of the dollar volume of these auctions) involves buyers and sellers that are both businesses or not-for-profit organizations. In many business-to-business (B2B) reverse auctions, the buyer acts as auctioneer and screens sellers before they can participate.

In a typical B2B reverse auction, the buying organization prepares specifications for the goods or services to be bought, and then decides how to structure the online auction event and when to schedule it. The buying organization then selects bidders, sends them copies of the specifications, clarifies any conditions that will exist in the final purchase agreement, explains bid rules, and arranges for the suppliers' employees (who will be doing the bidding) to be trained. During the auction event suppliers log on to a Web site created for that specific reverse auction and place bids.

In some reverse auctions, called open-bid auctions, suppliers are provided with a continual view of the prices being entered by their competitors. In sealed-bid reverse auctions, suppliers either have no information about other bids or only see their rankings in relation to the other suppliers' bids. Typically, reverse auction events are scheduled to run for an hour, but many include a provision that automatically extends the auction if bidding occurs within the last few minutes of the original event period. The main objective of a reverse auction is to obtain the lowest cost possible. Because the reverse auction event is conducted online, the buyer's procurement staff and executives can observe the event as it occurs. The results gained from reverse auctions can be made highly visible within the buyer organization.

Many businesses are creating various types of electronic marketplaces to conduct B2B transactions (Eng, 2004). Many of these marketplaces include auctions and reverse auctions. Jap (2003) reports that in 2001, glass and building materials producer Owens Corning held more than 200 reverse auctions for a variety of items including chemicals (direct materials), conveyors (fixed assets), and pipe fittings (MRO). Owens Corning even held a reverse auction to buy bottled water. Asking its suppliers to bid has reduced the cost of those items by an average of 10 percent. Because Owens Corning buys about $3.4 billion of materials, fixed assets, and MRO items each year, the potential for future cost savings is significant.

Both the U.S. Navy and the federal government's General Services Administration are experimenting with reverse auctions to acquire a small part of the billions of dollars worth of materials and supplies they purchase each year (Hannon, 2003). Companies that use reverse auctions include Agilent, BankOne, Bechtel, Boeing, Raytheon, and Sony (Emiliani, 2003).

Not all companies are enthusiastic about reverse auctions. Some purchasing executives argue that reverse auctions cause suppliers to compete on price alone, which can lead suppliers to cut corners on quality or miss scheduled delivery dates. Others argue that reverse auctions can be useful for non-strategic commodity items with established quality standards. However, as R. Gene Richter noted in a 2001 interview published in *Purchasing*, "Everything is strategic to somebody. Talk about ballpoint pens. A secretary has spots all over her brand new blouse because the pen you bought for a cent and a half is leaking." Companies that have considered reverse auctions and decided not to use them include Cisco, Cubic, IBM, and Solar Turbines.

CONCLUSIONS

With compelling arguments on both sides (see, for example, Carbone, 2003; Erdmann, 2003), the extent to which reverse auctions will be used in the B2B sector is not yet clear; however, some guidelines for deciding whether or not to use reverse auctions are beginning to emerge. In some industry supply chains, the need for trust and long-term strategic relationships with suppliers makes reverse auctions less attractive (Dunn, 2003). In fact, the trend in purchasing management over the last 20 years has been to increase trust-based relationships that endure for many years. Using reverse auctions replaces trusting relationships with a bidding activity that pits suppliers against each other and is seen by many purchasing managers as a step backward.

In some industries, suppliers are larger and more powerful than the buyers. In those industries, suppliers simply do not agree to participate in reverse auctions. If enough important suppliers refuse to participate, it is impossible to conduct reverse auctions. In industries where there is a high degree of competition among suppliers, however, reverse auctions can be an efficient way to conduct and manage the price bidding that would naturally occur in that market (Krizan, 2003; Magstadt, 2003). Supply chain conditions that are favorable for the use of reverse auctions include:

Suppliers are highly competitive
Product features can be clearly specified before the auction event
Suppliers are willing to reduce the margin they earn on the product
Suppliers are willing to participate in reverse auctions

Supply chain conditions that can discourage the use of reverse auctions include:

Product is highly complex or requires regular changes in design
Product has customized features
Long-term strategic relationships are important to buyers and suppliers
Switching costs are high

Reverse auctions work well for items that are interchangeable; that is, commodities that can be produced by a variety of suppliers. Specialized or patented products are not good candidates for reverse auctions. Simple items with few parts are good candidates because such products tend to be highly reliable. High reliability helps reduce post-auction costs. Highly interchangeable commodities are good choices for reverse auctions because they make the events attractive to more suppliers. The specification for an interchangeable commodity is likely to be better understood by a vareity of suppliers as well. A misunderstanding in specifications can lead to serious problems , including unfair competition during the auction and a resulting purchase of a product that is not constructed satisfactorily.

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A VALUE CHAIN PERSPECTIVE OF KNOWLEDGE DEFINITIONS AND TRANSFORMATIONS

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ABSTRACT

Knowledge Management exists at the intersection of human and computer-based knowledge systems, but rigorous research is hindered by the inconsistent and contradictory definitions given to such basic terms as knowledge, information, and data. One major school of thought is inspired by Polyani, who argues that all knowledge resides in the mind, which implies that knowledge does not exist in computer-based form. A second school of thought defines knowledge in terms of a value chain, and classifies expert systems as explicit knowledge in the Knowledge Hierarchy.

By extending and integrating theories from the value chain theorists, we propose the Value Chain Knowledge Hierarchy. It classifies knowledge into three classes based on its usefulness in performing a task. Facts are defined as observed values, Influences are defined as processed data in context that assists in making a decision, and Solutions are defined as an unambiguous set of instructions to be used in performing a task.

Evaluation of knowledge transformations from different theoretical and practical perspectives identifies transformations previously unreported in the literature. Facts may be transformed directly into Solutions. Additionally, the data used in Solutions or Influences may become Facts if used in a different context.

INTRODUCTION

A major difficulty in the research of Knowledge Management is the lack of a consistent vocabulary. After over 2,400 years of debate, the definition of knowledge is unclear. Without concise, accepted definitions of the key concepts in the domain, rigorous discussion is difficult. When transformations of knowledge are discussed, definitional differences are especially hazardous, as one man's knowledge is another man's information.

A common theme in the Knowledge Management (KM) literature is that data is combined to create information, and information is combined to create knowledge (Alavi 2001). There is a consensus that data are discrete facts. But after that, consensus is lacking, so we will provide a review of the many definitions for information and knowledge.

Information has been defined as: data in context (Galup et al. 2002, Zack 1999), result of analyzing and interpreting data that carries meaning (Bourdreau 1999), raw material (Dreske 1999),

relating to descriptive and historical fact (Kock and McQueen 1998), interpreted data (Vance 1997), analyzed data (Harris 1996), answers to the questions who, what, where, when, and how many (Ackoff 1996), data with special relevance and purpose (Drucker 1995), organized or structured data (Bohn 1994), data that makes a difference (King 1993), and factual statement (Kogut and Zander 1992). The most common component of these definitions is the notion that information is data that has been processed and / or placed in context (Galup 2002, Bourdreau 1999, Kock and McQueen 1998, Vance 1997, Harris 1996, Drucker 1995, Bohn 1994, King 1993).

There is even less consensus about the meaning of knowledge. The two major streams of research into the definition of knowledge are that knowledge is part of a value chain, and that knowledge is information stored in the mind of individuals. Some common definitions of knowledge from value chain researchers are: integrated information in context (Galup et al. 2002), a production made from raw material – information (Dretske 1999), the power to act and make decisions (Kantner 1999), meaningfully organized accumulation of information (Zack 1999), professional expertise appropriate for the domain (Bourdreau 1999), things that are held to be true and drive people to action (Bourdreau 1999), justified personal belief that increases an individual's capacity to take effective action (Alavi 1999), information made actionable in a way that adds value to the enterprise (Vail 1999), information valuable for an organization (Greenwood 1998), new insight or predictive understanding (Kock and McQueen 1998), information in context, together with an understanding of how to use it (Davenport and Prussak, 1998), information that has been authenticated and thought to be true (Vance 1997), selected useful information for a job (Knapp 1997), information made actionable (Mahlitta 1996), and contained in instructions, know-how (Ackoff 1996),

The second school of research about knowledge defines knowledge as a property of the human mind. Among others, Tuomi (1999) and Fahey and Prusak (1998) argue that knowledge does not exist outside of the human mind, and it is shaped by the individual's needs and current stock of knowledge.

One impact of these definitional differences occurs when discussing knowledge transformations. It is common to consider knowledge as arranged in a Knowledge Hierarchy, where data is transformed into information, and information is transposed into knowledge. For example, how do we classify an expert system? From a value chain perspective, the expert system contains knowledge. From the perspective that knowledge is contained only in the human mind, the expert system is classified as information and the human input to the expert system would be classified as knowledge.

To further examine these problems, we will now examine the use of these definitions in knowledge transformations. We will then provide a new definitional scheme for knowledge and discuss knowledge transformations. We will conclude with some directions for further research.

THE KNOWLEDGE HIERARCHY

The most common paradigm in the KM literature is of a Knowledge Hierarchy (Nissen et al. 2000, Davenport and Prusak 1998), as depicted in Figure 1. The Knowledge Hierarchy depicts the conventional concept of knowledge transformations, where data is transformed into information, and information is transformed into knowledge.

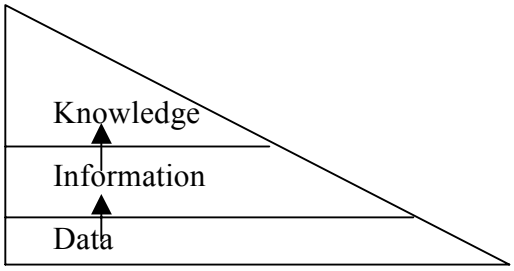

Figure 1: Knowledge Hierarchy

Variations on this central theme include Tuomi (2000), who proposes an inverted hierarchy. His position is that knowledge is required to represent information, which must be done to store data. Nissen (2002) extends this concept with a model containing two hierarchies. One hierarchy models the view of the knowledge seeker, where the second hierarchy is inverted and represents the view of the knowledge creator. From the creator's perspective, knowledge is necessary to create information, which in turn is necessary to create data. From the seeker's perspective, data is placed in context to create information, and information that becomes actionable is knowledge.

KNOWLEDGE DEFINITIONS FOR KM

In light of the many definitions of knowledge and the importance of definitions of knowledge to the topic of knowledge transformations, it is important to derive a consistent understanding of the terms used to describe the various components of knowledge. We will adopt a position similar to the value chain perspective. To avoid confusion with earlier research, we will use the terms Facts, Influences, and Solutions to describe the classes of knowledge.

Most value chain researchers posit that data is the raw material of knowledge; that data is processed and integrated to create knowledge, and information is processed and integrated to create knowledge. We consider the contents of a database to be an example of raw material, although some may argue that the contents of the database are information because that are in context and knowledge is needed to store contents into the database. We will use the term Facts as an approximate synonym for data.

Facts are defined as "atomic attribute values about the domain."

The second level of the Knowledge Hierarchy, information, is created by the processing and integration of data, often guided by the human mind. An Executive Information System, for example, processes the data in a database and provides summations of the data. The role of information is to be one of several considerations which are considered when making decisions, so we will use the term Influences as an approximate synonym of information.

Influences are defined as "data in context that has been processed and/or prepared for presentation." Many influences may impact upon a decision.

The final level of the knowledge hierarchy, knowledge, is considered to be created by the processing and integration of information and data. To distinguish information from knowledge, many of the value chain researcher's definitions of knowledge reviewed earlier imply or explicitly state that actionability is an attribute of knowledge. While Facts provide a foundation for the creation of information and knowledge and Influences provide insight into a decision, knowledge is seen as a complete solution.

Solutions are defined as "integrated, verified information and data in context combined with the ability to use the information."

Now that we have derived definitions suitable for both tacit and explicit knowledge, let us consider the transformations of the various classes of knowledge.

KNOWLEDGE TRANSFORMATIONS

While the Knowledge Hierarchy is a well known paradigm in KM, other research indicates flaws in the paradigm. Not all researchers are in agreement with the one way transformation from data to information to knowledge. For example, Tuomi (2000) argues for an inverted tacit hierarchy, where Spiegler (2000) argues for a double hierarchy for explicit systems.

The Knowledge Hierarchy dictates that data is transformed into information and information is transformed into knowledge. We contend that this is not always an accurate or complete description of the behavior of knowledge transformations. More specifically, data can be transformed directly into knowledge and knowledge in one domain is transformed into data when used in another domain. Let us give three short examples.

Neural networks are trained by exposure to raw data. The neural network analyzes the data and automatically converges on a solution, which can then be tested and deployed. In this example, data is transformed directly into knowledge.

An individual may possess all of the tacit knowledge necessary to solve a problem without having any explicit knowledge. This knowledge could be extracted by a knowledge engineer and used to create an expert system. In this example, tacit knowledge was transformed directly into explicit knowledge without any intermediate information stages.

In addition, knowledge in one domain is transformed to data when used in another context. For example, if Shell's Best Practices knowledge contains solutions for every location of a Shell drill, that knowledge could be used as data to create a listing of all Shell drilling locations.

Graphically, we can represent the transformations possible in the Value Chain Knowledge Hierarchy in a hierarchy, as shown in Figure 2.

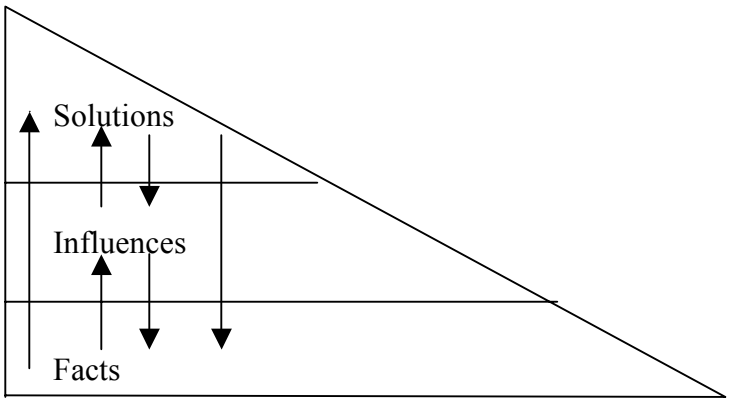

Figure 2: Value Chain Knowledge Hierarchy

The Value Chain Knowledge Hierarchy can also be used to evaluation of the knowledge assets of a firm by determining the quantity and quality of the knowledge assets at the various levels of the hierarchy. A firm with knowledge assets at the Solutions level would appear to be more advanced in their knowledge management efforts than a firm with assets at the Fact or Influences level.

The Value Chain Knowledge Hierarchy offers definitions that are consistent with many researchers and that are applicable to both tacit and explicit knowledge. It also integrates the Knowledge Hierarchy, Reverse Hierarchy, and Double Hierarchy. Finally, it adds three transformations (tacit Solutions to tacit Data, explicit Solutions to explicit Facts, and explicit Facts to explicit Solutions) to those previously expressed in the literature.

DIRECTIONS FOR FURTHER RESEARCH

While this paper has focused on transformations in general, more research is needed into the specifics of how these transformations take place in explicit systems. For example, data contained in databases at the Fact level can be transformed into information by data mining and Decision Support Systems. A flowchart of the transformations of explicit knowledge can be used as a guide to future Knowledge Management efforts. When used as a guide to further Knowledge Management efforts, the flowchart would indicate that the existence of a "Yellow Pages" of experts in a domain would facilitate the building of an expert system in the same domain.

We hope that this paper will encourage more research into the theory and practice of Knowledge Management. The extended paper and references are available from the authors.

A DECISION SUPPORT SYSTEM MODEL FOR FORECASTING IN INVENTORY MANAGEMENT USING PROBABILISTIC MULTIDIMENSIONAL DATA MODEL (PMDDM)

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ABSTRACT

Decision-making in today's business world requires extensive use of huge volumes of data. Real world data contain uncertainty and change over time. There is a need to have access to decision support systems that efficiently handle voluminous data, uncertainty, and modifications to uncertain data. An algorithm using mathematical concept based on set theory, probability axioms, and the Bayesian framework, as well as algebra to manipulate data and a framework to modify data, are developed and a decision support system (DSS) model for business area of Inventory Management is presented. The DSS model is in continuous process improvement and it has made significant progress over prior models.

INTRODUCTION

Businesses today are recording volumes of data reaching terabytes in size. Millions of transactions among retail chains, utility companies, banks, and insurance companies take place each day. Representative financial transactions of the International Technology Group (ITG) report indicate that a telecommunications company receives over 80 million transactions a month, or approximately 2.6 million transactions per day (ITG, 2000). It would be humanly impossible to interpret these transactions to find, for example, which class of customers makes more long distance calls. Similarly, a representative retail chain with 63 supermarkets selling 19,000 products can record a staggering 3.6 million transactions per day (SUN-Microsystems, 1999). Even a small percentage of waste or fraud will result in a loss of millions of dollars and, consequently, higher prices to customers. At same time, manual inspection of these data is not possible, as they are imprecise and change continuously.

Decision Support Systems (DSS) are used to support managerial decisions. Usually DSS involves analyzing many units of data in heuristic fashion (Inmon, 1990). To make optimal decisions using large volumes of data, managers of large enterprises need decision support systems that interpret huge volumes of uncertain data as well as handle data modifications. For example, a manager assigned to maintaining inventory for a given product category finds that demand for products changes continuously based on variables such as popularity, price, discount, advertising, and competition. Many of these variables cannot be measured precisely. In addition, these variables

by themselves do not identify required quantities of a product precisely, although historical information gathered weekly may be used to forecast demand.

Any forecast is subject to uncertainty; however, a database storing weekly forecasts may be generated and compared to actual sales data after the fact. When this process is applied continuously, the result is a dynamic database accumulating uncertain data. Once such a database is generated, managers may use On Line Analytical Processing (OLAP) and data mining techniques to make better decisions. Researchers have proposed several data models based on multiple dimensions, referred to as multidimensional data models. Most of them are based on a concept called *data cube*. Data cubes are primary data structures in OLAP and Data Warehousing (DW) products. Thomas and Datta (2001) proposed one such conceptual multidimensional data model. Advantages of this model include its theoretical framework and associated algebra, which is relationally complete, consistent, and closed. Moole (2003) proposed several enhancements to this model. This enhanced model is referred to as *Probabilistic Multidimensional Data Model* (PMDDM), with its most important enhancement being the addition of a framework based on probability theory to handle uncertainty—an important category of OLAP functionality requirements (Moole, 2003). Other enhancements include uncertainty-related algebraic operations. The model did not provide much required data modification framework or any analysis of its efficiencies. This represented an important area for further research on PMDDM (Moole, 2003).

The purpose of this study is to develop an application for decision support system using probabilistic multidimensional data model of Moole (2003) in the area of business in Inventory Management.

APPLICATION OF MODEL IN BUSINESS MANAGEMENT

In this section, a business management application is used to describe the PMDDM mathematical model. It is described with details similar to general market conditions. This application is for a grocery retail chain, which has several retail stores throughout the nation. General grocery store inventory management is done by category, referred to as *category* management. Category management involves dividing an entire store inventory into different categories such as fresh foods, soft drinks, cereals, and snacks. The rationale behind this is that consumers are more interested in a category of groceries than in a particular brand name product. For example, consider a consumer shopping for a party. One may be more interested in buying soft drinks than in Coke, Pepsi, or any other brand name product in particular. A primary advantage of this method of inventory management is that it does not require forecasting based on individual products within the category, therefore eliminating the requirement to capture and process data for individual products. Categorization of inventory simplifies data collection, storage, and analysis, and demand forecasting (Mantrala & Raman, 1999; Symbol, 2004). However, this simplification also results in loss of forecast accuracy and prevents inclusion of product specific promotion and competition information in forecasting process.

The most common process for inventory management, according to Symbol (2004) is as follows: The reordering process in use today relies entirely on human estimations. Using a handheld mobile computer with integrated bar code scanner, the department or night crew manager walks the store isles scanning bar code labels on shelves or products. Most systems enter an order for a single

case of each item scanned unless a larger order quantity is manually entered. When all needed products have been ordered, the mobile computer is connected to a phone line and the order is sent to the store's distribution center. The entire process can take 3-4 hours if done correctly. Normally, orders completed and sent to the distribution center by nine o'clock in the morning arrive at the store by seven o'clock in the evening so the night crew can restock the shelves.

This method of reordering heavily relies on the experience and educated guess of a single person. It could lead to inaccurate demand forecasts resulting in either overstocks or out-of-stocks (OOS). Overstocking costs money in terms of capital investment and shelf space. OOSs result in dissatisfied customers, leading them to competitors. Demand is dependent on several parameters such as category, price, promotion, competition, historic sales, new products, and even weather. Different demand forecast methods use different sets of these parameters in forecasting. Researchers found that forecast based on even primitive analysis of historical data (e.g. forecast based on average for previous week), is generally better than a pure guess (Foote & Krishnamurthi, 2001; Lancaster & Lomas, 1986; Symbol, 2004). Thus, ability to store and analyze historical sales data is a critical component of all these forecasting methods.

In this situation, a decision support system for inventory management, which can store and analyze large amounts of data will be useful. Due to this capability to store large amounts of data, historical sales data for each individual product can be maintained. This facilitates data analysis and demand forecast by product instead of category. The actual category inventory itself simply becomes an aggregation of individual product inventory. Forecasting by individual product also facilitates incorporation of product specific promotion information. For example, if a super bowl promotion advertisement for Diet Coke is running, it is possible to use this information in forecasting sales for Diet Coke. Even though overall soft drinks category sales may not increase, it can be assumed that Diet Coke sales will be higher due to the promotion. This information can be used also to adjust the sales forecast for other products in the soft drinks category (Lancaster & Lomas, 1986).

FORECAST METHOD

The forecast method used for this business application uses historical data, product promotion data, and competition data. For the purpose of this application, *forecast for demand* is considered *forecast for sales*, and these two phrases are used interchangeably. The forecast method utilizes heuristic rules specified below to forecast demand for each product in the category for the next day.

Average sales for the previous week (seven days): Demand is directly proportional to average sales M.

Promotion data for the previous week: Promotional factor, P, multiplies M. P is derived by incorporating total number of promotions.

Competition data (from other retailers in area as reported by agents) for the previous week: Competition, C, decreases sales.

Category sales forecast information: Final category demand, T_f, is equal to average category demand within the previous four weeks, T_a. This means, if tentative category demand, T_t (calculated by aggregating individual product demand in that category), is different from T_a, then the individual product demand has to be adjusted to make T_t equal to T_a.

To forecast demand using the above forecast method, the following information is needed:
Sales data for the previous week for the category;
Product promotion data for the previous week;
Competitor sales information for the previous week, as reported by agents; and
Daily category sales forecasts for the previous week.

Assume that this grocery retail store chain has 40 stores selling 19,000 products averaging 87,000 transactions per day in each store. That is approximately 3.5 million transactions per day and 97.5 million transactions every four weeks, throughout the chain. Assume sales data captured contains product, time, location, price, and amount. If 64 bytes are required to store each of these attributes, the total amount of space required to store the data is 215 MB per day or 6 GB for four weeks. Researchers and practitioners recommend storing data for at least 65 weeks (Foote & Krishnamurthi, 2001), which would require a capacity of about 100 GB to store sales data. Using similar assumptions and requirements for promotion data and competition data, this fictitious retail chain would require about 605 MB per day or 18 GB to store data for 4 weeks or 300 GB to store data for 65 weeks. Due to the large size of these data, only a tiny sample of them will be used to demonstrate usefulness of the PMDDM model.

SALES DATA MODEL

The sales data cube (Multidimentional Data Set) C_{Sales} is defined as:
The characteristic set C = {TIME, PRODUCT, LOCATION, SALES, BELIEF}, (m = 5)
The attribute set A = {day, month, year, product_name, city, state, price, quantity, pS}, (t = 9)
schema of C:
f(TIME) = {day, month, year}
f(PRODUCT) = {product_name}
f(LOCATION) = {city, state}
f(SALES) = {price, quantity}
f(BELIEF) = {pS}
dimension function d:

d (TIME) = 1	i.e., TIME is a dimension
d (PRODUCT) = 1	i.e., PRODUCT is a dimension
d (LOCATION) = 1	i.e., LOCATION is a dimension
d (SALES) = 0	i.e., SALES is a measure
d (BELIEF) = 0	i.e., BELIEF is a measure

A partial order on the Sales cube is as follows:
O_{TIME} = {⟨day, month⟩, ⟨day, year⟩, ⟨month, year⟩}
$O_{PRODUCT}$ = {}
$O_{LOCATION}$ = {⟨city, state⟩}
O_{SALES} = {}
O_{BELIEF} = {}

L is as follows:
Let us assume the following domains for the attributes
A = {year, month, day, product_name, city, state, price, quantity, pS}
dom year = {2004, 2003, 2002, 2001}
dom product_name = {DIET PEPSI, PEPSI, COKE}
dom city = {Boston, New York, Dallas, San Francisco, Chicago}
dom state = {MA, NY, TX, CA, IL}
dom price = {0, 1, 2, …}
dom quantity = {0, 1, 2, …}
pS = 1 (Belief strength of all the cells represented is true, making this a deterministic cube)

Sales data for the last 7 days for DIET PEPSI is specified as follows.
C_{Sales} = {⟨⟨2004,01,01, DIET PEPSI, Boston, MA⟩, ⟨100, 10⟩⟩,
⟨⟨2004,01,02, DIET PEPSI, Boston, MA⟩, ⟨125, 10⟩⟩,
⟨⟨2004,01,05, DIET PEPSI, Boston, MA⟩, ⟨160, 20⟩⟩,
⟨⟨2004,01,06, DIET PEPSI, Boston, MA⟩, ⟨130, 15⟩⟩,
⟨⟨2004,01,07, DIET PEPSI, Boston, MA⟩, ⟨180, 30⟩⟩,
⟨⟨2004,01,01, DIET PEPSI, New York, NY⟩, ⟨105, 10⟩⟩,
⟨⟨2004,01,03, DIET PEPSI, New York, NY⟩, ⟨105, 20⟩⟩,
⟨⟨2004,01,04, DIET PEPSI, New York, NY⟩, ⟨140, 5⟩⟩,
⟨⟨2004,01,01, DIET PEPSI, Chicago, IL⟩, ⟨200, 10⟩⟩,
⟨⟨2004,01,02, DIET PEPSI, Chicago, IL⟩, ⟨105, 10⟩⟩,
⟨⟨2004,01,03, DIET PEPSI, Chicago, IL⟩, ⟨110, 25⟩⟩,

This model can capture real world business data more accurately and queries can be formulated with uncertainity measures. Validation of this model with real world data is in progress. We believe Decision Support Systems based on this model will improve forecasting accuracy in Inventory Management area of business application.

CONCLUSIONS AND FURTHER RESEARCH

This study focuses on developing a decision support system model in the area of inventory management that can efficiently handle huge volumes of data containing uncertainty and is subject to frequent changes. A mathematical concept based on set theory, probability axioms, and the Bayesian framework, as well as algebra to manipulate data and a framework to modify data, are presented. The proposed model can be used to build a decision support system to improve business decision-making that may improve business performance with potential savings to customers. The algorithm in which this application built is in continuous process improvement and it has made significant progress over prior models.

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CONTRASTING WEB-CENTRIC AND PEER-TO-PEER ARCHITECTURES FOR CONSUMER-TO-CONSUMER E-COMMERCE

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ABSTRACT

An exciting area of growth in the world of E-Commerce has been the rapid rise of the Peer-to-Peer (P2P) architecture. While popular, as witnessed by the widespread use of file sharing programs such as KaZaA and Morpheus, this architecture has not yet been fully leveraged into a profitable business model. This paper presents a framework that a P2P architecture with the traditional Web-centric architecture for Consumer-to-Consumer (C2C) e-commerce transactions.

KEYWORDS:
Consumer-to-consumer
E-business
Peer-to-peer
Architecture
E-commerce
File-sharing

INTRODUCTION

This paper analyzes the tradeoffs between a distributed peer-to-peer (P2P) architecture and a web-centric architecture (the dominant e-commerce architecture) for consumer-to-consumer (C2C) online market makers. The analysis is used to compare the relative utility of both P2P and Web-centric architectures to support C2C transactions from information usefulness perspectives.

The analysis of architecture and its fit to business processes is important because the alignment of architecture with user processes is relevant to the success of organizational goals (Carleton, 2002; Eisenmann 2002). Since C2C mercantile interactions are fundamentally the transfer of information, goods and services, and payments between consumer peers, it makes sense that P2P based information architectures be considered for C2C interactions and business models.

A good example of this type of C2C market is the traditional newspaper classified consumer advertisements for well understood products such as cars or appliances. The classified section of the newspaper provides a forum for catalog information for sellers for a fee. This same type of

consumer classified market is available online for web-centric architectures. The Website www.cars.com is a good example.

For our tradeoff analysis, we assume that the P2P architecture is not centrally controlled or managed whereas the Web-centric architecture institutes centralized control over user information and activities. We also assume that C2C sellers have an always-on connection (such as Digital Subscriber Line (DSL) or cable modem), as opposed to a dial-up connection. If the user does not possess an always-on connection, then the analysis becomes trivial because the 24/7 availability of a Web server dominates any tradeoffs.

ANALYSIS OF PEER-TO-PEER AND WEB-CENTRIC ARCHITECTURE TRADEOFFS

Our framework contrasts the general architectural tradeoffs of P2P and Web-centric (client-server) architectures. We recognize that these tradeoffs will vary depending upon the specific application context, so we provide an explanation of how these tradeoffs apply. Using this information, the reader can adjust the analysis to fit their specific context.

Alter (Alter, 2002) has proposed a series of criteria for evaluating E-Commerce models using an information perspective. These are summarized in Table 1 and are used as a basis for comparing the relative advantages of the P2P and Web-centric architectures from an e-commerce consumer perspective. This evaluation also assumes that the user interface criteria (such as usability, user friendliness, responsiveness - etc.) can be made equivalent between the two architectures by proper design of the user interface layer. Since the transactions between buyer and seller over the Internet largely involve information exchange, the criteria are discussed in information terms.

Table 1. Evaluation Criteria from an Information Perspective

	Web-Centric	P2P
Information Quality		
Accuracy	+	
Precision		+
Age	+	
Completeness		+
Timeliness		+
Source	+	
Information Availability		
Availability	+	
Admissibility	+	
Information Expense		+
Information Security	+	
Information Presentation		+
Information Standardization	+	

Information Accuracy: This criterion measures how well the information represents what it is supposed to represent. In centralized systems, a single master copy of the data can be maintained and enforced. Any replication is performed explicitly (usually for backup purposes), so there is little chance that alternate inconsistent files exist. In a distributed P2P system, the same file can exist in several different places. For example, P2P users can download a product information file from the originator. If that downloaded file is modified, then two different files will exist that purportedly refer to the same product – which can breed inconsistencies and errors (Seltzer, 2002; Killdara Corp, 2001). Thus for this measure, the Web-centric architecture has the advantage. Additionally, because information is centrally monitored and controlled in a Web-centric system, inaccurate data can be removed from the system. In a truly distributed system, no such enforcement mechanism exists.

Information Precision: This measure addresses how well the information detail meets user requirements. In a Web-centric architecture that is centrally controlled, the user is restricted to supplying information in the format prescribed by the management authority. This may not allow for the level of information precision desired by the users. For example, a user may wish to provide a high resolution image of a product that exceeds the allowed web server file size. On the other hand, a distributed P2P system allows any desired data to be presented by the user, from videos of the product to detailed images with narration. The buyer and seller select the amount of information, along with the associated bandwidth and storage requirements, that best meet their transaction needs. Thus for this measure, the distributed P2P architecture has a relative advantage over the centralized web architecture.

Information Age: This criterion concerns how old the information is relative to the requirements of the task. In a Web-centric system, information can be controlled and removed from the system by centralized management when it expires (such as when the client sells the product). In a distributed P2P system, the architecture places that responsibility on each user. If users do not remove information from the network, then old, irrelevant information may still be available to users. Thus, the Web-centric architecture has an advantage for this measure.

Information Completeness: This criterion addresses how adequate the amount of information is for the task at hand. The Web-centric architecture, which is centrally managed, can limit the amount and format of information provided by the seller or buyer. The P2P architecture only limits information to that which can be handled by the bandwidth, storage, and format constraints of the buyers and sellers. Thus, the P2P architecture can provide better information completeness due to its scalability (Smaros & Framling, 2001). As an example, the amount of information stored and available to users of KaZaA, a popular P2P application is huge. For example, at 8pm on 16 March, 2004 the following statistics applied to Kazaa:

Over 2.5 million users online
Over 1.4 billion files
Over 4 petabytes (4 million gigabytes) of information
Information formats included audio, video, images, documents, software, and music playlists

Information Timeliness: This measures whether the information is provided quickly enough to meet user needs. In the P2P architecture, the information is available immediately (Merkow,

2000) as soon as the user moves the files into the shared folder. For the Web-centric system, the user must explicitly communicate information to the administrators (Smaros & Framling, 2001) and may need to wait until the user and/or information is approved for posting, which may reduce the timeliness of the data. Therefore, the P2P architecture has an advantage for information timeliness.

Information Source: This measure addresses the credentials of the supplier of the information. Is the source credible, trustworthy, and free from bias? Web-centric systems, with their centralized control, can institute trust mechanisms to verify system users. For example, Ebay provides various utilities for providing feedback on sellers and also for filing more formal complaints. These same types of verification methods are not as robust in a distributed P2P system. Thus, the Web-centric architecture has an advantage for this measure.

Information Availability: This measure addresses the extent to which the necessary information is available to the people that need it when it is required. In practical e-commerce terms, it is expected that data will be available 24 hours per day, 7 days per week (24/7). Web-centric systems can explicitly manage the replication of data and system redundancies to cope with a failure or error. In a P2P system, redundancy can, but does not necessarily, occur. For example files may be copied by prospective buyers, but this may not necessarily happen. Thus, if the file is copied by many users, it is possible that redundancy could be quite good (at the possible expense of information consistency). However, since there is no centralized management, replication of files is not explicitly required. Thus, it is also possible that redundant files may not exist in a P2P system. In a centrally controlled system, redundancy can be enforced. Additionally, 24/7 availability requires that the information source be continuously operating. A centralized web server has people dedicated to keeping the web server operating. This level of reliability may not be available to your average P2P user (Note that this analysis assumes that the P2P users have an always-on internet connection). For these reasons, the Web-centric approach has an advantage over P2P when it comes to information availability.

Information Admissibility: This criterion focuses on whether the information provided is socially, culturally, or legally appropriate. In a Web-centric system, management can remove objectionable information, whereas this does not occur in a distributed P2P system. For example, Ebay management removed items by individuals attempting to sell debris from the Space Shuttle accident. This problem with P2P has also been heightened by the wide press coverage of P2P sites such as Napster, that may be involved in intellectual property thefts (Carleton, 2002). Thus, the Web-centric system has an advantage for this criterion (unless the seller or buyer are specifically interested in exchanging inappropriate information).

Information Expense: This measure deals with the cost of executing transactions. In the P2P architecture, client software interacts directly with other client software. The expenses associated with data storage and bandwidth are borne by the client. With a Web-centric architecture, these expenses are borne by the manager of the Website. It is assumed that these bandwidth and storage costs, plus any profit, are then passed on to the users as fees (Smaros & Framling, 2001). If one assumes that a significant portion of user bandwidth and storage stands unused and idle, then the marginal costs of adding the P2P functionality will be small. Thus, from a user perspective the P2P architecture has an advantage.

Information Security: This measure addresses the level of protection against unauthorized information access or alteration. Centrally managed security can be more attentive and sophisticated

than security that relies on each user. It is well recognized that security is the Achilles heel of P2P applications because of the average user's limited awareness of security issues (Kalakota, Susarla, & Parameswaran, 2001). The Web-centric approach has an advantage over P2P which has more places where security can be breached (Killdara Corp, 2001).

Information Presentation: This measure addresses how the information is presented and how appropriate it is for the desired application. Since P2P allows users to provide information in any format desired (Framling & Holstrom, 2000), it has an advantage of the centrally controlled Web-centric architecture.

Information Standardization: This criterion measures how consistent information is across similar files. Standardization can help users because it supports a consistent view of information and easier information exchange. Since the Web-centric architecture supports the centralized management of standardization and can also provide translation services between different information formats (Smaros & Framling, 2001), it has an advantage over the P2P architecture.

If one examines the relative advantages and disadvantages of Web-centric and P2P architectures in Table 1, it is evident that the architectures have different strengths and weaknesses. Given this, it may make sense to consider a hybrid architecture that can take advantage of the relative strengths of both architectures. This may be a fertile area for future research.

SUMMARY AND CONCLUSIONS

This paper has examined the relative advantages and disadvantages of the P2P and Web-Centric architectures for C2C transactions. Based on this analysis, it is suggested that a hybrid Web-centric and P2P architecture might be a good approach to providing C2C services.

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A STUDY TO EXAMINE FACTORS THAT CONTRIBUTE SOFTWARE PROJECT SUCCESS

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ABSTRACT

The purpose of this research is to examine the factors contributing to software project success as perceived by a select group of project managers and project stakeholders. Specifically, this research aims to investigate the parameters that contribute to software project success and compare the findings to the Standish Group's Report that identifies common causes of software project success. A survey instrument is used to collect information on and document the perceptions of selective project managers and project stakeholders. The conclusions are documented and areas for future research topics are identified.

INTRODUCTION

The practice of project management has evolved over the past 30+ years and so have the roles and responsibilities of the project manager (Kerzner, 2000). During the period of traditional project management, project managers were selected from the technical ranks and expected to have significant technical expertise (Kerzner, 2000). Project success was measured by the technical merit of the project with little or no concern for the needs of the business or its customers (Kerzner, 2000). As project management evolved, however, there was an increased focus on the behavioral aspects of project management and the management skills of project managers (Kerzner, 2000; Kloppenborg & Opfer, 2002; Shenhar & Wideman, 2000). Modern project managers were expected to have basic technical skills and significant business expertise. Rather than performing the work, they built teams of subject matter experts that brought the skills needed to fulfill the project requirements (Kerzner, 2000).

Software project success has been a prevalent topic in industry publications and the subject of study by research analysts over the past several years. In 1994, the Standish Group issued its Chaos Report. The Standish Group surveyed 365 IT executive managers from companies in different industries and of different sizes to derive a quantitative analysis of project resolution by type. They also conducted a qualitative study using four focus groups. The purpose of the study was to understand the magnitude of software development project failures, the primary factors causing software development failures, and what factors could increase the potential for project success (The Standish Group International, 1995).

LITERATURE REVIEW

The classic definition of project success was on time, within budget, and meeting quality requirements (Shenhar & Wideman, 2000; Whitten, 2000). The definition has been broadened to include customer acceptance as another dimension of successful projects (Kerzner, 2000; Shenhar & Wideman, 2000). Early project management emphasized the use of administrative skills such as planning, organizing, executing, and controlling over other management skills as the way to ensure project success (Frame, 1994; Kerzner, 2000). In a follow up to the Chaos Report, the Standish Group published a research paper that was entitled Chaos: A Recipe for Success. While project management and the management skills of project managers were not mentioned in their original report, they were prominently cited in the current research. Project managers were described as being the "linch-pins" or glue that held all projects together (The Standish Group International, 1999, p. 6).

Project management was once referred to as the accidental profession. Project managers did not choose this job. Project managers were chosen from the technical and/or functional ranks (Kerzner, 2000). Today, project management is a recognized profession that is supported by a robust body of knowledge, several professional organizations, and opportunities for advanced study. The credentials that speak to commitment to a professional choice are now available in project management, affording it both credibility and respect. As a management discipline, management by projects has replaced traditional functional management structures as a new business model adopted to help companies accomplish business objectives. As a profession, project management has gained prominence in the business world.

The proper use of project management tools and the application of the mechanics of project management were once thought to be the major factors contributing to software project success. The management skills of project managers have replaced technical skills as the key contributors to software project success.

METHODOLOGY

A descriptive survey was used to collect information on and document the data required for the study. A descriptive survey is most commonly used when the researcher wants to study a current day condition or phenomenon (Leedy & Ormrod, 2001). This is as opposed to a historical analysis that seeks to understand events or conditions of the past (Leedy & Ormrod, 2001). The survey consisted of 43 statements. The statements were grouped into four categories. The four categories were Project Role, Organization Structure, Project Management Capabilities, and Project Success Factors. The survey participant was asked to choose one of six selections that best described their feeling or perception about the statement. The selections were "Strongly Agree", "Agree", "Neutral", "Disagree", "Strongly Disagree", and "Does Not Apply". The selections were mutually exclusive.

RESULTS

The data collected from the survey questionnaire was analyzed, summarized and then presented in the Survey Questionnaire Results. The results included a profile of who responded to the survey by project role and what percentage each role type represented out of the total population that responded. Project success factors were ranked from the one most often chosen to the least often chosen overall. The percentage of time a certain success factor was chosen out of all of the responses was also reported. Analyses of project success factors by project role, by organizational structure type, and by project management capabilities were reported on.

CONCLUSIONS AND FURTHER RESEARCH

This study was significant to the project management profession because it revealed current perceptions of project managers and project stakeholders about what factors contributed to software project success. Project management educators and trainers could benefit from the results of this research by evaluating their offered project management educational programs and ensuring a curriculum that would train project managers in all of the skills needed to successfully deliver projects. The Standish Group's Chaos Report was commonly cited as a significant source for statistics on and information about software project success. Project management, in general, and the management skills of project managers specifically, were not among the factors identified in the report as contributing to software project success. This study was intended to understand the current perceptions from project managers and project stakeholders about what they believed were the most important contributing factors. The results were analyzed and compared to the Chaos report. Conclusions were documented and areas for future research topics were identified.

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DRIVERS OF TURNOVER DECISIONS OF INFORMATION SYSTEMS PERSONNEL: JOB SATISFACTION VERSUS JOB FIT WITH QUALITY OF LIFE GOALS

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ABSTRACT

Over 12,000 academic and practitioner studies have been performed relating job satisfaction with voluntary turnover. However, researchers have been frustrated in explaining more than 20 percent of the variance in turnover. This paper presents the notion that traditional measures of job satisfaction may not fully capture the reason for staying or quitting. A new construct is presented that examines the congruence of fit between the job and the person's quality of life goals. A study is proposed that will utilize a sample of Information Systems personnel to be analyzed with PLS Graph structural equation modeling software. It is anticipated that the congruence of fit measures will be a better predictor of various measures of the turnover decision (i.e., thoughts of quitting, expectation of quitting, and intention to quit) than is job satisfaction.

Key words – Quality of life goals, job satisfaction, voluntary turnover, PLS, structural equation modeling, Information Systems personnel turnover.

INTRODUCTION

The prominent paradigm in the field of voluntary turnover research is that job satisfaction is related to the decision to leave an organization. The purpose of this study is to evaluate whether or not job satisfaction is a broad enough measure of a person's overall feelings about their job or whether a new construct that measures the congruence of fit between the job and the person's goals for quality of life would be a better predictor of turnover.

Understanding the turnover decision is a relevant topic regardless of where an organization is in its business cycle. Even in times like the present when the number of Information Systems job seekers exceeds the number of open positions in the U.S., practitioners are still concerned with attracting the right people and avoiding dysfunctional turnover. Dysfunctional turnover results when the organization loses the personnel that it can least afford to lose such as those with specific skills and/or abilities. Additionally, a recent ComputerWorld job satisfaction survey of Information Systems workers (ComputerWorld 12/8/2003), determined that 42 percent of IS employees were dissatisfied with their companies. Such a large amount of dissatisfaction potentially results in increased turnover when the job market improves.

LITERATURE REVIEW

Most studies of voluntary employee turnover trace the genesis of the field to the work of March and Simon in 1958. March and Simon introduced the notion of voluntary turnover resulting from an employee's perception of ease of movement and desirability of movement. During the last four decades, job satisfaction and employee turnover have become one of the most studied topics in both academic and practitioner research with over 12,400 studies by 1991 (Hom, Griffeth & Sellaro, 1984; Lee, Mitchell, Holtom, McDaniel, & Hill, 1999).

A significant step forward was taken when Mobley (1977) introduced the notion that turnover was actually a process. "The actual event of quitting is merely the final act following some series of mechanisms that leads to an intent and decision to resign. Thus, the sequence and duration of these mechanisms become of particular interest for the study of turnover." Mobley started the turnover process with job dissatisfaction being the catalyst. This catalyst then initiated thoughts about quitting and job searching, ultimately leading to an intention to quit and actually quitting. Until Mobley's work, turnover theory and research had not advanced much beyond the general framework of March and Simon (Muchinsky & Tuttle, 1979).

Extensive research has followed, refining and expanding Mobley's model, but has still only resulted in explaining less than 20 percent of the variance in turnover. Observed correlations between job dissatisfaction and turnover seldom exceed 0.40 (Hom, Griffeth, & Sellaro, 1984). In fact, in a meta-analysis of 47 studies, Carsten and Spector (1987) revealed a corrected correlation between job satisfaction and turnover of -0.26.

Job satisfaction is the extent to which an employee expresses a positive affective orientation toward his or her job. It has been measured by previous researchers either on a global or faceted basis. Tett and Meyer (1993) concluded from their meta-analysis of 155 studies "the assessment of overall satisfaction is not unduly compromised by the use of facet-based scales" (pg. 281). In other words, there is no difference in the predictive power of models using either the global or faceted measurement approaches. Thus, this study will employ a global measure of job satisfaction.

Global measures of satisfaction are typically worded as "All in all, how satisfied would you say you are with your job". Although the questions ask about the "job", the position of this paper is that there is room for interpretation as to how the respondent might consider this question. Do respondents answer it by focusing only on the job itself or are they also thinking of the job fit in terms of its' broader impact on his/her life? Perhaps traditional research focusing on job satisfaction is missing the true beliefs that make an employee begin having thoughts about quitting. The defining example is the schoolteacher who dislikes her job but does not intend to quit because the work hours satisfy her family needs. This person would answer a survey saying that they were dissatisfied with their job, but did not intend to quit – a possible anomaly for an empirical research project.

To answer this question, a new construct is introduced as an alternative to job satisfaction for predicting turnover. This construct evaluates the quitting process as a result of a failure of the job to fit with the quality of life goals the employee has for him or herself. In considering quality of life, George and Jones (1996) noted that "Well-being in life has three complimentary aspects of well being: value attainment (e.g., how one's life is evaluated relative to one or more standards or values such as virtue or success); life satisfaction (the extent to which one is satisfied with one's life

or has come to evaluate one's life in positive terms); and the extent to which a person experiences positive feelings or moods" (pg. 318). Brief (1998) described terminal needs in life as professional, social, and personal. Professional goals include professional growth or advancement and status within the community. Social goals include needs for recreation and social relationships. Personal goals are financial, work/family life balance, and spiritual/ethical goals. In this research, measures will be developed to tap into these facets of the congruence of fit of the job to the professional, social, and personal goals as well as to overall quality of life goals. Measures to reflect this construct will have to be developed because no empirically validated measures are currently available.

In order to evaluate this new construct against the traditional job satisfaction measures, an empirical study will be designed that will gather both job satisfaction and congruence of fit data coupled with 3 representative turnover decision constructs used in turnover literature. By triangulating the predictive power across three different dependent variables, a better understanding of the relative strengths of these antecedents in predicting voluntary turnover can be determined.

While, for many, the preferred dependent variable might be actual turnover behavior, that data is not available at this time and therefore surrogate turnover decision variables will be used. Specifically, thoughts about quitting, the expectation of quitting, and the formation of the intention to quit will be used as surrogates or immediate antecedents to the actual turnover behavior. According to Dalton, Johnson, and Daily (1999), "The key issue with regard to the appropriate use of a surrogate variable, however, is its relationship to the actual variable. The usual assumption is that the surrogate variable is highly correlated with its actual behavioral counterpart" (p. 1338).

The validity of the relationship between intention and behavior has been established in a number of different studies. A series of meta-analysis (Steel & Ovalle, 1984; Tett & Meyer, 1993) have reported weighted average correlations between intention to quit and turnover behavior of 0.50, 0.36, and 0.52 respectively. The genesis of this well-correlated relationship can be traced back to Ajzen and Fishbein's theory of reasoned action which says "according to the theory of reasoned action, attitudes follow reasonably from the beliefs people hold about the object of the attitudes, just as intentions and actions follow reasonably from attitudes" (Ajzen, 1988, p.32). A number of turnover studies have used this approach with success (Dalton, Johnson & Daily, 1999). Moreover, beyond behavioral turnover, these decision constructs can also be argued as potentially predictive of an employee's level of productivity, quality of work, or other withdrawal behaviors.

THE STUDY

A questionnaire will be administered to all information systems workers in an independent school district. The instrument includes measures of congruence of fit along with global measures of job satisfaction adopted from previous research. Responses will be given on a 7-point Likert scale and analyzed using the structural equation modeling software PLS Graph version 3.0 (build 1060). The research model uses both job satisfaction and congruence of fit to predict each of the three turnover decision constructs of thoughts about quitting, expectation of quitting, and intention to quit. In addition, model runs will be made where only one exogenous construct (either congruence of fit or job satisfaction) is used to predict each turnover decision. These nine analyses using three dependent variables will provide multiple criterion validity to the research.

CONCLUSION

A student recently said, "My Dad hated his job, but he worked at it for 20 years so that he could put my sister and I through college." The Dad hated the attributes of the job, but stayed with it because it fulfilled a quality of life goal to attain a certain level of financial well being. In response to a job satisfaction survey, the Dad would answer that he was dissatisfied with his job, but had no intentions of quitting. This dichotomy may represent a statistical confound for the traditional job satisfaction-to-turnover models. It was therefore posited that measures of job satisfaction do not necessarily reflect the congruence of fit with overall quality of life goals and thus a new measure could improve the prediction power of a voluntary turnover model.

The research question thus becomes: "Do some people look at their jobs in a broader context than just the attributes of the job itself?" In other words if a person is asked about their level of satisfaction with their job, can they differentiate the job itself from its overall influences on the quality of life? The authors' belief is that not all people are answering these questions in a consistent manner. Some respondents see job satisfaction as it relates strictly to the job itself and others see job satisfaction as the job relates to the quality of life. The lesson for the researcher is that this dichotomy may exist and in order to improve the results of models using the job satisfaction construct, specific instructions should be given to the respondent as to how that question should be evaluated.

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OFFSHORE INFORMATION TECHNOLOGY OUTSOURCING-A WISE CHOICE?

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ABSTRACT

The prospect of loosing many more Information-Technology (IT) related jobs to overseas markets is currently a major opportunity and concern for U.S. businesses. By 2015, the U.S. is expected to loose about 3.3 million "business-service" jobs to other countries – resulting in about US$136 billion of lost wages. Just as the U.S. got used to loosing jobs in the manufacturing sector, we now have to face the consequences of loosing several jobs in the Information Technology sector - one in which we are the leaders in the world. As the U.S. economy is finally beginning to show some strength, there is an expectation that there will be a lot more hiring in the IT sector. Recent data, however, suggests that the exodus of IT jobs to countries such as India, Russia, China and the Philippines shows no sign of waning. This trend might even accelerate as U.S. companies start embracing the "global" economy, and critically evaluate best practices in order to maximize profits.

The purpose of this paper is to study the phenomenon of offshore outsourcing in the Information Technology sector. It will identify the major advantages and disadvantages of offshore IT outsourcing, and its impact on the U.S. economy. The paper will be beneficial to business managers, as it will give an unbiased view of the outsourcing phenomenon, thus allowing them to make better outsourcing decisions. Academic researchers and faculty members in the business or information technology discipline will find the paper informative and stimulating – allowing them to be more knowledgeable teachers, and spurring them to develop new research metrics and methodologies for better studying the IT outsourcing phenomenon.

EVALUATION OF THE HOME PAGE OF THE TOP 100 UNIVERSITY WEBSITES

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ABSTRACT

Many Universities provide information through their websites for users. The key to the successful utilization of the University website is to attract users' attentions and then to provide the users good impressions of the University through its websites. The home page, the first page of the university website, is vital for that purpose. We have investigated and evaluated home pages of the top 100 University Websites selected by U.S News and World Reports magazine. In order to evaluate the home pages, 12 evaluation criteria (i.e., critical features of an ideal website) are selected through literature reviews on the website design. Those are scrolling text, screen length, search box, number of colors, number of images, number of background colors, use of web mail, sequential appearance of text and then image, use of different fonts, use of capital letters, use of breathing space, and use of multiple headings.

We found that most universities use scroll text (83%), search box (90%), breathing space (84%), and multi headings (98%) but they use neither more than one font, size, or style (85%) nor capital letters only (97%). They do not use more than four colors per screen (84%). The other critical features of an ideal home page are used relatively frequently but in less degree. But not a single university's website satisfies all 12 evaluation criteria.

Keywords: Home page design, evaluation criteria, and university.

INTRODUCTION

The university homepage is usually the first contact point for anybody who seeks information about the university on line. It is inevitable for the university to develop a dynamic homepage that captures its users' attentions and meets their informational needs. Nonetheless, many university home pages have inefficiencies, operational difficulties, and even defects that stop the users from conducting some critical functions. Thus, it may be worthwhile to investigate existing university home pages to find what the common critical features used (or not used) are.

The purpose of this paper is to investigate university home pages and to determine whether or not they employ selected principles of good home page design, structure, and content. These principles of good home page have been considered pivotal to the overall success of the website.

LITERATURE REVIEW

The first look of the home page is so critical that users may decide whether to spend time exploring the website and/or engaging in other favorable behavior such as book marking the website based on their impressions of the home page [16]. Thus, the home page should provide the sufficient information content in the right way.

After reviewing a literature on the issue of the home page design [such as articles 1, 2, 3, 10, 11, & 23], twelve characteristics of the good home page which are critical evaluation criteria for the academic home pages are selected. The first 7 criteria are about general characteristics of the good home page, while the last five criteria are specifically about the content of the good home page. The general criteria are as follows.

Scrolling Text. Most users seek complete information satisfaction in the home page, which influences the overall feeling of satisfaction about the website as a whole. [12]. Because of this, scrolling text fields that have much hidden information are deemed to be distractive from the core content of the website and to slow down use process of the website [13].

Screen Length. Users want to see all core website content at once in the home page [18]. When the home page ventures into more than one screen, most users would not travel beyond the first screen [12]. Thus, it is a common agreement among users of websites that the fewer the number of screens in the home page, the better the home page is.

Search Box. The search box is one of the most important features for the university home page. Many users can save time in searching information they want by using the search box, because a search mechanism can take the user directly to wherever the information they need is located. [16] It is better to have this function in the home page.

Web Mail. The web mail, E-mail that is accessible via a standard web browser, is another important feature of the university home page, because this function may make it easier for users to access to their university email accounts and hence coerce them to visit the university website more frequently. [9]

Number of Color. Van Brakel et al. [18] found that more than four colors per screen excluding logos and other images are distractive for users. A limited of number of colors rather than too many colors in a screen make a home page more focused. [8]

Background Color. Van Brakel et al. [18] also recommended that light blue, white, or gray color be used for background of the home page, because the light colors such as those than the dark colors make the home page more conspicuous. It is better to use one of these colors than to use all three colors for the home page at the same time. [19].

Number of Image. The home page should not use more than three images per page. Excessive number of images causes long loading time and hence distracts rather than attracts the user from the web site. [5, 21]

The five content criteria are as follows.

Sequential Appearance of Text and Then Image. The home page should show the text, first, and then the image, because the image consists of lot more pixels than the text. In doing so, users can identify the content of the home page while images are being loaded. [21]

Use of Different Fonts. The home page should not use more than one font size or style except for titles to make the layout of the site consistent and user-friendly. [21]

Use of Capital Letters. The home page should not use all capital letters in the home page unless in page titles, page headings, or acronyms. It is because the home space may be wasted and the home page may be hard to read [21].

Use of Breathing Space. The home page should use white space, called "breathing space" between page elements, effectively to avoid a crowded home page [14, 15].

Use of Multiple Headings. A proper use of different headings such as title, sub titles, and sub-sub title is always beneficial to the efficient structure of the home page and hence makes it easy for the user to comprehend the home page. [6, 17].

METHODOLOGY

We investigate home pages of the top 100 university websites selected by the U.S News and World Reports magazine. Due to the existence of multiple universities with the same rank, the total number of sample-university websites investigated is 105.

The number of screens in a home page is measured as follows. First, the vertical length of the home page is measured. And then it is divided by the height of the viewable monitor screen of the computer which is used in this investigation. If the division produces an integer number only, then the integer number is the number of screens in the home page. If the division produces an integer number and remainder, the number of screens in the home page is one plus the integer number.

The latest version of Microsoft Internet Explorer, version 6.0, and Microsoft Windows XP operating System are used to examine all contents of the home page. Some contents of the home page can not be seen using the old operating system.

The sample university home pages are investigated and evaluated by the twelve afore-mentioned evaluation criteria.

DATA ANALYSES and DISCUSSIONS

The results from these analyses are as follows.

Scrolling Text. Only 17% of the top 100 university home pages use scrolling text and hence the remaining 83% of them do not use it. It may be because scrolling text is relative outdated and impractical function in the contemporary home pages.

Single Screen. 53% of the home pages surveyed use a single screen to present their complete information, while 45% use 2 screens and 2% use 3 screens.

Search Box. 90% of the sample home pages provide search box, while 10% neglect to provide the box. The linked search file is also available in some sample university home pages.

Number of Colors. We found that 19% of the sample university home pages use 2 colors in their home page, whereas 38% use 3 colors, 25% provide 4 colors, and 16% use more than 5 colors.

Number of Images. 20% of the home pages analyzed have a single image in their home pages, whereas 22% have 2 images, 19% have 3 images, and 37% have more than 3 images. Only 2% do not have any image in their home pages.

Number of Background Colors. 54% of the sample home pages use a single back ground color in their home pages, while 39% use 2 back ground colors, and 7% use more than 3 back ground colors.

Web Mail. Only 18% of the sample home pages provide the web mail function, while 82% neglect to provide the function.

Contents. 7% of the sample home pages analyzed provide texts, first, and then images, while 93% do not show texts and then images, sequentially. 85% of the sample university home pages use more than one font, size, or style, where 15% use only one. It is discovered that 97% of the sample home pages do not use capital letters only unless in page title, page heading, or acronyms, while 3% use capital letter only. We find that 84% of the sample home pages have the breathing space between elements, while 16% do not. 98% of the sample home pages categorize their content using at least one of the following headings: topic headings, subtopic headings, or horizontal lines. None of the sample home pages meet all twelve afore-mentioned criteria.

CONCLUSIONS

We have investigated and evaluated home pages of the top 100 University Websites selected by U.S News and World Reports magazine. In order to evaluate the home pages, 12 evaluation criteria (i.e., critical features of an ideal home page) are selected through literature reviews on the website design.

We found that most universities use scroll text (83%), search box (90%), breathing space (84%), and multi headings (98%) but they use neither more than one font, size, or style (85%) nor capital letters only (97%). They do not use more than four colors per screen (84%). The other critical features of an ideal home page are used relatively frequently but in less degree. But not a single university's website satisfies all 12 evaluation criteria.

** Reference will be provided upon requests.

AUTOMATIC CONFLICT RESOLVING WEB-BASED CLASS SCHEDULING SYSTEM

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ABSTRACT

This paper explores the possibility of an interactive web-based class schedule management system, which includes automatic conflict resolution functions. This system utilizes the automatic conflict resolution capability to solve tardiness and complexity of class scheduling problems and to save time consuming in the scheduling for both instructors and administrators. The system allows instructors to enter their class schedules to the system directly and solve most of the conflicts with other classes by the criteria already set in the system. The system finalizes each scheduling when the conflicts are solved by the set rules, and administrators intervene to the scheduling process only when the system cannot solve the conflicts even after applying all the criteria. In this case, involved instructors and administrators receive a message from the system to have further adjustment.

Through this process, the system provides efficient and powerful means to instructors to set up their class schedule by themselves every semester in timely manner without sacrificing all the stakeholders' interest. By replacing a primarily paper-based work process and utilizing web-based on line scheduling system, both instructors and administrators can use all the scheduling information saved in database and update it whenever they use the system. This practice may save time and cost in class scheduling tremendously for all sort of educational institutions.

Keywords: *Web-based Class Scheduling, Automatic Conflict Resolution, HTML, PHP, MySQL, and Database*

INTRODUCTION

The purpose of this paper is to explore the possibility of an interactive web-based class schedule management system, which includes automatic conflict resolution functions. To accomplish this objective, this study provides an essence of the proposed system development to show how it was developed, what it looks like, how it can be used, and what are the criteria used in the PHP programming. The study also provides a few captured screens of the user-friendly interfaces of the system. The proposed system provides an efficient and user-friendly Web-based interface to the instructors, too. It also responds immediately to any course scheduling requests with

conflicts. The system resolves the conflicts automatically whenever it finds any applicable pre-set criteria for the conflict.

METHODOLOGY

Three important steps in coding class schedule management systems are: creating tables in MySQL, creating HTML pages, and embedding PHP codes into HTML tags. We download PHP [3, 6, 10] and configure PHP to run on personal computer and test the PHP script, first. Then we install and configure MySQL [8, 9], which is followed by a coding of HTML pages. In order to publish the webpage and run it on a web server that supports PHP & MySQL, we gained an access to a DATAFLAME web server supporting PHP and MySQL. Once we learn how to administer the web server, we begin to create tables in database and load the tables with data. PHP files for HTML pages are coded to show that what kind of information instructors can enter into the program and what kind of view the program produces in response using PHP coding.

The database for this application is developed using MS Access that is widely used for the small database. This database is linked with the web pages in this application. We design nine tables for instructors and administrators: Login_info, Courses_Offered, Semester_Description, Room_Assignment, Bldg_Description, Time_Slots, Requested_Schedule, Instruction_Description, and Conflict_Description

Login_info table - It stores the login information such as User ID and password. First name, last name and email address of the user are also stored in this table. Users can be department administrators, facility administrators or instructors who want to register for teaching courses.

Courses_Offered table - This table has the basic information about the courses being offered in a particular semester of a year. Instructors choose from amongst these courses. And his choices are populated in the Requested_Schedule table. It shows course identification numbers, credit hours and the semester and the year in which the course will be offered.

Semester_Description table - It stores the descriptions of the semester codes that are being used in the Course_info and Requested_Schedule tables.

Room_Assignment table - This table shows the room number, building number and the capacity of the room.

Bldg_Description Table - This is another description table of the building codes that are being used in Room_Assignment and Requested_Schedule table.

Time_Slots table - This table shows the day and time available for the slot.

Requested_Schedule - This table gets populated when the instructor chooses course ID, room No, time and other information related to the class that he/she wants to teach. As the relationship window illustrates, this table is getting values from the others tables.

Instruction_Description - This table shows the descriptions of codes for instruction methods. For example code 0 means that instruction method is face to face and code 1 means that it's a web course.

Conflict_Description Table - This table shows the description of codes for different class scheduling conflicts.

Considering the above-addressed typical tables of this application, we design the entity relationship (ER) diagram that is a logical representation of the data as shown on Figure 2. The database reflects the principal information system of basic functionalities. The tables are accessed by primary key(s), which are bold, and they are interconnected by foreign key(s) from other tables. All tables are linked by the Requested_Schedule table which shows instructors' offering courses.

RESOLVING CONFLICTS IN THE WEB-BASED CLASS SCHEDULE MANAGEMENT SYSTEM

Conflicts occur when more than one instructors request for the same classroom and the same time slot or when more than one instructors teaching different required classes request for the same time slot. These conflicts will be resolved in the web-based class schedule management system using the following criteria.

Criterion 1: the required course has a preference over the elective course, which means scheduling requests for the required course should be granted, first, between the required course and the elective course.

Criterion 2: the upper level course has a preference over the lower level course. The upper level course is a course offered to the upper class students, while the lower level course is to the lower class students. For example, among advanced level course, intermediate level course, and introductory level course, scheduling requests for advanced level courses should be granted, first, then intermediate level courses, and introductory level course, last.

Criterion 3: the course in the core competent area of the instructor has a preference over the course in the non-core competent area of the instructor. For example, schedule requests for MIS classes by instructors with MIS expertise should be granted before the approval of schedule requests for MIS classes by instructors without MIS expertise for the benefit of students.

Criteria 4: scheduling requests that cause violations of the institution's teaching policy, if not granted, have preferences over the other class scheduling requests that do not. Suppose that an instructor's teaching schedule will violate the institution's teaching policy that prohibits any instructor from teaching more than 3 days a week, if his or her course scheduling request is not granted, his or her course scheduling request should be granted, first.

The above-mentioned 4 criteria should be applied in the same order as they are presented. In other words, apply the criteria in the order of criterion 1, 2, 3, and then 4. It is necessary to apply the immediate subsequent criterion, only if the immediate preceding criterion does not resolve the conflict in the scheduling requests. If all four criteria do not resolve the conflict, the system informs the requesting instructor that he or she must contact the administrator to resolve the conflict.

CONCLUSIONS

This paper explores the possibility of an interactive web-based class schedule management system, which includes automatic conflict resolution functions. This system utilizes the automatic conflict resolution capability to save time and effort consumed in the scheduling process for both instructors and administrators. The system allows instructors to enter their class schedules to the system directly and solve most of the conflicts with other classes by the criteria already set in the system. The system finalizes each scheduling request when the conflicts are solved by the pre-set criteria, while administrators intervene to the scheduling process only when the system cannot solve the conflicts even after the system applies all the criteria. In this case, involving instructors and administrators receive a message from the system to have further adjustment.

Through this process, the system provides efficient and powerful means to the instructors to set up their class schedules by themselves every semester in timely manner without sacrificing any stakeholders' interest. By replacing a primarily paper-based work process with a web-based scheduling system, both instructors and administrators can use all information saved in database of the system and update the database whenever they use the system. This practice may save time and cost in class scheduling tremendously for all sort of educational institutions.

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