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Volume 2, Number 1 1998

Proceedings of the Academy of Information and Management Sciences

April 13-16, 1998
Myrtle Beach, South Carolina

Jo Ann and Jim Carland
Co-Editors
Western Carolina University

The Proceedings of the
Academy of Information and Management Sciences
are published by the
Allied Academies, Inc., PO Box 2689, Cullowhee, NC, 28723.

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Proceedings of the Academy of Information and Management Sciences

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IMPROVING PRODUCT AND PROCESS: IMPLEMENTING A METRICS PROGRAM IN A MID-SIZED SOFTWARE DEVELOPMENT COMPANY

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ABSTRACT

This paper discusses the implementation of a metrics program in a mid-sized software development company. Areas discussed are the importance of metrics in the software industry, strategic goals and metrics, selecting and presenting initial measurements, and planning for the future growth of a metrics program. It is assumed that the reader is familiar with the strategic value of goals, and has intermediate knowledge of how software development companies are organized and operate.

INTRODUCTION

Over the last several years, software managers have begun to use Total Quality Management (TQM) as a tool to improve the quality of software development in firms. Expectations are that great improvements in software quality can be experienced similar to the manufacturing industries. One approach to using TQM to improve the quality of software has been the implementation of metrics programs to measure different aspects of software development. The software development business is very different, however, and many experts have yet to be convinced that great improvements can be made in this area.

This paper discusses the implementation of a metrics program in a mid-sized software development company. Areas discussed are the importance of metrics in the software industry, strategic goals and metrics, selecting and presenting initial measurements, and planning for the future growth of a metrics program.

THE METRICS PROGRAM CONCEPT

A metrics program is based on the measure of any quantifiable observation about some attribute or aspect of the company's products, processes, or projects. For example, "The observation may range from very simple counts (lines of code) to much more complex computed or derived measures of properties like functional complexity, test thoroughness, quality, productivity, or effectiveness" (Hetzel, 1993, p. 4). There are two types of measures used in this program--metrics and meters. Metrics are measurements used to compare software processes and projects or predict

software outcomes. Meters are measurements used to control or regulate a software activity or process. Managers need to have a clear vision of what they want to measure and how they will use the results to improve some aspect of the company's product, processes, or service. The measures must be a convincing source of accurate and helpful information and they must be relevant and readily used by both practitioners and managers. This paper will help chart a path for making those decisions that are so crucial for the program's initial success by familiarizing the reader with metrics implementation concepts and several basic measurement examples.

THE IMPORTANCE OF MEASURING SOFTWARE QUALITY

Unfortunately, the current state of software measurement practice is very immature. The industry is young, and has traditionally been in a constant state of flux as the pace of technological developments and their pressures continue to be unyielding. It is not surprising that until recently structured processes and engineering standards have not been a focus for software developers. In the following section the strategic benefits that a company can gain from implementing a metrics program will be discussed. There are however, more basic reasons why the US software development industry is beginning to invest large amounts of resources in such programs. Many international and foreign software developers are focusing on quality in much the same way that auto makers did in the late 60's and early 70's. Because US companies have traditionally been the leading producers, and because the rate of technological change is still increasing phenomenally, development has been focused on getting new products to market quickly. This has also been fueled by pressures from customers who are trying to take advantage of the latest technology in their particular field. For example, software developed for office automation is always being revised to take advantage of faster PC's with more memory capabilities. Because these programs are written so quickly in order to meet demand, testing and quality are often overlooked. Although the products are usually tested to some degree, their producers may plan to release a new version to fix pending problems or add enhancements later rather than improving the current release. This precedent among US software developers has been reinforced by the economic culture of the industry. Competing customers will purchase what they can immediately, and wait to find improvements down the line. Although this fast paced development/release cycle has been profitable for many companies, quality is beginning to become a critical factor for success.

As occurred in the auto industry, foreign and smaller US firms are beginning to implement exceptional process control and quality standards. Measuring has therefore become a natural part of their business procedures. Process improvement and metrics almost necessarily will lead to improved quality. Because these newer firms have been able to start off right, implementing standards has not slowed their development efforts or significantly changed company culture. They are now producing high quality software at similar rates to the older firms which are producing software that is not problem free.

In lieu of such competition, US firms are starting to use metrics to not only improve their quality, but also to gain certification with regulatory agencies such as SEI and ISO9000. These certifications, and the results of measurements should help convince customers that the company has quality measurements in place, and that the reliability and maintainability of their software is high.

SCORECARD APPROACH

The "Balanced Scorecard" approach is used to identify the measures used by managers to manage a software development project. The scorecard concept adds additional measures from a variety of perspectives to the traditional financial measures. It presents managers with four different perspectives from which to choose measures: performance for customers, internal processes, financial performance, and innovation and improvement activities (Kaplan, and Norton, 1993, p. 134). A major benefit of this approach is that it gives managers an overview of the company's performance at a quick glance: "The scorecard minimizes information overload by limiting the number of measures used. It forces managers to focus on the handful of measures that are most critical" (Kaplan and Norton, 1992, p. 72).

The customer perspective usually will focus on time, quality, performance and service, and cost. These are areas where all software customers are looking for excellence. The internal measures should reflect the processes that have the greatest impact on customer satisfaction. For example these might include factors that affect cycle time, quality, and productivity. The innovation and learning perspective measures the company's ability to innovate, improve, and learn. It also can focus on the ability to develop and introduce standard products rapidly. The financial perspective should indicate whether the company's efforts to implement strategy are contributing positively to the bottom-line, "If improved performance fails to be reflected in the bottom line, executives should reexamine the basic assumptions of their strategy and mission" (Kaplan and Norton, 1992, p. 77). Not all long-term strategies are profitable strategies. Periodic financial statements remind managers that metrics motivated improvements benefit the company only when they are translated into increased sales and market share, or reduced expenses.

IMPLEMENTING COMPANY GOALS

Companies often develop elaborate and appropriate goals to give direction to their activities, and to improve performance of the company as a whole. Although goal setting has been popular for years, there has always been debate over what the best way to turn goals into reality is. Logic tells us that different companies will need to take different steps to achieve this transformation. What a metrics program can do is help managers identify those specific activities or changes that need to happen for the goals to be met. The benefit of using the scorecard approach is that it puts strategy and vision at the center. After the establishment of goals is complete, the process allows employees to take whatever actions are necessary to arrive at them. The process will include developing goals for each of the chosen perspectives and then translating these goals into specific measures. This can be done by managers, or employee teams. In this sense the metrics program will become a tool of empowerment because the employees themselves can chose what will be done to measure their progress towards achieving their own goals. The only requirement is that the measures chosen to support the scorecard should be designed to pull people toward the overall vision. The scorecard is therefore a way to incorporate the corporate vision, "The balanced scorecard is most successful when it is used in this way to drive the process of change" (Kaplan and Norton, 1993, p. 142). The underlying message from the scorecard success is that metrics programs are management systems that initiate exceptional competitive achievement.

THE METRICS IMPLEMENTATION TEAM (MIT)

Although employees have a lot to gain from the implementation of a metrics program, they are the hardest to convince of this. Often they are initially opposed to the programs because they fear being challenged with unobtainable expectations. They are also often concerned that the time spent collecting measures and inputting data into tracking systems will reduce their productivity more than the results will improve productivity. This is a valid concern. Implementors need to be cautious not to begin increasing the demands on the time of developers. Initial program measures should come from existing systems that are already collecting data, or from data collection efforts on the part of the metrics team or managers. Of course employees also fear that they will be reprimanded or even fired once measurements set standards and introduce comparison. Managers must be conscious of this so that the data they receive is not skewed. Employees should be convinced that in no way will the implementation of a metrics program threaten them. Negative employee performance that is identified via the program should be addressed positively. Later we will discuss the need to set up trigger values and action statements for all measures, however, when employees are involved these actions taken should be focused around helping them to improve.

Employees stand to gain from the metrics that are collected. In general, the measurements will allow improvement of engineering practices. Developers will be able to design and develop code that is specific, quantifiable, and has quality attributes. Learning to do these things automatically will make them better programmers. Results of measurements will also let employees know they have done a good job, and give them feedback about their performance. From project metrics, programmers will have better day to day direction. These results should also help them to identify quality problems that result from their personal style. In addition, employees will be equipped from the program's implementation process with the discipline and desire to adhere to agreed upon standards (SQE Seminar Notebook, 1997, p. 1-22).

THE PROJECT LEADERS

The MIT project leaders have a major responsibility in the implementation of the metrics program in that they are responsible for providing the project estimates and information about the processes. This data is the more abstract than code or test measures, and therefore more challenging to gather and interpret. They must be able to motivate the programmers and analysts to accept and use the program so that they supply correct information to the system. This can be a problem since some team leaders may estimate the project and process times rather than develop a formal methodology for calculating such values. If they are consistently inaccurate, they will be challenged to improve, and this may mean changing they way they are used to doing things, and require that they learn new and better techniques for estimating project and process times.

Project leaders will gradually learn that there are major benefits in the implementation of a metrics program. They will learn how to plan and control software projects, and how to improve their time estimates, resources, costs, and schedules. These efforts will improve product quality and customer satisfaction. Project improvements should also help them to maintain timely and accurate reports, assess manage risk, and monitor the development process. For example, the examination of measures used to evaluate different phases in the project can identify where defects are most often

introduced; therefore, the leader can plan for extra testing of that particular phase (SQE Seminar Notebook, 1997, p. 1-21).

MANAGERS

Metrics programs are also designed to give managers in the organization the necessary information for managing a software development project. The program gives managers visibility concerning product quality, productivity, support demands, and customer satisfaction. Managers can use metrics to compare people, projects, products, and companies. They can also be used to evaluate contractors (SQE Seminar Notebook, 1997, p. 1-20). Managers also enjoy the support measures will give to their decisions, "In meetings with upper management or with customer, measurement reports can substantiate the schedule needed for changes, the time and resources required for incorporating proposed changes, and other typically controversial issues" (Rifkin and Cox, 1991, p. 4). In addition, measurements can help managers prepare to meet government and ISO9000/SEI certification requirements.

CUSTOMERS

The least obvious beneficiary of implementing a metrics program is the company's customers. Metrics results will provide customers with proof of the vendor's quality. They will have confidence in delivery dates, and a way to assess the reliability of the software they are interested in purchasing. Surprisingly, metrics can also be used to improve customer product understanding (SQE Seminar Notebook, 1997, p. 1-23). By giving quantitative measures about the software, it becomes less abstract, and the customer can begin to gain familiarity with the product before purchasing it and using it. This is especially important to new applications and for software vendors that don't yet have a large market presence.

PRINCIPLES OF SELECTING METRICS

Once specific goals have been identified, the metrics implementation team, managers, or employees must select those measures which best evaluate how well the goals are accomplished. Traditionally there are two methodologies used in this process: (1) a top down model; and (2) a bottom up model. One top down model is the Goals, Questions, Measures (GQM) model. It begins by producing the questions that should be asked about progress toward specific goals. Then a set of metrics are derived to measure that progress. Although this approach is better than none at all, it is beset with problems. First, it fails to recognize that managers don't always know what their goals should be (SQE Seminar Notebook, 1997, p. 2-11). Sometimes it takes specific measures which alert the manager that problems exist and that goals are needed to avoid problems in the future. Top-down methods lack support and enthusiasm from the practitioners. It encourages "data-manipulation." With a set goals in mind, the data collection or processing procedures tend to produce results that show improvement because the people developing the measures are focused on the goal and what the numbers are *expected* to show.

A popular bottom up apporach is the Input, Output, Results (IOR) model which focuses on measures at the practitioner level. From these measures questions are formulated about what should change to cause improvement in quality, service, etc. The answers to these questions become the goals, and measurements are continually taken to track progress toward attainment of the goals. "Input measures provide information about the resource (people, computer, too, and other work products) applied and the process steps or activities carried out. Output measures provide information about the deliverables and work products that are created. Results measures provide information about the usage and effectiveness (perceived and actual) of the deliverables and work products in fulfilling their requirements" (Hetzel, 1993, p. 29).

When choosing measures to conform to one of these models, there are several fundamental principles to keep in mind. First, the purpose of measures is to drive stepwise process change and adjustments. They should initially be developed to focus on the software practitioner as the primary customer. These are the employees that will be most affected by the results and changes that are implemented. Employees must be comfortable with the metrics program and be willing to accept its requirements as a daily part of their work. Measures should initially focus on establishing project and engineering processes. For the program to survive it must be able to validate results and justify its use in the organization. During the initial stages of introducing metrics to the organization, many managers will need to be trained to expect and require measurements as inputs to decision and goal setting. Measures should be used to create an understanding of reality which will drive questions, more measures, and enable goal setting.

FIVE KEY MEASURES

There are five key elements used to measure the successful implementation of a software development program: (1) defect density; (2) productivity; (3) maintainability of code; (4) timeliness; and (5) testing. Although these measures are widely used in the industry and apply to a variety of different businesses, it is not implied that a successful metrics program cannot exist without these measures, nor that they necessarily apply to all businesses.

Defect density is the number of defects per lines of code or function points. Defect density indicates the quality of an application. A defect is any non-conformance to expected requirements after an application has been released. The number of defects is usually the defects over the life, (defects per month*36 for a three year expected life of the system). As this measure is taken over time, trend lines can be established to show whether quality is improving or getting worse. Whether a company uses lines of code of function points to represent program length is a matter of choice, and will not be investigated further in this paper. Because defect density is so common, it can be used to compare quality from one company to the next. It is important to note, however, that development of different kinds of software applications will probably have vastly different average defect density rates. Also, when a metrics program is first implemented, there may be a tendency for programmers to "pad" lines of code to reduce their defect rates. Although this causes misleading numbers, as time moves forward and employees realize that the data is not being used at a personal level, their desire to do this will diminish. It is important for management to ensure that measurements are not used at a personal level, doing so will protect the validity of the data.

Productivity is measured by dividing output by input. For example, lines of code produced per month. It is instantly apparent that this number could easily be manipulated by padding code, or including/not including comments, copybooks, or shared code in these measures. They will be useful, however if the company decides on one way to take them and sticks with it. As long as the same thing is always being measured, there will be consistency in the results, and managers will be able to identify significant change for better or worse.

Maintainability of code is usually measured by McCabe's Cyclomatic Complexity which essentially measures the number of decisions or branch points in a computer program. One note of caution is that "this won't work for decision points that have more than 2 branches, such as the CASE statement" (Hetzel, 1993, p. 123). Measuring complexity will help determine if a program will be difficult to maintain in the future. This is a very important key to the value of an application. Customers do not want to purchase software that will be impossible to maintain, because it necessarily reduces the life of the product. It also may imply that the programs were too complex to accurately and fully test. If this is true the customer may be afraid that the application could cause them to lose money and it would be next to impossible to correct.

Timeliness is the cycle time it takes to make a correction or enhancement to a program or application. This measure shows the calendar time it takes to resolve a defect or enhancement change request. Sometimes correction or enhancement measures that are similar in length and complexity should be measured in groups. The groupings will be different depending on the nature of the products, and the variety in products for a particular company. For example a company may have corrections that affect more than one application running under one architecture, and they may have corrections that do not involve other applications or the architecture. These kinds of changes would probably need to be measured in separate groups. If such grouping is not enforced, that results may appear to be skewed. If a team has been regularly working on one type of correction that is very short, and suddenly acquires a complex type of correction, their measures may inaccurately indicate that timeliness has decreased. This issue needs to be addressed before implementing a timeliness measure.

Testing software using a model such as Detection Efficiency which is the number of (defects detected * 100%)/defects available to detect. This measure is expressed as a percentage and measures the percent of the defects present that were discovered during a given test or evaluation activity. The total number of defects should be a summary of those found in code inspections, unit testing, system testing, and 6 months of production. For each unit, (for example code inspections) the detection efficiency should be measured. This will help testers identify weaknesses, and the testing stages that need to be improved.

MEASUREMENT STRUCTURE

One of the first things that needs to be considered before actual implementation of a metrics program is how the program will be structured across the organization so that it's collection and presentation is meaningful and logical. A presentation technique that is commonly used with the balanced scorecard approach is to use "dashboards" across the organization. This means that each unit, division, or department in the organization will have its own set of measurements that are presented together, and that there will be a different "view" of measures for the executive dashboard.

Some measures that appear on the top level dashboard may be rolled up numbers from those calculated for the various departments, or they may be unique overall measures. These decisions will have to be made to mirror the organizational structure of the organization and the information needs of the managers. The most important thing to remember is that none of the dashboards should have too many measures. Each should be easily presented on one or two pages (4-8 measures) so that the information is not complex, lengthy or confusing, Remember that the purpose of the scorecard is to show at a glance the conditions in the company. The individual dashboards for each division may include measures that are unique to them, and can continually be changed or enhanced to meet the needs of lower level managers. The executive scorecard should always be kept in mind, however, so that department measures that are rolled up do not get removed.

A SIMPLIFIED PROCESS

When they company begins to implement a metrics program, it should focus on fundamentals, be implemented as a pilot on selected projects, and be very simple to collect, analyze, document, and quantify. It is very important for the program to start off simple. Many valiant efforts fail because the scope of the metrics project is larger than can be handled by the number of people assigned to the project. It is therefore important to do a few things, do them well, and show positive results quickly. Remember that, "The goal of any metrics project is to make metrics collection and analysis a natural and helpful part of the software development process (Pfleeger, Fitzgerald, and Rippy 1992, p. 9). The metrics team should be able to show improvement within the company as to help justify the existence of the metrics program. Companies should also try to take small steps so that they don't rush invalid metrics. Because employees know that they will be measured on certain tasks, accomplishments, etc., those are things that will automatically be focused on, and they will therefore begin to improve. It is important not to rush the implementation of a metrics program because of this aspect of human nature. In a sense, you are choosing what to improve, and so it is important that this is the right choice for your company. SQE recommends the following approach:

Start with what is available from the building block systems
Focus on the "core" metrics of size, effort, schedule and quality (defects and problems)
You can't do everything at once so:

Prioritize

Look at data already readily available

- Seek out the most practical meters
- Understand management's needs

(SQE Seminar Notebook, 1997, p. 3-20)

FOUNDATION SUPPORT SYSTEMS

There are three core systems that data will come from: resource tracking, work products tracking, and problem tracking. Resource tracking will estimate and track the employees' time, tasks, deliverables, and milestones. Work products tracking (sometimes called configuration management) will help control the flow of source code, and possibly document versions and changes. This data will

be used to calculate measures such as code complexity. Problem tracking will control problems, defects, and open issues and give preliminary measures of work effectiveness. These are the core internal systems from which most of the measurements data will come. They can be purchased or developed internally. Their specifications and output of these systems is too business specific and complex for discussion in this paper. Research will have to be done pre-implementation to determine how the data necessary for measurements will be collected.

DATA COLLECTION

In addition to the internal systems, there are several traditional techniques for gathering data. First, software analyzers can be run automatically as programs are submitted to the mainframe compiler. As a side benefit of such analyzers, information can be gathered dynamically (during the course of software development) to help monitor the programming process. The kind of data collected from software analyzers is by nature objective. Report forms (whether they are manual or on-line systems) are information gathering forms to be completed by analysts and programmers at various milestones. A report form might have entries like data, time, activity, and number of hours involved. Interviews can also be conducted to collect certain kinds of data (Conte, Dunsmore, Shen, 1986, p. 23).

The basic measurements process model is to define, collect, present, use, and validate. Once a measurement set has been developed, each needs to be carefully defined. This will help ensure that the correct collection and use is made of the data. It will also serve as a source of documentation for the program. When changes are analyzed, or when new managers need to review the measurements, they will want to see documentation about how the measures are being collected, what their target values are, and how the presentation should be analyzed. The measurements specifications will end up looking a lot like a element definition list. According to SQE training literature the following should be defined for measures:

Name:	Convenient short name
Description:	Short description of what the measure is and the purpose for collecting
Observation:	How the measure is captured or collected
Frequency:	When the measure is collected
Scale:	Units of measurement
Range:	Minimum and maximum values observed or experienced
History:	What the measure has been like in the past
Expectation:	What the measure is expected to do in the future
Relationship:	How the measure is assumed to relate to the software process-goals
Threshold:	Control or trigger values for metering action
Validation:	How the data can be validated if questioned, how often it will be validated

(SQE Seminar Notebook, 1997, p. 3-22)

ANALYSIS

After measurements are gathered, the researcher must draw out of that information as many potential relationships as possible. A primary activity when analyzing data is to try to find relationships between and among metrics. Thus we may discover that size of the software and programmed time are related because as one increases, so does the other. These types of relationships are generally explored via correlation, a traditional technique that can be used to suggest generally linear relationships. There are also tests for the significance of any presumed relationship. A special sub team or individual on the metrics team may be charged with doing this kind of analysis on the results presented by the primary metrics program. If so, there are many statistical tools such as ASPG that can help simplify such tasks.

CONCLUSION

To successfully implement a metrics program the team will have to enlist the support and "buy-in" of managers and practitioners. If the program is being championed by a manager, executive, etc., those people should set up project presentation sessions to help explain to others in the company what the purpose is, and what has been planned so far. Surveys should also be done to gauge the acceptance level among employees. The presentation should be structured to show what kind of improvements are expected from the program. These should be improvements that are easy for employees to appreciate. At this point data collection issues should have already been established and the measures defined. Once the team is comfortable with the level of support provided by employees, they should begin collecting the necessary data. Data collection will usually be in the form of reports generated from the three core internal systems. The metrics team will have to develop a database to store the data, and also develop the processing piece so that the desired measures are easily obtained. The processing can often be coded as a part of the database, or another application can be used for this. Next, the output format will have to be developed. This may be the building of graphs or charts. Finally, the document that will be published monthly needs to be designed. This most likely will be a packet of the dashboards leading with the executive dashboard. Detail does not need to be included in this package, but target and trigger values should be. If managers identify problems with any of the data, or are curious about developing trends, they can request detail reports or investigation to be done by the metrics team.

PROGRAM GROWTH

There are many resources available today to help software companies prepare for the implementation of a metrics program. These include journals, books, articles, Internet pages, and news groups. The benefits of such a program as introduced in this paper are becoming more obvious as competition is increasing in the industry. For a metrics program to succeed, however, implementors need to plan and strongly champion the project. As quality begins to improve, the program will gain more recognition from upper management. At this time, if funding for the project increases, new methods of communication may be investigated. For example, monthly dashboards may be presented as web pages on the company intranet. Communications Technology such as Lotus

Notes and Domino may allow managers to dynamically interact with measurements data. When reviewing their dashboards, there is potential that they could go to one place on the server to run queries and new reports against the data. This would allow them to "drill down" and gain more understanding of why trends are developing. The potential for the metrics program to grow is great. Managers need to be introduced to the concepts of metrics by a patient and strong team who are skilled at quickly analyzing data to explain business problems. The program and its measures will need to be monitored and adjusted as the company itself grows. It is especially important to reflect organizational changes in the metrics structure. Because metrics are an avenue for goal achievement, they should be aligned to help groups of people who are working toward the same goals.

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AN EXAMINATION OF THE IMPACT OF ATTITUDE ON END-USER COMPUTING

Leslie W. Campbell, Woodbridge, Virginia

ABSTRACT

This study, in progress, examines the relationship between end-user attitude and several variables, and their impact on the computer end-user in the hotel industry. End-users were surveyed to determine their beliefs about information systems attitude and the base theories which accompany MIS theory. The surveys will be analyzed using a multivariate statistical tool, looking for relationships. Results will then be interpreted and the study will be completed. Using a model proposed by Culpan and using the accompanying instrument for the construct of end-user attitude: This study will show the relationship between information systems and end-user attitudes. The Culpan model uses several variables that impact attitudes. They are: technology, obstacles to training, management support from an indirect mode, initial interest, and learning to use information systems, which appear to directly affect attitudes. Culpan's research was conducted using data from both the service and manufacturing industries. Her study shows that there is a difference between the same variables, depending on the industry. Therefore, this study, in progress, will use a specific industry within the service industry, that of the hotel industry, to examine the relationships between the variables.

Many of the MIS theories are not well grounded. This is a study which will examine definitions and explanations of these constructs and will examine the lack of grounded theoretical basis for MIS attitude research. This paper will survey end-user attitudes and their associated constructs. MIS theory will be reviewed along with MIS attitude theory. The MIS attitude instrument, will be evaluated and reviewed. It's use will be studied in an empirical investigation of the impact of the hotel industry's end-user attitude on end-user computing satisfaction. While this paper is constructed using research on the relationship between end-user attitude and end-user computing satisfaction, it is also suggested that these relationships can be measured by questionnaires that ask hotel property management system end-users for their objective belief and attitude.

INTRODUCTION

In this day of computerization at every level, it is difficult to explain the reasons why people accept and reject the use of the computer system. It is the intention of this research to key on the reasons for peoples' attitudes concerning computer information systems and the impact that these attitudes have on the resulting level of satisfaction with computing information systems. There have been many studies concerning both computing information systems attitudes, as well as research focusing on end-user computing satisfaction.

It is the study of this body of information that is the intent of this research. This is a study which will examine definitions and explanations of these constructs and will examine the lack of

grounded theoretical basis for MIS attitude research. This paper will survey end-user attitudes and its associated constructs. MIS theory will be reviewed along with MIS attitude theory. An MIS attitude instrument, Culpan (1995), will be evaluated and reviewed. It's use will be studied in an empirical investigation of the impact of the hotel industry's end-user attitude on end-user computing satisfaction. While this paper is constructed using the research on the relationship between end-user attitude and end-user computing satisfaction, it is also suggested that this relationship can be measured by questionnaires that ask hotel property management system end-users for their objective beliefs and attitudes.

COMPUTER END-USERS ATTITUDES AND LINKED CONSTRUCTS

"If one is to measure user attitudes toward a management information system (MIS), such an analysis is facilitated by providing a structure to aid individuals in expressing themselves" (Zmud, 1978, p. 189). Attitudes seem to be important in determining end-user satisfaction with information systems. Information systems have become an essential part of managerial decision making. (Galetta and Lederer, 1989). Not everyone, especially those who need to use computers in their jobs, is able and willing to use computers or information systems, instead they resist using the computer or information system. What causes this resistance to computer use? Computer information systems are extensively available and have been installed in nearly every business in the United States, and in a few years, perhaps, the entire industrialized world. Explaining the causes for computer or information system resistance is a very difficult job. It has proven to be one of the most challenging issues in information systems (Davis, Bagozzi and Warshaw, 1989, p. 982). In response to this challenge, a large body of research has been conducted to determine the affects of attitudes and beliefs on individuals' use of computers or information systems DeSanctis , (1983); Fuerst and Cheney (1982). However, it has been suggested by some researchers that these findings have been mixed and are inconclusive. This may be due to a wide variety of attitudes, beliefs and satisfaction measures which have been employed, often without adequate theoretical justification (Davis et, al 1989, p. 983). When experienced workers need to work on new information systems; they need to learn new skills, which requires the change of old attitudes. If practitioners could discover the reasons end-users resist the use of computers, they would be able to address the problem and, perhaps, increase the quality and productivity of the information system. This study will also review the measurement of the construct of attitude.

THE MEASUREMENT OF ATTITUDE

Through research it is possible to get a set of information systems related measures to use in the development of a framework for a better explanation of end-user attitudes towards computer information systems. The Culpan instrument seems to do this. As far back as 1974 researchers used attitude as a dependent variable (Lucas, 1974; Robey, 1979; Shewe, 1976). "In particular, a theory of MIS development requires a theory of MIS utilization, in order to distinguish between successful and unsuccessful MIS, efforts"
(Swanson, 1982, p. 158), which can be developed by studying MIS users' attitudes. The reason why the measurement of attitudes became an established component of research is due to management

information system failures. Of the systems installed, most have not been able to match the expectations of the organizations and the rest have failed miserably (Meier, 1985, p. 171). Swanson, as well as many other researchers has called for more examination of information systems implementation.

MANAGEMENT INFORMATION SYSTEMS THEORY

There are very few studies which rely on strong existing MIS theory as a basis for a theoretical model. This is because MIS theory is difficult to demonstrate. Only a very few studies hypothesize the structure of the attitude construct based on an underlying theory (Goodhue, 1988, p. 6). The theory of Management Information Systems, unlike other disciplines does not have strong theoretical underpinnings. Theory advocated is seldom grounded in any existing theory. "In the long run, the concept of 'user attitude' may itself be too broad for useful theory development" (Swanson, 1982, p. 161). End-user computing attitude is part information systems, part sociology and part psychology. Much of the research done in information systems has shown different strengths of attitude and computer relationships (Swanson, 1982); (Doll, Xia, and Torkzadeh, 1994); (Culpan, 1995); (Igbaria et al, (1997). Research has also been done from the psychology perception and has indicated relationships (Fishbein and Ajzen, 1975); (Triandis, 1971). Research has been done from the perspective of business management for a look and how management relates to attitude, (O'Reilly, 1982); (Courtright et al, 1989).

To build a new attitude theory, we need to have a general group of accepted constructs. This is missing in the user attitude theoretical context set. A new attitude theory needs a strong attitude theory research tradition from which to draw. MIS could strengthen its research abilities by borrowing and expanding theory from relevant reference disciplines, which would provide both models and precisely defined theoretical constructs (Goodhue, 1988, p.10). Attitudes can be viewed as surrogates, such as: How well the design of a system meets the needs of the users. Fishbein and Ajzen (1975) suggest that beliefs are predictors of attitudes, which are predictors of intentions, which in-turn predict actions. Goodhue says that job satisfaction research is a reference discipline for information systems satisfaction. "The small correlation between job satisfaction attitudes and job performance is worthy of careful consideration by information systems attitude researcher" (Goodhue, 1988, p. 11). Satisfaction and performance are weakly related. There may be a weak link between a supervisor's belief and an employee's feeling of satisfaction. However, this can be a leading factor in the employee's job satisfaction attitudes.

Researchers in the area of attitudes impacting information systems have chosen many different variables, such as: quality, accessibility, use useability, intelligence, choice, design. Some would say that there are only a few main dimensions such as the impact of attitude on usage, which has been studied by Shewe (1976), Robey (1979), and Swanson (1982). Involvement's impact on attitude was studied by Swanson (1974). Information systems sophistication's impact on attitude's was studied by Cheney and Dickson (1982). Their method was to adapt existing measurements, instead of developing original measurement instruments. Cheney and Dickson, used the measurement instrument developed by Lucas (1975). This has been the method of many researchers. Ives, Olson and Baroudi (1983) actually used the Bailey and Pearson (1983) instrument as the basis of their research measurement. Ives, Olson and Baroudi (1983) were in need of a measuring instrument and

after examining several possibilities, chose the Bailey and Pearson (1983) instrument as the standard MIS measuring instrument. Although Ives, Olson and Baroudi defined user information satisfaction (UIS) as, "the extent to which users believe the information systems available to them meets their information requirements," they never developed a theoretical basis. The construct of end-user attitude has never had a strong research legacy using universally recommended techniques which can be used to construct new theory, (Goodhue, 1988). Since the theoretical base for MIS research is not well grounded, it is easy to see why defense or explanation for hypothesized formations has very little grounded theory.

THE CULPAN INSTRUMENT

Based on the standard method of borrowing another researcher's instrument it is this study's technique to borrow the Culpan (1995) instrument to study the impact of end-user's attitude on computer information systems. Culpan surveyed 50 businesses. Of the 50 businesses 10 were small businesses, with a maximum of 100 employees, 27 were businesses from 101 to 1000 employees and 13 had more than 1000 employees. Randomly selected from a telephone book, 25 companies were service oriented, and 25 companies were in manufacturing. Of these companies, 13 had mainframes and microcomputers; 11 had minicomputers and microcomputers. Six had microcomputers only (Culpan, 1995, p. 170). Of the 239 respondents,

Six end-users from each of seventy small businesses were surveyed using the Culpan (1995) instrument. The results of this study have not been analyzed, as this study is still in process. However, when the analysis is done, the following factors will be considered: Education, work background, demographic characteristics, end-user computer hardware, software, and computer usage. Major obstacles to learn were: reluctance to invest time initially, lack of availability of hardware, lack of instruction, and the initial fear of computers (Culpan, 1995, p. 171).

Culpan's research focused on learning about computers, user attitudes, and computer usage. Training was found to be related to computer usage. Most of the end-users in the Culpan study are non-management employees. In this study end-users will also be non-management employees. The Culpan study used both manufacturing and the service industry. This study will use only the service industry. Culpan's results point to a difference in attitudes between users in the two industries concerning computer usage, due in part to unique application in each of them.

When an industry, such as the service industry, puts an automated system into use in their business, employees are forced to use computers. In some cases the use of industry applications require special education. Culpan found that the results differed depending on the kind of industry. Therefore, research should be done on a specific industry because of the specificity of the applications. This is why this study will center on the hotel industry where the principal computer application is a property management system. Through this computer program, the hotel is able to make reservations for sleeping rooms as well as meeting rooms. The property management system is also able to track and total all charges for services in the hotel, such as: The room night stay, any food consumed, either in the room or in one of the hotel's restaurants, through the point of sale system interface, which brings the charge to the hotel room folio (receipt) in the property management system. It will also track and total the following hotel services: In-room movies, telephone calls, gift shop purchases and other entertainment items and services available in the hotel.

A survey of property management system end-users should avoid the bias involved in multiple industry studies, according to Culpan's research. Integrating jobs and information systems can encourage employees to learn the technical skills necessary when management creates an environment for uniting employees and the information systems tasks. Management should consider motivating employees by giving rewards as suggested by an expectancy model (Vroom, 1964).

SUMMARY

A general lack of grounded theory in MIS research has not kept the MIS researchers from developing empirical studies and a large body of literature concerning MIS and MIS attitude as it impacts end-users. MIS needs to borrow theory from pertinent reference disciplines by expanding that theory with theoretical constructs and models. Through an empirical study of a specific industry, (the hotel industry) the attitude construct and its impact on end-user satisfaction can be explained. This research proposes that end-user computing satisfaction is determined by end-user attitude. The questionnaire used in this study on user attitudes should show the variables which have the strongest relationships. Developing and measuring constructs such as these, using the hotel industry, brings information systems one step closer to having a common frame of reference for valid relationships and perhaps grounded theory.

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PERSONAL TRAINERS: GETTING THE BUSINESS SCHOOL PC FIT!

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ABSTRACT

Western Carolina University (WCU) will require PCs of all incoming freshmen beginning 1998/99. Recognizing the importance of faculty development to the success of this initiative, WCU is engaging in a monumental training effort to provide faculty with the expertise to integrate technology into the curriculum. At the university level, training classes and desktop training software are available. At the college level, an additional effort is being undertaken to engage faculty in training through the use of student personal trainers. The purpose of this paper is to describe the effort of the business school.

INTRODUCTION

With the twenty-first century "knocking at the door," many colleges and universities are examining their campus computing efforts. A key question that institutions are asking is whether or not students should be required to purchase their own computer. For those that answer the question favorably, a major campus-wide effort must be undertaken to ensure technology is integrated into the curriculum in a way that enhances and improves learning. While the hardware and communications infrastructures are being laid, faculty must face the monumental job of determining what to do with technology.

Successful implementation of a universal computing initiative is not just about solving an access problem. As Candiotti and Clarke (1998) explain, other issues must be addressed, particularly faculty development. Six years after Drew University's Computer Initiative was adopted, personal computer (PC) use had not penetrated the curriculum. Alumni reported that "aside from word processing, they had received few or no assignments requiring the use of the computer in academic courses."

Western Carolina University (WCU) will require PCs of all incoming freshmen beginning 1998/99. Recognizing the importance of faculty development to the success of this initiative, WCU is engaging in a monumental training effort to provide faculty with the expertise to integrate technology into the curriculum. At the university level, training classes and desktop training software are available. At the college level, an additional effort is being undertaken to engage faculty in training through the use of student personal trainers. The purpose of this paper is to describe the effort of the business-school.

REVIEW OF THE LITERATURE

Many different approaches are available to help faculty learn how to use computer and network technology. Harp, Satzinger, and Taylor (1997) examined 30 different ways people learn

software based on "their learning styles and preferences, type of work, and experience." Participants ranked activities on a scale of 1 (least useful) to 5 (most useful). With one exception, "experimenting with the software" was ranked as the most preferred learning activity. Participants identified as dependent learners ranked "working one-on-one with a consultant" as their first choice for gaining software expertise.

In both academic and business environments, formal classes or workshops are often used for getting the training biggest "bang" for the dollar. One of the most widely publicized workshop efforts that received the 1997 Hesburgh award was the creation of the Faculty Development Institute (FDI) at Virginia Polytechnic Institute and State University (Sorensen, 1997). The FDI program "provides faculty the opportunity to rethink methods and improve instruction through the use of technology."

While workshops are an effective approach for delivering training they do suffer several disadvantages. First, workshops are not always offered at times and locations convenient for faculty. Second, once workshops are conducted, participants often return to their offices only to find that their desktop configurations are different that those used during training. Finally, workshops will sometimes provide more information than a participant wants or needs.

Recognizing that different learners have different needs, most institutions use a multi-faceted approach to training. For example, Acadia University relies on its "Sandbox" (a.k.a., Acadia Institute for Teaching and Learning) to provide general workshops, one-on-one meetings, and guest presentations (MacDougall, 1998). Likewise, Wake Forest University has created a faculty group called the Computer-Enhanced Learning Initiative (CELI) that employs strategies for reaching the late adopters of computer technology. The CELI sponsors workshops, presentations, and discussion groups (Brown, Burg, and Dominick, 1998).

PROJECT BACKGROUND

Western Carolina University, located in Cullowhee, NC, is one of the sixteen public senior institutions of the University of North Carolina. The College of Business, accredited by the AACSB, employs 50 faculty to teach about 700 undergraduate and 150 graduate students. Each faculty member in the college has a Pentium-level PC in his/her office with access to the campus network. All classrooms in the college are wired for network access. Cullowhee, the town in which the university resides, was recently named North Carolina's most-wired small town.

The freshmen computer requirement at Western Carolina University was adopted in 1997 for the 1998/99 academic year. The requirement gives students the option of purchasing either a Windows-based or Macintosh system with minimum specifications established by a campus committee. The requirements for the Windows-based computer system, the only one relevant to business majors, are described in Table 1.

Western Carolina University has adopted a two-prong approach to providing faculty with the support needed for integrating technology into the curriculum: (1) formal classroom training designed to familiarize faculty with key software packages and (2) computer-based training (CBT) software accessible from the desktop for tutorial or reference purposes.

The responsibility for faculty training has been given to the Faculty Center for Excellence in Teaching and Learning (FCETL). The FCETL has a strong history of working with faculty to

develop instructional applications of personal computing technology. Similar to Acadia University's approach, the FCETL describes its technical facilities as the faculty "sandbox."

Table 1: Personal Computer Requirements

166 MHz processor (Intel Pentium, AMD k6, or Cyrix 6x86)
16 MB RAM, expandable
1.2 GB hard drive
Color monitor, .28mm or lower dot pitch
1.44 MB floppy drive
CD-ROM drive 2X or higher
16-bit sound card (Sound Blaster compatible), Speakers
3Com Ethernet adapter (on-campus) or
28.8 Kbps modem (off-campus)
104 key keyboard
Mouse or pointing device
2 ISA/PCI PC expansion slots

Although training classes can be very effective, Harp, Satzinger, and Taylor (1997) found formal training to rank only 23rd out of 30 preferred learning activities. It did not even rank as a top ten choice when participants' preferences were analyzed by software experience, work type, or learner type. Although the use of on-line tutorials was considered somewhat more preferable, it still only ranked 19th overall. One option that did rank in the top ten overall as well as the first choice for dependent learners was working one-one-one with a consultant.

Recognizing that faculty might need another option, the College of Business at WCU adopted a third approach, assigning faculty a personal computer trainer. Similar to the model of a personal trainer at the gymnasium, faculty (and staff) would work one-on-one with a consultant to assess their needs and develop a personalized plan. In this case the PC trainers assigned to work with faculty were upper-level computer information systems majors.

PROJECT METHODOLOGY

The project was conducted during the Spring semester, 1998. Student trainers from an advanced computer information systems course were paired with faculty/staff volunteers from the business school. The project began with 43 students and 22 faculty/staff clients. With almost a 2:1 ratio of students to faculty/staff, trainers were assigned in pairs to clients (with one exception).

The project was organized into four phases conducted over the course of the semester. The principal activity carried out in each phase is summarized in Table 1. Upon completion of the analysis, design, and implementation phases, student trainers were required to submit a deliverable. The requirements for each deliverable are summarized in Exhibits I, II, and III.

Table 2: Phases and Activities

Project Phase	Activity
Initiation	Problem definition, team formation
Analysis	Needs/skills assessment (Exhibit I)
Design	Training plan (Exhibit II)
Implementation	Training sessions, final report (Exhibit III)

Caudron (1997) identifies the first step in launching a new technology as assessing employees' needs, attitudes, skills, and behaviors. As a result, a needs assessment was conducted using an instrument developed by the FCETL. The assessment instrument identified the core set of skills being taught through FCETL training classes. These skills included desktop and network navigation, web publishing, word processing, spreadsheet processing, database creation and maintenance, and presentation graphics. Student trainers examined the skills identified by the instrument to determine (1) the areas in which clients had the greatest training need and (2) the areas in which clients had the greatest priority. Since the total training time was limited, only the highest priority needs could be addressed during the project.

With the adoption of the freshmen computer requirement, standardization of application and communication software gained greater importance. The needs assessment could not only consider client priorities, it also had to incorporate university requirements. Of particular concern was the vehicle for electronic mail. Faculty and staff were accustomed to using WordPerfect's Groupwise for communications. However, when freshmen arrive on campus, syudents will be use Netscape Communicator's mail feature.

Student trainers needed information on those standards that the university was adopting. Prior to completing the training plan, two instructors from the FCETL visited with student trainers and briefed them on the university's priorities for faculty training. Each group was then able to include these requirements in the personalized plans.

After completing the needs assessment, each student team developed a personalized training plan for its client. The plan identified the objectives for training, a schedule for when training would occur, and an outline of activities that were anticipated for each session. Each training team was required to complete a minimum of 300 minutes of training over an 8-week period. Student trainers worked with faculty/staff clients to determine the best approach for meeting the 300-minute minimum. Most teams built some slack time into the schedule in case progress did not move forward at the pace anticipated.

After the plan was complete, student teams were allowed to begin training. Each team was responsible for maintaining a journal (log) of each training session. Upon completion of the project, students must report on their actual training results as compared to their planned schedule. Additionally, clients will evaluate the quality of the training effort and the degree to which their objectives were met.

PROJECT RESULTS

At the time this paper is being written, data about the training project is still being collected. Student trainers are in the middle of conducting sessions with faculty and staff. The training most requested by clients has been World Wide Web publishing. Without a doubt, the Web is perceived as a major vehicle for communication between students and faculty/staff.

Success of the project will be assessed in several ways. First, students are responsible for reporting on their planned vs. actual training. Since this is a first training experience for many of the participants, large variances are anticipated between what was planned and what actually happened. Second, faculty/staff volunteers will have an opportunity to complete an evaluation form that gathers input about (1) the performance of their trainers and (2) the overall quality of the experience. Finally, students will also assess the success of the project in terms of their own participation.

Although the training project obviously benefits the university and its employees, students are also gaining great experiences. First, training faculty/staff on the use of application and communication software helps the students hone their own skills. Students have commented frequently that they will have to learn a particular application or feature before they can demonstrate it to their clients. Second, computer information systems graduates often deliver training, formally or informally, as part of their job requirements. This training project provides an opportunity to enhance their interpersonal communication skills before they undertake a "real world" job. Finally, students are gaining invaluable experience as project managers. By the time the semester is over, they should be able to develop a project plan and monitor its completion.

SUMMARY

While formal results are not complete, anecdotal evidence indicates the project is a success. Several faculty have asked if the project will be repeated in future semesters. Students seem pleased to develop a close working relationship with a faculty member.

If the project is successful, there are ample training opportunities for the future. Application packages will be upgraded, Windows 98 is on the horizon, and faculty will be ready to venture into new technology territory. If there is one thing that never changes, it is that there is always something new to learn.

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Exhibit I: Skills Assessment Requirements

Purpose:	To determine your client's (1) current level of PC skill and utilization and (2) client's PC training objectives.
Requirements:	Prepare a report that answers the following questions: 1. What is the client's current skill level? 2. How does the client use his/her computer? 3. What are the client's own objectives for training? What does he/she want to be able to do?
Process:	1. Review the skills assessment survey with your partner. Prepare a supplemental set of questions/items that you want to ask your client. 2. Contact your assigned faculty/staff participant and set up an appointment to complete the skills survey and discuss training needs. Both student trainers should meet with the client. Use the highest standards of professionalism during your appointment: *a. Dress appropriately.* *b. Arrive on time. If an emergency requires you to cancel (and I do mean an emergency), contact the client and reschedule.* *c. Be prepared. Use the interview time effectively.* *d. When the interview is complete, thank the client.* 3. Complete your Skills Assessment Report for February 9. The instructor will review the report, make comments, and assign a grade. After the instructor has reviewed the report, you will be asked to share it with the client.
Report requirements:	Format: typed; no spelling errors or grammatical errors. Use the following report structure: a. Report heading: Skills Assessment Report, your names, report date b. Client info: Name, Office location, E-mail address c. Interview: Time and date d. Summary: Provide responses to the three questions identified above (in the Requirements section); attach copy of completed skills survey.
Evaluation:	This report will be worth 30 points of the total 200 points on the project. Criteria used to determine the grade will be: (1) completeness of the skills assessment, (2) quality of the report summary, and (3) adherence to report requirements.

Exhibit II: Training Plan Requirements

Purpose:

To develop a training plan for your client that includes the following elements:

1. objectives for training
2. schedule for training
3. training session outlines

Objectives for training:

Identify what you expect your client to be able to do after training is complete. Remember, this should be a realistic assessment of what can be accomplished. More is not necessarily better. Consider the following example of an objective:

Upon completion of training, John Doe will be able to:

Create a course Web page using Word.

Publish a Web page on the Vax.

Schedule for training:

If you are working with a partner, a total of 300 minutes of training time will be required. Individual trainers (those not working in pairs) also will be required to log a total of 300 minutes. However, keep this very important point in mind: there is a difference between 300 minutes of training and 300 EFFECTIVE minutes of training. The time requirement defines a minimal effort. We are concerned with results B so I will be looking also at what you accomplish during the time.

The schedule should organize the training into sessions. Each session should have a planned date (by week is okay), responsible trainer (does not have to be both individuals), and objectives (what will be covered). Since this is a plan, your actual sessions and schedule may vary. You will be responsible for keeping track of and later reporting your planned and actual schedule.

Although the work between partners does not have to be split 50-50, it should be fairly distributed.

Training session outlines:

It is very important that you outline what you plan to cover in each training session. Again, this may vary somewhat after you get started. But it is important to have an idea of how learning will take place. The outline should be as detailed as possible.

Plan Format:

1. Typed; no spelling errors or grammatical errors.
2. Cover page: Title: Training Plan, your names, report date; Client info: Name, Office location, E-mail address
3. Detailed plan with the three sections described above.

Evaluation:

This report will be worth 50 points of the total 200 points on the project. Criteria used to determine the grade will be: (1) appropriateness of the training plan, (2) level of detail provided (3) professional quality of the write-up.

Exhibit III: Final Report Requirement

The final report for the training project will be consist of four parts:

1. Written report as described below, 80 points
2. Oral presentation of training experience (10-12 minutes), 20 points
3. Client evaluation, 20 points

Written Report:

The written report should contain the elements identified below.

Recap of Training Needs and Plan

Assessment of training needs (report 1)

Training plan (report 2)

Description of training sessions:

The description should be extracted and summarized from your journals:

When did training take place?

Who performed the training?

What was accomplished ?

What problems/questions were addressed?

Comparison of planned vs. actual

This will be a summary of major differences between what was planned and what actually took place. For example:

Schedule variances (if any)

Content variances (what content was actually covered)

Client objectives (did the client change focus or interest)

Appendices:

Handouts, materials distributed to client

Journal of training sessions

Oral Presentation

The oral presentation should be a high level summary of your training experience. Projection equipment will be available for those choosing to do a Powerpoint presentation. If you are working with a partner, BOTH PARTNERS ARE REQUIRED TO PARTICIPATE IN THE PRESENTATION.

Client Evaluation

During the last week of class, I will ask each client to complete a simple evaluation of the training experience. Input will be sought regarding (1) your performance (preparedness, promptness, expertise, etc.) as a trainer as well as (2) the client's satisfaction with the training experience (to help me with future projects).

Peer Evaluation

For students working in pairs, an opportunity will be provided to evaluate each other's performance. The input from the peer evaluation will be used to make adjustments to the final grade. If partners report that work is evenly distributed, the final grade will require no adjustment. If one partner provides a greater contribution than another, final points may be adjusted accordingly.

HOW CAN YOU IMPEDE A DISASTER BY USING A WEB SITE TO SUPPLEMENT AND COORDINATE INSTRUCTION?

William Perry, Western Carolina University

INTRODUCTION

During the Fall of the 1996-97 academic year, an Analysis and Design class (CIS 455) was scheduled to be to taught at 11:00 AM in the Spring Semester of 1998.

The class was canceled by college-level administration after the Spring schedule had been published. A small number of students, who needed the course for Spring graduation, complained. The class was re-instated but the time for the "new class" was inaccurately posted. Five students registered for the class at one or the other published times.

University-level administration, at the beginning of the Spring semester, deemed that the class was to be canceled yet again due to low enrollment. The students who needed the class for graduation re-asserted their disapproval. The class was once again scheduled.

The instructor who was to teach CIS 455 had been assigned to teach a night section of CIS 251, Introduction to Information Systems when CIS 455 was canceled. The original instructor, however, agreed to teach the CIS 455 class as an overload. A problem still existed as some of the students had registered for different times. Schedules couldn't be changed due to other conflicts.

Does any of the preceding sound familiar?

The instructor (with the help of a graduate student) planned to create a supplemental web site to help avert disaster and coordinate instruction.

STATEMENT OF THE PROBLEM

The problem to be solved with this action research study was to provide the highest possible quality of instruction to a small group of senior-level students who were enrolled in the same class at different times.

PROCEDURES

The instructor decided to create a web site to coordinate and supplement instruction. Specifically, the instructor wanted the ability to publish assignments, solicit feedback and the capacity to hyperlink or send students to relevant sites.

A conscious decision was made to avoid ascending the HTML or DHTML learning curve. The development tool that was chosen for web site creation was Microsoft FrontPage97. The Computer Center was contacted and asked if support could be provided for a virtual web-site for the class using FrontPage97. The instructor was informed that the request was impossible to honor.

A remote web host was chosen. Anaserve was selected for this study. A commercial URL, which had been previously reserved for a business, was designated to be used to store the files associated with CIS 455's web site.

Initial Lessons Learned

1. Select a web site development tool. You must do this or learn to write "code" in HTML or DHTML.
2. Determine if your computer center or network server will support a web site that can be accessed by students over the Internet. If so, how much space and support can you count upon? Will your software be supported?
3. If your computer center or network can't support a web site for your class, establish a relationship with a remote hosting service. You will more than likely have to create a private URL (http://www.countrythings.com for this study).
4. Make certain that your remote host supports the software you are going to use. (Microsoft FrontPage97 requires that extensions be stored on the remote host in order to work properly).
5. To keep from raising the ire of your parent institution, strip out all references in your site to your institution. A hypertext search of your school's name would turn up your handiwork on a commercial web site. Our institution was and is involved in defining who we are on the Web and wouldn't take too kindly to being listed with a commercial URL.
6. Purchase at least one very good reference book for the development tool you are using. You'll need it.

Once we had established where our site would be hosted and by whom we proceeded to create a list of what we wanted to contain. We chose the following items for our home page: Articles, Careers, Course Profile, Feedback, Handouts, Lab Assignments, Lesson Plan, Sites to Visit, Technology News, What Do Graduates Have to Say and Vendor Certification.

The graduate assistant began working on scanning graphics to include for the course syllabus, lesson plans, lecture notes and assignments. Links to industrial sites were established and tested. A student feedback form (viewed by the instructor as critical) was developed. Also, feedback from graduates was solicited.

Hours were spent developing the pages, establishing links and testing them. An even larger number of hours were spent on the technical support line with Microsoft over an arcane feature known as "reverse resolve" which related to the feedback form.

You can simply expect numerous problems when implementing your site so be ready.

Intermediate Lessons Learned

1. There is little need to scan in graphics. Use .gif or .jpg images. There are a ton of the backgrounds, images and graphics on the web that can be used.

2. Make sure that your remote host can handle student feedback forms or that someone knows how to write CGI scripts. Using a software development tool that supports automatic CGI script generation for interactive features is strongly recommended.
3. Organize, organize, organize. We failed to do so and were always "dropping back five to punt." Use a standard naming scheme for your image files, your page files and other data files. Make the method of your madness obvious to yourself. In the old days we referred to this as "creating a good directory structure". The process of establishing, running and maintaining a site is cryptic enough without being complicated by file naming schemes rooted in randomness.
4. Use a consistent interface throughout your web site if possible. Ours was evolving. We still lack a consistent "feel" and I think that distracts from the site's effectiveness.
5. Determine whether you want to store your supplemental instructional materials on your host or use hyperlinks. You'll know it's there if you store it on the host. You'll have to update the hyperlinks otherwise.
6. Test before you publish. Most development tools will allow you to do so using one of the Internet browsers.
7. Test all links (both internal and external) frequently. You may maintain your site but those to which you've linked may have lost their relevancy.
8. Maintain a positive attitude because you are going to experience technical difficulties. Don't be afraid "not to know". Very few people do. This story is being written as we speak.
9. Strongly consider using what others have done. If you see a feature you like in someone's web site - copy the methodology.
10. If more than one computer is used to develop the site, be certain that you understand how to transfer developmental files between the computers.
11. An enthusiastic graduate assistant is extremely helpful.
12. The net is an abundant resource for web site development. Use it!

We deployed our web site in stages. Once we had a section working properly we would publish it and go to another. Students were encouraged to access those portions of the site that were "up and running".

The supplemental web site is a different instructional paradigm. Students must be oriented to using the web site and to depend upon it. However, putting up a web site has little effect on your students' motivation. They still are late with assignments and have the same variety of excuses - only a touch more sophisticated.

One excuse you'll hear for sure is "I used the form and it kept getting returned." Also, I didn't receive your e-mail. All of the stories could be true. We ran into problems with the University's "fire wall." I learned quickly to ask students to confirm every message by a certain dead line.

You can expect other technical problems. Your remote host's machine can "go down." Communication lines can be disrupted. You could commit an error in the development of your site that cascades throughout your site.

Final Lessons Learned

1. Developing a web site to supplement a class' instruction takes a great deal of time.
2. The feedback form or interactive portion of the supplemental web site is one of a supplemental site's most useful features. It is possible to manage assignments outside of the classroom's walls.
3. You have to "publish" material on your web site that keeps your students returning. We found our news site worked fairly well.
4. Using a web site to supplement instruction is a major paradigm shift. If you succeed with bringing students to your site they will "hold your feet to the fire". Once you convince your students to use the site you are responsible for maintaining it throughout the instructional period.
5. Archive the sections that "turn-over" regularly (i.e. such as the technology news section). You'll want to review them later. Use some type of numbering scheme.

There are advantages and disadvantages to utilizing a web site to supplement the instructional program. Some of each are listed below:

ADVANTAGES

1. You can save a tremendous amount of effort with regards to duplicating handouts, articles, etc.
2. You can easily maintain contact with your students outside of the classroom - timeliness
3. You can publish your thoughts, references to articles you read and other items without having to cope with the traditional copy room cycle
4. You can utilize the vast resources of the Internet to supplement your classroom instruction and activities
5. Students can't lose a web page the way they lose handouts!

DISADVANTAGES

1. A tremendous investment in terms of time on the part of the instructor is mandatory (both in development and maintenance)
2. You can anticipate technical difficulties
3. You'll be out there on the "bleeding edge"

SUMMARY

There's little doubt that the supplemental web site for our Systems Analysis and Design class (CIS455) required a tremendous amount of time on the part of the instructor and graduate assistant. However, the instructor believes that much of the burden consisted of an initial "learning curve." The instructor was without web development skills prior to the class beginning.

There is little doubt that the supplemental web site for CIS455 was a work in progress. We learned lessons as we went along and the site improved.

More importantly, there is little doubt in the instructor's mind that a supplemental web site for an on-going class is a powerful tool that we need to learn to use. There's an unquestionable paradigm shift in terms of time, logistics, cost-savings, the linking of the instructor with students and the capability to "hook-up" your students with a large and vast set of resources.

The instructor believes he was better able to manage instruction rather than to "give it". A key point in this action research study came when a student gently suggested that it would be more helpful to him if we were to "post" our chapter study guides in advance rather than distribute them on the occasion of the class' physical meeting.

A web site designed to supplement instruction proved to be useful. The researcher believes that further investigation is needed to learn how to derive the maximum benefit of the paradigm shift that web supported instruction most assuredly offers.

TRAINING DURING SDM IMPLEMENTATION

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ABSTRACT

A primary focus for any information systems (IS) managers is to improve the effectiveness of the software development process (Brancheau et al., 1996). One of the methods being used to accomplish this task is the implementation of a system development methodology (SDM).

This study addresses training issues during SDM implementation. The survey instrument was created from a review of the literature concerning SDM and through the use of expert interviews concerning SDM (Roberts & Gibson, 1996). Expert interviews helped to ensure content validity for the items in the research questionnaire. The instrument included information on training issues during SDM implementation. The respondents were asked to respond to training items on two six-point Likert scales. The first scale asked the extent the item "should contribute" to SDM implementation. The second scale asked the extent the item "currently contributes" to the company's SDM implementation process.

Companies used in the study were selected using a criteria that they had to have been implementing an SDM for a minimum of two years. Sixty-one Companies representing all parts of North America from a variety of industries were selected. A total of 192 organizational personnel directly involved in the SDM implementation process were polled. The survey respondents represented four constituencies: Functional managers, IS managers, systems personnel, and external consultants.

Paired t-tests at the .05 significance level were performed on each item between the scales to determine if significant differences existed regarding the actual contribution of an item to SDM implementation as opposed to the belief of the respondents regarding their importance. The results of the tests indicated significant differences did exist between what organizational personnel believed was important while implementing an SDM and what they actually did during the implementation process. The results will be presented at the meeting, including the implications of those results relative to organizational training issues. The primary finding of the research project was that trainers need to more judiciously practice what they believe to be correct while implementing an SDM.

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DEVELOPING ENTREPRENEURIAL ATTITUDES IN BUSINESS SCHOOL STUDENTS: TWO EXAMPLES FROM MIS

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ABSTRACT

While some believe that entrepreneurs are born and that the entrepreneurial spirit cannot be developed, others hold that the seeds for such an attitude can be planted, cultivated, and nurtured throughout the educational process. Those of the second mindset often attempt to incorporate aspects of entrepreneurial development into course syllabi. This paper examines an introductory computer skills class and a graduate Management Information Systems class. Both courses encourage students to explore the pitfalls and rewards of starting and maintaining a business. In the skills class, students use an integrated office software package to advertise, monitor and develop their business. In the graduate class, students use the World Wide Web to develop a business plan and simulate a Small Business Association loan application.

INTRODUCTION

In this paper, we present an overview of two courses that foster an entrepreneurial spirit among the students taking them. The courses are typical of those required for business majors. The first course is an undergraduate class that teaches basic computer skills. Most universities require that students either demonstrate their proficiency in basic computer skills or take a course that provides them with these skills. It is not the MIS course standard in AACSB colleges, but it is the course that precedes it.

The second example presented in this paper is a graduate-level introductory MIS course typical of many MBA programs. The course is targeted toward students who intend to be managers, not toward information or technology specialists. The course is designed to prepare future managers to be effective exploiters of information technology. As such, a major group project is used to simulate the real world use of teams and to reinforce and integrate knowledge developed during the course.

The courses presented herein were developed to spark student interest in MIS, thereby motivating them to learn. In addition to doing so, they also have encouraged students to be creative, competitive and even entrepreneurial in their approaches to completing the course requirements. Several students (both undergraduate and graduate) have used the work they completed in the class to jumpstart small businesses. Others have used the assignments to develop presentations to obtain loans, to develop clients in existing businesses, or to demonstrate their business acumen during job interviews. Overall, student response has been extremely positive and the popularity of the classes has grown.

In the sections that follow, we first present details from the syllabus and class assignments for each course. Next, we present and discuss results of some of these assignments. Some positive outcomes from the classes and future plans are presented last.

THE INTRODUCTORY SKILLS COURSE

This course is a lower division undergraduate class. Business majors form the majority of the class; however, typically there are several students from other majors in each class. Ability levels range from novice (there are still some students who have never turned on a computer!) to advanced. The course is a blend of basic computer skills (E-mail, word processing, spreadsheets, database, the World Wide Web and presentation graphics) and basic computer knowledge.

THE COURSE SYLLABUS

To motivate the students and encourage them to use the more advanced features of the office package, the current course curriculum was developed. It is now in use for the fourth time, and it has gone through several revisions. As available technology has changed, so have the course requirements. For example, presentations now employ animation, sound and video clips. The first time the curriculum was used, the WWW component was minimal; now, students critique web pages and develop their own. The course follows a theme throughout the term -- students will "run" their own business, using the features of an integrated office package.

Students first decide what type of business they want to run. They are not restricted in their choices; however, some guidelines are provided. First, the business should not be too large. Multiple locations, numerous employees, and complex business situations are all discouraged, although students are free to choose such a business if they want. It is also helpful if students have some knowledge of the business they select, or at least a great interest in it. Among businesses chosen in the past are day-care centers, travel agencies, mail-order catalogues, bridal shops, nightclubs, beauty salons, restaurants, and financial investment firms. Finally, students are allowed to change their minds about their businesses up to the time they turn in their first assignment. After that, they are considered to have "invested their money" in the business.

INDIVIDUAL ASSIGNMENTS

Students complete assignments in electronic mail, word processing, spreadsheet, the World Wide Web, and database. To learn E-mail, students send their business selection to the instructor electronically. The first software package covered in the class is word processing. Students first must create a logo / letterhead for their business, using any of a variety of methods, including downloading pictures from the web or scanning them into their document. Students also compose an open letter to perspective customers, and prepare a flyer to announce the opening or renovation of their business.

For the web assignment, students are first shown some business web sites that have won awards (both positive and negative). Details about the sites are discussed in class so that students become familiar with the evaluation criteria. Some of the criteria are: time to load, originality, ease of locating information, and effective use of color and graphics. Students then search the web for

sites of businesses similar to their own, and choose two of the sites to explore and evaluate using the criteria discussed in the first part of the assignment and any they choose to add.

Spreadsheet assignments vary. Typically, students must develop a budget for their company, including loan repayments and income and expense projections. Students also purchase a vehicle for the business, and use the data from the budget to determine their maximum monthly payment. Students also create cash flows for their businesses. Finally, students select a new product or service and develop a new product forecast using the what-if analysis and goal-seeking functions of the spreadsheet.

GROUP ASSIGNMENTS

Once the word processing, spreadsheet, and WWW assignments are completed, students form groups of three or four persons to complete the remaining course assignments. The group's first task is to select one team member's business to develop further. By this point in the course, the students typically have become very competitive. They are often unwilling to show their work to other teams and are struggling to develop the most unique and creative products and services.

The database assignment is very limited. The team creates at least three tables appropriate for their business. After data are added to each table, several reports and data entry screens are created. The basics of a graphics presentation package are presented to students in one class period. Students are shown how to select a background, transition slide, and add pictures, sound, video and animation to a presentation. Teams then use the graphic package to create one part of their presentation.

Using tools available in the integrated office package, teams construct a web page for their businesses. There are few guidelines for this assignment; teams are free to develop any type of web page they want. Some teams create the ability to order products from their web pages; others create surveys for potential customers to complete. Teams also develop a newsletter for their business.

THE DELIVERABLES

Teams must present their business in a fifteen-minute presentation at the end of the term. By the time the date for the presentation arrives, the teams have typically become highly competitive and secretive about what they plan to do. Each glimpse at another team's presentation plans sparks the other teams to do more. While seemingly hard at work on their team activities, most students nonetheless keep one ear on all conversations the other teams have with the instructor, hoping to glean something they can use to be the best presenters.

Each team decides the nature of its presentation. Some present their businesses as if they are recruiting new employees on a college campus. Others take the opportunity to introduce the community to their new business, pretending that the audience is a group or perspective customers to whom they are selling their products and services. Such presentations tend to be rather theatrical — one restaurant brought in samples of their cuisine during their presentation! Still others present a more dignified picture of their firms, acting as if the audience were bankers considering making a loan.

COURSE GRADING

The course has individual and group components, and grades are assigned differently in each area. Individual assignments are graded based on the extent to which the students meet requirements. In the word processing assignments, for example, a student receives the base number of points for developing a logo/letterhead, a flyer and a memo according to the criteria specified. Students who simply meet the requirements receive a C; students who exceed the requirements (using enhanced graphics, for example) receive a higher grade.

For the group assignment, students receive three distinct grades. First, they are graded on the work they produce. They are also graded on the presentation itself. The instructor issues these grades. Finally, each team member must evaluate the other team members by allocating points. Students are given 100 points to distribute to their team members in any way they choose. The total points a student accumulates is then used to determine that student's percentage of the group grade. In this manner, students who slack off their responsibility on the project will not be given the same grade as those who work at it.

THE GRADUATE MIS COURSE

This class is the traditional MIS course taught in an MBA program. Typically, students have undergraduate degrees in business. Those without such degrees have taken core courses in each business discipline and often have real-world business experience. The course is targeted toward students who will become managers in areas other than IS; its purpose is to prepare these future managers to exploit information technology effectively. Information technology is viewed broadly to include office automation systems, telecommunications, decision and executive support systems, and electronic commerce.

THE COURSE SYLLABUS

The course curriculum includes a variety of activities as might be expected in a graduate level MIS class. There are two exams, an individual term paper, miscellaneous assignments and class participation, and a group Internet project. It is the Internet project that is the focus of this paper. Students use the resources of the web to create a business development plan. The plan follows the format of a Small Business Association's (SBA) loan application package. In the sections that follow, more details about the teams, the project and its deliverables are presented.

GROUP ASSIGNMENTS

To complete the business development plan, students are grouped in teams. Depending upon class size, teams consist of four to five student participants. Typically, there are nine or ten teams. Students may select their own team partners within specific diversity guidelines. These diversity guidelines (for the typical five-person team) specify that no team can contain more than three persons of the same gender. No team may have more than one non-native English speaking student, and each team must have a proportional number of other minority members as represented by class population.

Email ID's are assigned the first night of the class; the Internet project is introduced on the second night of class, and projects are due about six weeks into a 16-week term.

The instructor selects the possible businesses on which the teams can work after reviewing suggestions from the class. Teams must choose from among the approved businesses. Sample businesses used in class in past classes include a carpet cleaning service, a cybercafe, a home computer installation/repair service and a home health care service. Although teams may select any business, to instill a competitive spirit, two or three teams must select the same business. Thus, the average class will have three or four distinct business plans being developed simultaneously.

Teams work independently of each other to develop their business plans. They are told that resources (i.e., grades) are scarce and that only the best plan will receive full funding (i.e., an A). Business plans are ranked within the business and across the class. The best plan in one business may achieve only third or fourth place in the overall competition. In this manner, competitiveness among teams is fostered.

PROJECT DELIVERABLES

The final deliverables for the group Internet project are a class presentation of the business plan and a notebook with supporting documentation. Teams develop an application for a SBA business loan, so the first item in the notebook is a letter of transmittal for the business plan to a lending officer (the instructor). All team members must sign this letter of transmittal. The notebook must also contain an executive summary of the business plan, developed according to the Small Business Association (SBA) standards which students can obtain on the web. The full business plan is the third item in the notebook. A hardcopy of the class presentation is also included in the binder. For this Internet project, students are restricted to web-based resources only. They reference web information by URL for citation purposes, and a "screen print" of each cited URL is also submitted (sorted by URL address).

Students must also present their business plans to the class (simulating a loan committee) on a scheduled class day. Presentations are strictly timed and followed by a brief question and answer period conducted by the loan committee (the class and the instructor). All classrooms are automated and PowerPoint presentations are the norm.

Although the exact nature of each group's business plans is a closely held secret within the group, students do learn from each other during the course of the class. The instructor will only answer questions about the team project at scheduled times during the class. Every team hears each team’s questions and the answers to them. Teams learn rather quickly that they must take care in asking questions so as not to give too much of their plan away. Refusing to answer questions not asked during class ensures that no team receives an unfair advantage in the project. Teams also learn to apply planning techniques and teaming techniques to accomplish the end goal and are encouraged to define roles early in the project. Not each person will perform each role (including the presentation).

COURSE GRADING

The grade for the group project has three components. Recall that there are typically three or four groups presenting the same business, and that there are three different businesses in each class. The class votes on the outstanding group in each business type. Once the top three groups have been selected, the "best of the best" is chosen. The presentation itself is also graded as well as the notebook each group has compiled. Similar to the skills class, students are given one hundred points for each team member other than themselves. They then can allocate fewer or more than one hundred points to each team member, based upon each member's individual contribution to the project. Each student's total points are then used to determine the final project grade.

RESULTS OF ASSIGNMENTS

These classes have produced a wide variety of outcomes, most too lengthy and detailed to be included in this paper. In this section, some of the broader outcomes are discussed. The evidence presented in this paper is anecdotal in nature, but leaves the instructors with the clear opinion that entrepreneurial attitudes of the students are significantly enhanced, and that the students are excited about the subject area. We recognize that our intuitive findings should be empirically validated; such concerns are addressed in our summary.

THE SKILLS CLASS

As might be expected, students have exhibited the most creativity in the word processing, World Wide Web, and graphics presentation assignments. Not content to create a simple flyer, approximately twenty-five percent of the students in each class produce a tri-folded brochure, complete with mailing label. While most students are satisfied with the standard pictures available with the word processor, others diligently search the web for just the right graphic for their logos. Even the spreadsheet assignments are creative. Many students package their spreadsheets within cover letters; some add charts to explain their numerical data, and create web pages to display their financial reports.

It is for the final presentation, however, that students are the most creative. In one class, a travel agency held a mock cruise giveaway and actually awarded the lucky winner a small toiletry travel pack. In another group, one member was unable to dress in a business suit. These resourceful students dressed up in holiday garb complete with Santa hats to hawk their festive fare. Several groups have developed presentation to be given in real life, using the final class as a dress rehearsal. Two students have actually started real businesses using the skills acquired as part of the class -- one has begun a small day-care center and the other has started a mail-order catalog. A third student is seeking funding to begin work on a recreation center.

THE GRADUATE MIS CLASS

While the completed assignments in the graduate course are more formal, they are no less impressive. The complexity of the business issues examined and the detailed nature of the plans

provide a highly integrative framework for each student. For some students, this project is their first real exposure to business integration since many courses tend to be discipline specific or even job specific. The level of integration and the degree to which MIS facilitates organizational integration always seems to be a surprise to the students, many of whom tend to look at business from the narrow perspective of their academic or professional area. This provides a very nice springboard for discussion.

Since project information resources are limited to those acquired on the web, the experience also provides an excellent foundation for classroom discussions related to the benefits and deficiencies of such information, intellectual property rights, quality and quantity issues, and even what constitutes a "good" web page. This information is later contrasted with information from other sources usually contained in libraries. Classroom discussion topics are plentiful and the students are eager to share experiences.

Additionally, the Internet project allows each student to actually experience a group environment that simulates the real world use of teams. In this manner, individual team members are exposed not only to the subject material but also to some of the group dynamics that affect project quality. These dynamics provide a significant opportunity for class discussion. Project planning (usually a dull topic) and role determination takes on new significance, particularly if examined after the project is complete.

By exposing student participants to an "entire" business in a competitive environment, entrepreneurial tendencies seem to be stimulated. This approach has been used for five terms. A few students have opened their own business either in the topic area studied, or they have applied the same techniques to develop a case for an SBA loan to start up a different small business. Additionally, students have reported that they have used their project notebook to advantage in job interviews. Students react very favorably to these experiences as demonstrated by classroom feedback and course evaluations.

THE FUTURE OF THE COURSES

Both the instructors and the students are pleased with the outcomes of the course. Student interest in the courses has increased, as evidenced by the course evaluations and number of non-business majors enrolled. Each term, students from several other areas, including Nursing, Health Science, and Psychology enroll in the courses. Students especially enjoy the technology components of the courses, specifically the World Wide Web and graphics presentation package. Student evaluations indicate that the real world projects enhance understanding of technology concepts and help students integrate their computer knowledge.

The authors recognize that this paper has a significant shortcoming in that their beliefs regarding the impact of the courses described herein are not validated. They are currently sifting through the strategy and entrepreneurship literature to find an appropriate instrument to measure pre and post entrepreneurial attitudes.

THE ASSESSMENT OF TRAINING FOR COMPUTER PROFESSIONALS

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ABSTRACT

This paper introduces an important, existing training assessment framework to the computer information systems literature. The introduction of this framework will expand the breadth of our consideration of training assessment. The framework is then used to summarize the existing computer professional training assessment literature and provide a foundation for the development of a comprehensive approach to the assessment of training for computer professionals.

Improvements in training increases the likelihood of information systems (IS) success. Increasing our understanding of assessment will improve our training in two ways. First, the effectiveness of the traditional "comparison to feedback to adjustment" loop will be improved. Second, broadening our understanding of assessment will produce a richer, more useful set of training objectives.

OVERVIEW

The assessment of training spans a wide range of activities. Compeau, Olfman, Sei and Webster divide these activities into three phases: initiation (assessment of needs and materials), learning and delivery (assessment of delivery), and post-delivery (assessment of learning and impact). (Compeau et al, 1995) This paper focuses on post-delivery assessment.

There is very little recent publication in the computer related literature that focuses directly on the assessment of the training of computer professionals. Post-delivery, "reaction" assessment is the prevalent method reported in the computer related literature. However, the general training literature offers a plethora of work on assessment.

An assessment framework developed by Donald Kirkpatrick in 1959 is a mainstay of much of the general assessment literature. The framework identifies four levels of training assessment; reaction (trainee satisfaction), learning (knowledge acquisition), behavior (knowledge application), and results (organizational impact). (Kirkpatrick, 1959a; 1959b; 1960a; 1960b).

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YEAR 2000 CONVERSION STRATEGIES: STUDIES IN THE INSURANCE AND BANKING INDUSTRIES

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ABSTRACT

The Year 2000 issue is defined and some possible consequences for government and business are discussed. Conversion strategies of two busineses are examined in detail to demonstrate different approaches which can be used to address the problem.

INTRODUCTION

What exactly is the year 2000 problem? Storage and space would seem to be the answer to this question. The decision was made over 40 years ago to use a two-digit field to represent the year instead of the full four- digits, in order to save valuable storage space. In order to do so, 00 was used to represent the year 1900. So when the date of 1968 is used, it becomes just 68. The 19 in front of the 68 is dropped and is understood on computer systems. Now the problem is how to recognize the new millennium in the same amount of space. As the year 2000 approaches, when 00 is displayed, the system will think that it is the year 1900 and not 2000.

Every legacy computer system that exists today will have to be changed in order to make it year 2000 compliant. Making a system compliant means the operating system that reads dates have to be modified to recognize 00 as 2000 and not 1900. If systems are not maintained properly, then the world of technology as we know it today will no longer function. Every system that is not made compliant may cause major problems: from the government, to businesses, to banking and personal computing, all systems will fail without the necessary changes.

How Does Year 2000 Affect the Government? Imagine that at the stroke of midnight on January 1, 2000, the air traffic control systems breakdown and the communication system for the United States Army goes haywire. What will happen? The United States Government is asking this question everyday. Every aspect of the government has a computer system that must be made year 2000 compliant. There are over 4500 "mission critical" systems that are operated by the government. By July of 1997, only six percent of these systems had been made complaint (Chandrasekaran, 1997).

If the FAA has not performed maintenance to the air traffic control systems, there will be total chaos at airports and in the air. The FAA relies on the air traffic control system to translate the radar signals into visual data. The system uses the visual data to track the location, identity, altitude, speed and destination of each aircraft that takes off and lands at anytime and from anywhere. Just picture what it would be like to be in flight on January 1, 2000 if no one knows the location of any aircraft.

The Department of Defense has roughly 358 million lines of code to review for possible date changes (Adhikari, 1996, 4.40). Without the defense system being year 2000 compliant, there is a

possibility of failure for the entire military communication systems. Currently if one system fails, the military has a work around for that one system. However, if most of the systems breakdown at the same time, this would result in a major catastrophe.

Each area of the DOD uses systems that produce information based on dates. If the government payroll and finance systems are not corrected by the year 2000, Armed Services personnel will not receive the proper pay. If the logistics and transportation systems are not in operation, then people and equipment will not be delivered to the correct place at the correct time. The results of this could be devastating if it happens during a time when troops are reacting to a crisis situation. Some of the weapons systems that may need to be used are date driven. If our troops need computerized weapons during a period of downtime, what happens?

The Medicare system has the most intensive date driven system that is operated by the government. The system heavily depends on dates to determine benefits eligibility. It uses dates such as date of birth, date of medical procedures, insurance coverage and beneficiary claims. It is estimated that Medicare will make payments totaling over $288 million by the year 2000. The officials of Medicare have a plan to integrate all of the payment systems currently in use today. The system will be the Medicare Transaction System (MTS). However, Medicare currently contracts out the day-to-day operations to over seventy private firms. The Health Care Financing Administration (HCFA) has delegated to these firms the task of making the new system year 2000 compliant. As of mid 1996, the HCFA has not required the seventy firms to submit their year 2000 plan for approval (Adams, 1996, 10). If the contractors are not ready, there is the potential of issuing up to one billion bad checks based on incorrect data.

The Internal Revenue Service has over 100 million lines of code in over 50,000 applications. These applications are housed in three mainframes at headquarters and about 60 mainframes scattered across the country (Duffy, 1998, 14). A change in just one line of code can result in a shut down of any one of the 50,000 applications being utilized by the IRS. Estimates show that it will take about 900 programmers working full time to maintain one module. As of mid 1996, there were four modules remaining. Not only does the IRS system record dates, it also houses the tax deduction information and tax rates. At the turn of the century taxation as we know it may no longer exist. There have been rumors that the IRS will have to go with a flat tax rate because the current taxation system "will no longer be administrable by the end of the century" (Duffy, 1998, 14).

Of all government agencies, the Social Security Administration has made the most progress. Although some of the databases are year 2000 compliant, there are still 30 million lines of code that need to be reviewed in order to finish the conversion on time (Adhikari, 1996, 4.40). Some problems may arise with outside data that could derail its entire repair efforts (Scheier, 1997, 70). For example, the IRS is planning to tap into the SSA's system to verify IRS data. This verification could cause problems with both systems. The SSA issues 50 million checks each month and has a near zero defect rate. Even with a one percent error rate, 500,000 recipients would be calling about their checks. What is the impact if the SSA is only 90% compliant by the year 2000? It could mean that 10% of checks send out will have been prepared using bad data. It means that five million people will be calling the Social Security office complaining about the check they received or that they did not receive. The remaining 45 million recipients will travel to the bank to cash their checks. However, they may be in for a rude awakening if the banking systems are not Year 2000 compliant.

Businesses will be affected by the Year 2000 problem also. As we roll over into the new millennium, the computer systems that are mission critical to businesses will do one of three things: they will compute erroneous results, they will reject legitimate entries, or they will simply not run. If the Year 2000 problem is not addressed immediately there may not be time to avoid a catastrophe that could throw the world into chaos. Peter de Jager wrote in the September 1993 issue of *Computer World* that it was already too late to avoid a crash because of a general reluctance to address the problem. The two-digit date affects data manipulation that primarily perform subtractions, additions, or comparisons. The two-digit dates exist on millions of data files used as input to millions of applications. The task facing business today is to identify and correct all the date data, and to check the integrity of all calculations that involve date information. The correct data must reside in all files or code must be written to generate four-digit date fields. De Jager writes "one IS person I know of performed an internal survey and came up with the following results: of 104 systems, 18 would fail in the year 2000. These 18 mission critical systems are made up of 8,174 programs and data-entry screens as well as some 3,313 databases." Because there are no standards for labeling data used in date calculations, the only way to correct the problem is to examine each line of code, which is very expensive.

Why has so little been accomplished since the early 1990's? Mr. Ken Orr, president of the Ken Orr Institute, feels the real problem is the attitude in the computing community. He has spoken at business association meetings and seminars, where he asked for a show of hands of people who are addressing the year 2000 problem. He typically gets snickers and comments such as "I won't be in this position or this company in the year 2000. It's not my problem." Gerald Weinberg, author of Quality Software Management and winner of the 1991 J. D. Warnier Prize for Excellence in Information Science, believes this procrastination is an indication of deep management malaise. Casper Jones, chairman at Software Productivity Research says, "I expect that most companies will not start worrying about the problem until 1999. For some, this will be too late." As we hurl toward the year 2000, some feel that "this is the year a long-obscure software bug will begin to reshape American business in earnest" (Scheier, 1998). A survey of Fortune 500 companies released in October of 1997 by Cap Gemini America, a New York base consultant, showed that only one-fourth had a detailed year 2000 plan and only 16% had started repairs. That fact worries industry analysts, who point out that code repair is only 20% of the entire effort (Scheier, 1997, 69). The bulk of the work is analyzing which application must be fixed first and coordinating the repairs with that of other internal and external interfaces. So far, no silver bullet solutions have appeared.

Two Georgia companies that are addressing the problem will now be examined. Blue Cross, Blue Shield of Georgia is the state's largest health insurer. When someone is sick or injured, they expect their insurance company to provide service, whether it is today, or January 1, 2000. Total System Services, Inc. is the second largest credit card processor in the United States. Credit cards are an vital part of daily purchases for millions of Americans.

BLUE CROSS BLUE SHIELD OF GEORGIA

Georgia's first Blue Cross Plan, the Unit Hospitals Service Association of Atlanta, was established in 1937. The following year, the Hospital Association of Savannah was formed, and in 1947 the West Georgia Hospital Service Association was organized in Columbus, Ga. Together

these three Blue Cross Plans made hospital coverage available to all Georgians. By 1953, Blue Shield coverage was also available throughout the state. Until the late 1970's, Blue Cross and Blue Shield Plans were separate corporations, even when they shared the same office space and administrators. In order to fortify themselves in the changing turbulent environment of rising health care cost, inflation, and depressed markets, the Blue Cross Association and Blue Shield Association decided to merge in 1975. Atlanta's Blue Cross and Blue Shield Plan became one corporation and later merged with the Blue Cross and Blue Shield Plan of Columbus in 1983.

Blue Cross Blue Shield of Georgia assigned Michelle Thrash to the year 2000 conversion. In October, 1996 Michelle took over after years of nothing being done. She was a production manager with no prior background in this type of operation. Blue Cross Blue Shield of Georgia, not realizing the immensity of the project did not delegate Michelle's regular duties to someone else. When she started researching the project and realized the size, scope, and time frame she was dealing with she immediately told her supervisors that this was a full time operation. Her previous duties were then delegated to others and her time allocated solely to work on this project.

The first thing Michelle did was to attend a year 2000 convention. This convention conveyed the complexity of the operation. Talking to participants, Michelle realized that many of them were investment brokers. When asked why they were there, the brokers said that they figured any company at the convention would be a good investment. This showed her the scope of the problem. Learning all she could, she started noting the companies involved in the conversion process. She wanted only a reputable company to perform the conversion for Blue Cross, Blue Shield of Georgia. The Gartner Group is a "think tank" organization that is globally recognized as a premier supplier of current information on pertinent business topics and organizations. Michelle chose to make all solicitations of a conversion vendor through the Gartner Group, who rates the best conversion companies. Time was of the essence. As the turn of the century draws nearer, the best conversion companies will be overloaded with work. After talking with CAP Gemini, Michelle signed an agreement for them to do the assessment phase of Blue Cross Blue Shield of Georgia. The assessment phase took about two months.

Nineteen million lines of source code were taken from the mainframe and shipped off to CAP Gemini's factory so a proposed solution could be found. CAP Gemini and Michelle started "brown paper sessions" so a visual representation of how the system worked could be made. The "brown paper sessions" were a series of meetings in which brown paper was actually hung on the wall and each group that came in documented how they worked and all their linkages. In these sessions, department heads, programmers, analyst, users, and anyone involved in the operation would discuss or argue until a mutual decision was made. For example, if the sales department decided that they had linkages to accounting and marketing they would draw these linkages on the brown paper. Each group would do this. These sessions took over a month and a half, but once completed a visual map of the system available. These sessions allowed CAP Gemini to assess the complexity of the problem. The fourteen complexity categories identified by CAP Gemini are: Technical Approach; Critical Company Exposure; Mainframe Environmental Considerations; Languages; Home Grown Software; File Structure; Date Complexities; Third-Party Software; Company External Interfaces; Source Complexities; Application-Specific Complexities; Near-Term Known Failure Dates; Testing Complexities; and Non-Mainframe Complexities. A detailed explanation and finding for each

complexity is beyond the scope of this document since the CAP Gemini Complexities Document for Blue Cross Blue Shield of Georgia is 70 pages.

The complexity labeled "Critical Company Exposure" includes those issues caused by highly visible and mission-critical applications. Some applications are high-risk because of their usage volume, or because of high re-run costs. If these applications (or their data) become unavailable for long periods of time, it could have a significant impact on the organization. In general, the applications that were considered critical were those that had a high volume of activity, or a high dollar impact on operations.

High volume applications are defined by project documentation as those applications that handle transactions in excess of 100,000 transactions per week. The complexity involving these applications deals with both on-line and batch processes. Both high-volume processes represent high risk because the impacts are immediate, can be severe, and usually ripple to other processes.

High Dollar Applications are those transaction applications that revolve around the billing and receivable functions. There are also systems that, though not high dollar, are used by systems that process high dollar transactions. The complexity involves the processing of information and transactions that are related to income from subscribers or payment to providers. The loss of system functionality would have a dire impact on the organization's ability to function as a corporation. The impact will range from processing manually, to closing the doors, or losing certification from one or more of the certification sources. The decision to highlight these complexities does not diminish the importance of the others found by the CAP Gemini study, but rather should emphasize the relationships among them, and the impact that the approach to one problem has on the choice of solutions to other problems.

The technical approach that a company takes to resolve its Year 2000 problems has a significant impact on the amount of time and money that will be spent during the conversion. Therefore, it is very critical that each alternative approach be weighed (in cost-benefit or risk analysis) for each complexity occurrence. The following table lists the benefits, features, and exposures of the two renovation strategies considered, as presented in CAP Gemini's Complexity Document:

Treat 2-digit years before 19XX as Year 2000+

Advantages	Disadvantages
Good stopgap approach	Most difficult to maintain
No bridging	Requires Changing Programs
Lowest initial cost	Sorting existing fields is difficult

Field Expansion: Expand year to 4 digits

Advantages	Disadvantages
Solves THE problem	Extensive bridging
Easiest to Maintain	Time-consuming
	Creates DASD requirements
	Requires changing: Programs, Files, JCL

"When I first assumed the responsibility for the Y2K project in October 1996, I was very closed minded about how we would accomplish this behemoth task. The only solution that I could see working was to expand the date field of every single occurrence of date sets found in the current configuration of code. This mindset gave me two big concerns," stated Michelle Thrash, manager, Y2K office. "The code itself was a concern because there were over 19 million lines." After the initial assessment conducted by the Transmillenium Services through CAP Gemini was completed, a complexities document revealed that only 1/3 of the 19 million lines of code would require Y2K compliance. The second concern actually has two parts contained within the concern of Interfaces. Specifically, the interfaces with over 200 trading partners and over 300 vendors. "It is not enough to ensure that all internal systems are certified and capable of translating data successfully from one century to the next. After one has done everything possible to make their computer systems Y2K compliant, they will likely run into at least one other minefield if they regularly import data from the outside world and that outside year-designation information is in the two digit format. If the external transmissions containing year designations have only two digits, and are compared with internal applications and databases that have been updated to four fields, the computer will have to decide in which century to locate the incoming data, and without some help, it's likely to decide incorrectly much of the time. Michelle's office decided that based on the outcomes of the compliance monitoring that they established with their trading partners, it might become necessary to discontinue business relationships with certain partners that could not successfully make the transition.

Michelle's initial thought was that every date in the system would have to be expanded, but after the initial sessions, she realized the date of birth would be the only date that had to be expanded. The rest of the dates could be interpreted. This solution had the lowest initial cost and will allow the completion of the project on time, although it is the most difficult to maintain. Basically interpretation or "windowing" is the idea of using a check digit such as 50. If the year, such as 98 is above 50 then the century is interpreted as 19; below 50 the century would be interpreted as 20. Michelle liked the solution that CAP Gemini proposed. Now a bid for the actual conversion process would take place. There were many organizations that solicited Blue Cross Blue Shield of Georgia but only those recognized by the Gartner Group were asked to submit a bid.

There were five primary vendors whose proposals were considered: CACI/ViaSoft, CAP Gemini, Computer Horizons, IBM, and SYNTEL. Michelle wanted to include some offshore opportunities in the conversion bids. SYNTEL is a software company based in India. However, there were several issues not acceptable to Blue Cross Blue Shield of Georgia for this company to conduct the assessment. One of SYNTEL's requirements was that all testing would be conducting on the CPU at Blue Cross Blue Shield of Georgia and the CPU was already running at full capacity. Also, the communication factor was unacceptable because Michelle wanted actual face to face time between her team and the programmers that would be handling the assessment and possible conversion process. This was not possible with the time difference and distance to India, so SYNTEL was not chosen. IBM was selected, after considering all companies. Probably the most important reason for choosing IBM was the off-site testing facility. This allowed business to proceed as usual while Year 2000 work was being tested. The chart on the next page illustrates the actual decision process for the companies on the short list of five.

COMPANY	REASONS FOR CHOOSING OR NOT CHOOSING
Computer Horizons	Good company but would have to rent factory space from them for conversion.
SYNTEL	Good company that is very responsive but the cost of the long distance communication process (fiber optics) was high
Viasoft	Good company but Blue Cross/Blue Shield would have to create own database and tools for conversion process
CAP Gemini	Prior dealings with assessment was great but their asking price was too expensive
IBM	Great company with an off-site facility to handle conversion process, a flat fee for tool use, and able to multi-task.

An important issue that must be addressed is Y2K compliance of all companies that work with them. Any company that transfers data with Blue Cross Blue Shield of Georgia must be compliant. These companies must be able to demonstrate and document that they are compliant. Users send reports to Michelle that document the steps taken for compliance. All steps must be documented for legal reasons since year 2000 problems may be a cause for litigation. Following an established policy, and documenting each step of compliance is the best defense for any form of litigation.

TOTAL SYSTEM SERVICES

Columbus Bank and Trust began offering credit cards to their customers in the early 60's. The success of this program raised opportunities to sell processing services to other banks. A separate company, Total System Services, Inc. (TSYS), was spun off in 1983. Today they process more than 90 million accounts for banks in the US, Mexico, and Canada. The legacy computer systems work extremely well, but the year 2000 problem was recognized as a potential show stopper in the early nineties. In addition, management wanted to enhance the system by offering more flexibility and convenience to its clients as well as to eliminate hardcode specific to individual banks. The result was TS^2, a DB2 and IMS system that is Year 2000 compliant and a recognized benchmark in the credit card processing industry. Once clients are converted to TS^2, a wide range of options become available that no other credit card processor can match.

The very success of the program has become a problem; more banks want to convert to the system than TSYS can easily accommodate. The extensive options of TS^2, and the fact that it is Year 2000 compliant, has provided a window of opportunity for TSYS. Some banks have chosen TSYS as a processor instead of changing their own code to handle the year 2000, because of the extensive rewrite requirements at their site. Currently, more than 10 million accounts have been converted to the TS^2 system, which is the same as the entire number of accounts being handled by TSYS when the TS^2 system was just a conceptual idea. The focus in 1995 changed to making the TS^1 system Year 2000 compliant.

The credit card industry has many dates that are frequently changed and that must be processed accurately. The date of birth and date the account is opened do not change; however, the date of last credit limit increase, expiration date of the card, dates to begin and end special promotional interest rates, dates of disputed items, as well as many others do change frequently. As with many other industries, TSYS agonized over the best method of updating a field that was already packed. Most dates at TSYS are stored in just 3 bytes, in the format MMDDYY. This is done by

storing the date in packed nosign format instead of character format. The EBCIDIC representation of '1' in character is 'F1', '2' is 'F2', etc. Using packed nosign data involves using each half of the byte to store one number. So instead of 2 bytes to store the year '98' as 'F9F8', it can be done in one byte as '98'. This practice saved a lot of space back in the early 60's when all data was entered into the computer via punch cards. Anyone who thinks it is easy to store an extra three or four cards per account to allow for one or two unnecessary bytes for each date obviously has not tried it when the number of accounts reaches into the millions.

One early proposal was to simply expand all date fields to be four bytes long instead of three. At a first cursory glance, this appears to be a workable solution. However, programmers will quickly point out the problems associated with that solution. If the date is expanded, then every field after that is moved over one byte. If the available money field follows a date, then the program that was looking for the available money in positions 471-475 today would have to look in positions 472-476 tomorrow when the change is made. There are thousands of programs that reference the master file at TSYS. The use of copybooks ensures that each program looks at the same place for the data, but every single program change must be coordinated at the same time, or 60 million accounts could have an incorrect available money field one morning. Needless to say the cardholders would not be happy about that. There are more than 50 dates on the TSYS master file. Extreme care would need to be used to make sure each was handled correctly, and that all programs were regenerated simultaneously to use the new copybook.

There are still other problems. Programs are run inside jobs or procedures. For different applications, files must be sorted in different ways. Sometimes a report is sorted by date, sometimes by account number, sometimes by a bank or by a bank agent. The sort statements are in Parameter libraries, called by the job or procedure. A typical sort statement might look like

SORT FIELDS=(62,2,BI,A,115,2,BI,A,95,19,BI,A,1,12,BI,A).

This instruction tells the sort program to sort starting in position 62, for 2 bytes long, using binary, in ascending format. Then within that sort, sort position 115 for 2 binary bytes in ascending order, etc. This particular parm sorts records by file number, bank number, account number, then date and time. If the length of the record changes, position 115 may no longer be the bank number, but some other field. The report that runs after the sort would not be accurate (garbage in - garbage out). So any job or procedure that uses a program that accesses the master file would have to be checked to see if any action that is taken affects data on the file. If so, the position number would have to be changed.

Because the master file contains critical information, a bank representative must be able to access the file to answer cardholder questions. The file is backed up to tape every night, so that if a problem arises, the master file for a particular day can be loaded from the tape and looked at. Looking at it involves using the copybook to see where the fields are that contain the desired data. If the length of the master file is changed, some way must be found to locate and update the positions of the fields on the master files that have already been backed up to tape. Everything must be synchronized or one winds up with a string of letters and numbers that are difficult to decipher.

A last consideration when changing the length of a file: what if the change has to be backed out for some reason? When a major change is contemplated, one obvious question that comes up is,

"What if it does not work?" The normal response is to back out the changes and perform more research and testing. If thousands of programs do get changed in a coordinated manner (usually on a weekend when the clients will be least affected), and it becomes necessary to back out the changes, will there be enough time to do it without affecting peak processing times? Changing or regenerating thousands of programs back to the previous format is also risky. For all of these reasons, TSYS looked for another solution to the Year 2000 dilemma.

A second proposed solution to the Year 2000 problem was windowing. This technique was explained in the Blue Cross and Blue Shield case and will not be repeated here. This solution is being adapted by many computer companies, and works well for most applications. VISA and MasterCard will only permit an expiration date on a card to be a maximum of 20 years from the current date, so windowing works well for the expiration date. However TSYS also had to consider Date of Birth, date account opened, and other dates that do not lend themselves easily to windowing. In addition, windowing does not address the problem of sorting records by date. Sorting is not usually done inside a program but in a JCL statement, so moving a date to a temporary work field cannot be done. The file must be sorted from data already existing on the records. Jobs will sort by year in ascending order, but the '00' year would be first, and not last in the file.

The solution TSYS developed is called extended nosign data. Any half of a byte can contain one of the following values: 0,1,2,3,4,5,6,7,8,9,A,B,C,D,E, or F. As has already been explained, an EBCIDIC representation of a character '9' is 'F9'. TSYS will use the characters A through F to represent years 2000 through 2059. The year '00' will be stored on the master file as 'A0'. The year '10' will be stored as 'B0'. The year '59' will be stored as 'F9'. The beauty of this solution is that the jobs, procedures, and parameters that sort files will recognize that 'A0' is greater than '99', so all existing sort routines can be left as they are. Any programming logic will also recognize that 'A0' is greater than '99', so fewer programming changes will be needed. After TSYS made its decision to proceed this way, new sort facilities were made available that would sort '00' after '99', but they still required an identification of every date in each sort parameter. TSYS continued as planned, both because it was well along in its changes, and because it does not have to identify every date for every parameters. The sort jobs will work correctly. Of course, before the year is put on a screen or a report, it will have to be converted from 'A0' to '00'. Dates that clients put on a screen, such as the date a card is reported lost, will use the windowing technique to determine if it should be stored on the master file in extended nosign or regular nosign. In this way, no data has to be mass converted, it can be coded now, and whenever a date passed year 2000 is needed, it will be placed on the master file in extended nosign format. By the time the year 2059 arrives, everyone should have long since been converted to TS^2, if not TS^3, TS^4 or TS^5.

Once the decision had been made of how to handle a Year 2000 date, the next problem was to identify every place in the programs that a date is used. Like many legacy systems, the one at TSYS had incomplete documentation. Rarely did documentation exist outside the program, unless it was in the form of a training manual. Training manuals teach users what data to enter on the screens, not how the code was written. In most cases, the only documentation in the program was put there by the programmer that wrote the code. If that programmer had plenty of time, and the work schedule was not too pressing, the comments may have been fairly complete. If five clients were all screaming for their critical changes to be implemented right away (as is normally the case), the comments are cryptic or non-existent. If a field has the letters 'DATE', or 'YY', or 'MM', or

'DD' somewhere in the name, it is relatively easy to find. But what if the date is moved to a field called 'WORK3' and then 'WORK3' is used a thousand lines later for a comparison?

There are several software companies that have sprung up with 'silver bullets' to handle the Year 2000 issue. TSYS examined several of them and decided that for the most part, those companies just had ways to potentially identify a field that could be a date. There was nothing that would automatically change the date, or if it would, it would put the date into a format that would not work correctly with the sorts. The final decision was that programmers would have to go through the code line by line and correct dates as they were found. The copybooks were scrutinized first to locate every date and determine which ones should be left alone, and which ones should be converted to extended nosign format. VISA and MasterCard both require that expiration dates remain in a 2 digit character format. Windowing would be used to compare these changes.

TSYS has several different departments that handle different aspects of the credit card industry. Some of the departments are: ACE (Automatic Credit Evaluation to open accounts), Authorizations, Embossing, Posting, Statements, Collections, Fraud, and Interchange (to send and receive files from VISA, MasterCard, and other outside sources). Each department was made responsible for changing their programs to make them Year 2000 compliant. Reviewing each program line by line is a tedious process, but there was no other way to catch all dates. It is possible that a few dates could still be missed, but they should be few enough in number that they can be corrected in year 2000, especially since the critical programs will be carefully examined.

Some departments have different deadlines than others. For example, there are cards that have already been issued with expiration dates in year 2000. The Embossing and Authorizations department have already had to be sure they can handle Year 2000 dates for certain critical programs. These changes have been made. Currently, cards with Year 2000 expiration dates have been issued, and used without problems at TSYS. Unfortunately, not every merchant Point of Sale terminal was ready by the deadline established by VISA, and some declines have been done because of merchant equipment. The manual override process at TSYS does work successfully, so these accounts can still be authorized if the merchant will call in for an authorization.

The deadline for all programming departments to complete programming changes (for critical functions) is April 1, 1998. At that time the Year 2000 testing department will begin extensive testing on a separate machine to verify that code for each department works, and then to test the interaction between departments. Finally several complete end to end tests, from swiping the card at a Point of Sale to posting the transaction to printing and mailing statements will be done. This testing is scheduled to be completed by year end of 1998. That schedule will allow a full year for clients to perform their own testing in the TSYS test system.

Several unique situations exists that must also be tested. TSYS not only processes VISA and MasterCard accounts, but also private label accounts for individual stores. These cards have no expiration date; that is, most merchants do not put an expiration date on their cards. To designate a never expire card, '1299' was put in the expiration date field. Once January 1, 2000 arrives, the system will consider these cards expired. A decision was made in 1996 not to issue any cards with a '1299' expiration date. Instead clients would be forced to use '1199' or '0100'. This decision worked until TSYS converted a client that already had '1299' cards issued. With several potential clients also ready to convert, management decided never expire dates would be changed to '1249'

with windowing to determine if the card was expired. To further complicate matters, VISA in 1997 that never expire card dates for them would be '2222'.

When a card is reported lost, the client has the option to report it only at TSYS, or to also report it to VISA or MasterCard. TSYS handles requests for authorizations on lost cards by declining the request. If the link between VISA and TSYS is down for whatever reason, then VISA handles the authorization request. There is a monthly charge for each account on the lost card files at VISA, at MasterCard, and at TSYS. When banks report a lost or stolen card to VISA or MasterCard, they also include a date that tells VISA or MasterCard when that lost card is to be purged from the lost card file. VISA decided that '9999' would be the value for a card never to purge from the lost card file (called an exception file at VISA), unless a bank representative manually removes the account when they are comfortable that no further fraudulent attempts to use the card will be made.

The problem for clients is to remember which value to use for never expire: '1249' at TSYS, '2222' for cards that never expire for VISA, and '9999' for never purge from the VISA exception file. MasterCard has not yet made a decision about their exception file, but they are expected to adopt the '9999' value since that is what VISA uses. TSYS will allow clients to enter '1249', or '2222', or '9999' on screens for any of these values and convert it to the correct number.

Handling the internal code at TSYS is one thing. But what about software that TSYS buys from software vendors? Early in 1997, TSYS sent out questionnaires to every identifiable software supplier asking them for their Year 2000 compatible plans. Replies varied from we are currently ready, to we will be ready, to the especially disturbing reply we have chosen not to become year 2000 compliant. Apparently a few companies will cease operations December 31, 1999 if their code does not work for Year 2000. In some cases, TSYS will modify vendor software, if it is necessary to the operations at TSYS and the vendor cannot or will not make it Year 2000 compliant. This vendor software will also be tested in the year 2000 separate mainframe to ensure the integrity of data produced by these programs.

The key to any project is management cooperation. Having the best plans in the world is useless if management will not allocate the resources to implement the plan. TSYS has proven itself to be a leader in this area of the Year 2000 problem. Upper management (several of whom started as programmers) recognized the problem early and have allocated the resources necessary to complete the Year 2000 project well before the December 31, 1999 deadline.

CONCLUSION

The first solution to any problem may not be the best. In both companies, the first choice examined was that of expanding all files to include a century as part of each date field. In both cases, once the full complexities of that choice was realized, actions were taken to see if other solutions were available. Date of birth was a field that gave both companies a problem. If the windowing solution were chosen, then anyone born before 1950 would be considered born in the Year 2000. In addition, the rapid growth of the population segment over 100 years old in our country will force many companies to develop a solution to this problem. Blue Cross Blue Shield of Georgia decided to expand the file only for date of birth. For the insurance company, other dates, such as dates of operations, accidents, physical therapy visits, etc. will be handled by windowing. Blue Cross Blue

Shield decided to outsource the Year 2000 fix and testing to a firm that met its needs. Total System Services, Inc. made the decision to fix the Year 2000 problem internally and purchase a separate mainframe for Year 2000 testing. Their unique data solution of extended nosign best solves the situation for them. Neither solution is right or wrong; it is the best solution for these companies with the criteria and resources available to each. As other companies must rapidly come to grips with the issues of Year 2000, they can use the decisions made by these two companies as a model for their own.

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GLOBAL SOFTWARE OUTSOURCING: THREE OUTSOURCING PROJECTS IN INDIA

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ABSTRACT

Strategic outsourcing is emerging as one of the fastest-growing management tools of the decade. Today's businesses have spent the past few years scaling a mountain of rapidly changing and increasingly complex business forces. As the going gets tougher, it is clear that the task of managing all the environments necessary to get to the top cannot be handled by a single organization working alone. The complexity of operations, the regulation and deregulation of markets, the steady and rapid advance of technology, and the need for constant growth are conditions that require core competence in too many functional areas. This study illustrates the various dynamics of outsourcing while concentrating on global software outsourcing in India

INTRODUCTION

Outsourcing, in general, and global outsourcing, in particular, is rapidly becoming an accepted management tool for redefining and reengineering the corporation. It challenges today's executives to rethink the traditional vertically-integrated firm in favor of a more flexible organization structured around core competencies and long-term outside relationships. Outsourcing is being applied to every facet of the company – from fleet vehicle management to business support services to human resource staffing to information technology.

It's often said that the only constant in business is change. As a result, mastering change is possibly the most important challenge faced by any company. Markets, competition, government regulations, financial conditions, and technologies all change extremely quickly. This business climate demands that companies live and breathe change. In fact, change is the key word of the outsourcing revolution. The outsourcing revolution helps the organization ride the sea of change, from hierarchical to flat, from tactical to strategic, from vertical to virtual.

As Sharon Browne, vice president and general manager for Xerox Business Services Worldwide Marketing and Operations, observes, "Managing this change is one of the most important drivers for our customers." (Outsourcing Institute, 1998,1). Creating outsourcing alliances between companies and countries, each specialist in their field, is emerging as an important new strategy for not just managing change but mastering it. Global outsourcing on a larger scale has been made feasible by advances in telecommunications technology, thereby removing traditional geographic boundaries. Several countries have pools of well trained IS professionals and staff whose salaries are

significantly lower. This differential provides a cost-effective advantage for an organization having a scarce human resource. Global outsourcing is a rapidly growing sector of the outsourcing market.

Today China is emerging as the labor outsourcer, as it can provide cheaper labor. India is emerging as the software paradise, as it provides low cost processing and innovative products and services. Other Asian countries like Singapore, Malaysia, Philippines, Hong Kong, and Taiwan are slowly emerging as potential outsourcing markets. Ireland, in Europe, is a well-established source of data processing. As mentioned earlier, global outsourcing has been a viable option due to tremendous technological and telecommunications advances in the last two decades. This option means, that any country has the potential to be a player in this market, only limited by its technological resources.

FACTORS LEADING TO GLOBAL OUTSOURCING

Research reveals that the global outsourcing market experienced its most successful year in 1995 with total worldwide revenues of more than $76 billion.(Outsourcing Institute, 1998,1). In both revenue and market significance, outsourcing is growing and becoming an increasingly feasible option for both larger and medium sized firms. Today, when firms are becoming international in the sense that they have operations in different countries, then this firms want to have an IT platform in other countries from day one. This can be achieved only by outsourcing IT activities.

An MAPI survey of 80 large US companies found lower cost as the number one reason for outsourcing. (Outsourcing Institute, 1998, 1). Increased competition and the increasing focus on core competencies are forcing organizations throughout the world to carefully consider what tasks should remain in house. Different types of vendors and vendor strategies and service offerings continue to stimulate a wide and ever increasing range of choices. Other advantages include exploiting the use of newer technology that the outsourcer may already have implemented. Outsourcing may also free up capital that would be spent on expensive hardware and software. Companies may feel that their prime business mission is being hampered by the attention required to manage IT. Outsourcers will have better ability to handle IT requirements.

Some of the factors leading to the rapid growth in global outsourcing are relatively low entry costs, worldwide availability of PC's, efficient telecommunications network, higher labor costs in industrialized countries.

THE TOP TEN REASONS COMPANIES OUTSOURCE

One of the most important insights gained while performing this topic study is the simple but often overlooked fact that for outsourcing to be successful, management must have a clear set of goals and objectives in mind from the start. Outsourcing may entail significant organizational upheaval, transfer of important assets, dislocation of people, and long-term contractual relationships with an outside partner. None of these make sense unless the benefits to be gained and the risks involved are clearly understood and managed from the outset.

Outsourcing is a long-term strategic management tool. For this reason, we will review the ten reasons for outsourcing in order of strategic importance. The first five reasons are more strategic, long-term benefits. The second five are tactical, short-term issues (Outsourcing Institute, 1995).

Reason #1: Improve Company Focus

Outsourcing lets the company focus on broader business issues while having operational details assumed by an outside expert. Outsourcing is an organization-shaping management tool that can lead to a clearer more effective focus on meeting the customer's needs. Outsourcing can enable an organization to accelerate its growth and success through expanded investment in the areas that offer it the greatest competitive advantage.

Reason #2: Access to World-Class Capabilities

By the very nature of their specialization, outsourcing providers can bring extensive worldwide, world-class capabilities to meet the needs of their customers. Just as their clients are outsourcing to improve their focus, these vendors have honed their skills in providing specialized services. Partnering with a world-class provider can offer the following advantages:

Access to new technology, tools, and techniques.
Avoidance of the cost of chasing technology.
Better career opportunities for personnel who transition to the outsourcing provider.
Competitive advantage through expanded skills.
Access to industry knowledge and expertise the provider has gained from other clients/partners.
On-site staff to support the client's needs.

Reason #3: Accelerate Reengineering Benefits

Outsourcing is often a byproduct of another powerful management tool, business process reengineering. It allows an organization to immediately realize the anticipated benefits of reengineering by having an outside organization – one that is already reengineered to world-class standards – take over the process.

Reason #4: Share Risks

There are tremendous risks associated with the investments an organization makes. Outsourcing providers make investments not on behalf of just one company, but on behalf of their many clients. By sharing these investments, the risks borne by any single company are reduced.

Reason #5: Free Resources for Other Purposes

Every organization has resource limitations. The constant challenge is to ensure that its limited resources are expended in the most valuable areas. Outsourcing permits an organization to redirect its resources from non-core activities toward activities that have greater return.

Reason #6: Make Capital Funds Available

Outsourcing is a way to reduce the need to invest capital funds in non-core business functions. Instead of acquiring the resources through capital expenditures, they are contracted for an "as used" operational expense basis. Outsourcing makes capital funds more available for core areas, eliminating the need to show return on equity from capital investments in non-core areas.

Reason #7: Cash Infusion

Outsourcing often involves the transfer of assets from the customer to the provider. Equipment, facilities, vehicles, and licenses used in the current operations are, in fact, sold to the vendor. The vendor then uses these assets to provide services back to the client and, frequently, to the other clients.

Reason #8: Reduce and Control Operating Costs

The outside provider's lower cost structure, which may be the result of a greater economy of scale or some other advantage based on specialization, is clearly and simply one of the most compelling tactical reasons for outsourcing.

Reason #9: Resources Not Available Internally

Companies outsource because they do not have access to the required resources within the company or country. If an organization is expanding its operations, especially into a new geography, outsourcing is a viable and important alternative to building the needed capability from the ground up. Similarly, rapid growth or expansion of operations is a strong indicator that outsourcing may be right for a company.

Reason #10: Function Difficult to Manage or Out of Control

Outsourcing is one option for addressing these types of problems. Outsourcing does not, however, mean abdication of management responsibility nor does it work well as a knee-jerk reaction by companies in trouble. If the real problem is that the organization does not understand its requirements, then it certainly won't be able to communicate them to an outside provider either.

RISKS OF GLOBAL OUTSOURCING

Firms are reluctant to outsource mainly because of their fear of losing control to the outsourcing vendor. Another reason is that the short-term cost savings are not significant. Many CIOs fear irreversibility of contractor or the high switching costs often connected with long-term outsourcing. In case of global outsourcing, the firms have to even consider the foreign government's policies that might adversely affect the business. Another risk is that firms may become too reliant on the outsourcers especially if the outsourcer turns out to be less than competitive and inflexible to

the changing business needs. The physical distance between the client and outsourcer also may prove to be a hindrance in some cases.

Client firms often overlook the global outsourcing costs such as unit price, export taxes, international transportation costs, insurance, brokerage costs, risk of obsolescence, cost of rejects and employee travel costs. When they overlook these costs, they may make wrong decisions about outsourcing when it may be worthwhile to carry on the operations in-house (Dier, 1997).

Global outsourcing vendors have the difficult task of designing a network across multiple countries, each with its own regulations, price structures, currency, language and network interface standards. Employees need to be trained to familiarize them with compliance issues and information regulations in foreign countries.

AVOIDING PITFALLS – THREE WARNING SIGNS

An unsuccessful outsourcing engagement is defined as one where the company expected that costs would decrease and that the capacity and quality would increase when, in fact, the exact opposite occurs. That is, instead of having capacity and quality increase, one or the other actually decreases. The following three warning signs provide some insight into why outsourcing essays fail (Outsourcing Institute, 1996).

Warning Sign #1: Finance, Legal or Vendors Dominating the Process

Outsourcing is, after all, a strategic business decision, which must be made by the business' managers. Finance and legal have to play a critical role in supporting these managers, but they should not dominate the decisions. If they do, the risk is that the real business objectives may get lost in the details of the financial and legal terms of the relationship between the customer and the vendor.

Similarly, the relationship between the customer and the vendor must be a true partnership. However, a too high level of involvement on the part of the vendors in the actual decision process is another warning sign. This involvement can cause the relationship to become uneven or even vendor-driven. Once again, outsourcing works best when the business' manager:

> drive the process based on clear, well understood measurable objectives, follow a disciplined process, and carefully build toward a win-win relationship with the ultimate vendor(s).

Warning sign #2: Vendors Not Pre-qualified Based on References, Reputation or Existing Relationships

The second warning sign when comparing successful and unsuccessful outsourcing projects is the relative importance placed on the various factors used to determine which vendors receive the RFP. Studies show the lower importance placed on *references, reputation or existing relationships* in unsuccessful projects is striking. This finding adds support to the growing emphasis on pre-qualifying outsourcing vendors based on their total capabilities.

Warning sign #3: Short-term Benefits Dominate as Decision Factors

The final warning sign is an over emphasis on short-term benefits as the main reason for outsourcing.

INDIA: A LEADING CHOICE FOR IT OUTSOURCING

Our field study focuses on outsourcing to India. First, some background information on the Indian IT industry, on India's technical infrastructure, and the software industry will help one understand the outsourcing scene. India's natural resource is its abundant technical skills. This natural resource is the reason why India is called the 'software powerhouse' of the world. Hence, it is not surprising that when people talk about worldwide software development today, they talk of the Indian software industry.

India offers cost effectiveness, quality, speedy deliveries, reliability, and, above all, use of state-of-the-art technologies in software development. According to a World Bank survey, India was rated as the top outsourcing destination by vendors in the U.S. The survey also reveals that India has captured a 16.17% market share in the global customized software development market. When Microsoft's Bill Gates visited India in March 1997, he observed that India has the potential to emerge as the software super power in the 21st century (Financial Times, 1997, 04). India has experienced a steady growth in outsourcing projects (Rao, 1997).

SOME STATISTICS ON INDIAN IT INDUSTRY

In 1995 the Indian software income was 61% more at Rs. 4,190 crore (1Crore=10 Million). India's share in the 1996-1997 market was about $305 billion, showing an increase of 0.2% in the last five years. Customized software development services decreased to about 49% in 1995-1996 (Business India, 1996,200). However, consultancy and data processing segments of software business are picking up. India is making huge gains from the global YEAR2000 problem. Providing solutions to this problem involves about $60-300 billion (Business India, 1996, 200).

Every year more than 250,000 computer professionals graduate in India. USA accounts for 58% and Europe accounts for about 20% of India's export revenue. During this year (1998), India's software industry expects to earn revenues of Rs.10 billion (Business India, 1996, 200).

TYPES OF OUTSOURCING PROJECTS IN INDIA

In the past decade, India has carved a niche for itself by performing outsourcing operations for some of the biggest corporations of the world, producing some of the best software, and providing continuous maintenance support to some of the most critical applications. Some of the projects being done in India are as follows:

Software that digitizes, manipulates, and displays images on scanners such as GELX 1.5T.
Software to manage complex networks is written by teams at Wipro Systems, based in India.

Software to shorten the cycle time of getting chips to market software simulators for chips that power phones like the Motorola 8700 is developed in India.
Software that guides the satellites and produces the images for the remote scanning satellites, which India builds and launches.
Other GE divisions, such as the aircraft engines are doing development work in India, which is so innovative that GE refuses to talk about it (Rao, 1997).

CASE STUDIES – THREE OUTSOURCING PROJECTS IN INDIA

We will study three projects and mention some other projects outsourced to an Indian software company called Wipro Systems. Wipro Systems is a large software company based in the town of Bangalore. Known as the Garden City of India, Bangalore is slowly acquiring another sobriquet: the Silicon Valley of India. Bangalore boasts of big names in IT computing from all over the world. We will look into the reasons why the projects were outsourced to Wipro Systems:

Skilled technical manpower at a bargain price.
Fluency with the English language.
Vast and proven experience in the outsourcing field.
Strict adherence to quality and timeliness.
Large pool of widely qualified programmers.

Project #1: Customer Records On-line Extended Service Options (CROESO)

Three electrical utility companies of UK sponsored this automation project. The companies involved were SWALEC, SWEB, and SE. IBM of UK was the technical consultant. CROESO was designed to provide strategic advantage to the member firms. CROESO would facilitate services like Bill Automation, Document Image processing, Voice/Telephone functions, etc.

The project was initially developed using a CASE tool called ADW. But during implementation, the output of the CASE tool was a failure. Due to the magnitude of the project and the resulting crisis, a decision to outsource the project was undertaken.WIPRO Systems was chosen by IBM to develop the 'server' part of this Client/Server project. IBM using Presentation Manager on OS2 developed the 'client'. SmallTalk was used to generate the code for Presentation Manager. The 'server' was a DB2-CICS-COBOL environment. The middleware was Messaging Manager based on APPC.

As the initial design was available (output of CASE tool), Wipro's task was to code and test the programs. One hundred programmers were involved in this project for about one year. An employee of IBM, UK was always available on-site as a liaison between the WIPRO programmers and the electrical company, assisting in quick and correct communication and resolving issues regarding design. After the programs were written and unit-tested, a batch of fifty programmers performed a successful integration testing in UK.

Project #2: Dispatching and Reporting Transactions, DART

GECS, a subsidiary of GE, is a computer outsourcing company. Companies outsource their IT needs through GECS. GECS provides them with support and enhancements. The DART system handles technician queries of GECS. It also handles materials and purchasing systems. When companies have problems with their computer systems, they log a complaint with GECS, and GECS pages the closest technician, who then resolves the issue. When the programs behind these functions fail to work, the operations suffer.

GECS has outsourced the programming part of this EDI based system to WIPRO systems. Due to the 10 ½ hours time difference between Atlanta and Bangalore, GECS has 24-hour support available to its customers, through programmers in India. Ten programmers are always on-site in Atlanta and about the same number of programmers provide offshore support. This successful outsourcing partnership is an ongoing one.

Project #3: GEMS

GEMS is one of the largest manufacturers of medical equipment. As that happens to be their core area of competency, they have outsourced the IT segment to various companies in India. WIPRO Systems provides most of that service. This project requires continuous presence of about thirty programmers at Waukesha, WI, and about fifty programmers at Bangalore.

The projects deal with the following tasks:

- the on-line center which handles customer queries,
- providing data for field people irrespective of their geographic location,
- providing tools to see images from the customer site for problem diagnosis,
- customizing software to handle bulk of customer calls.

Most of the projects are on mainframe using IEF, COBOL, DB2, CICS, etc. (Sunil Bhandari, 1998).

Wipro Systems has a long standing relationship with General Electric (GE) over the last six years providing software services on a wide range of business applications and technology areas. Wipro Systems has been supporting GE in their application software services needs in multiple locations across USA, UK, France, Asia, and Australia.Over 450 engineers of Wipro Systems are dedicated to GE projects who are located in various Wipro-GE Offshore Development Centers in India as well as at GE locations worldwide.

Wipro Systems has well defined, mature project management and software development processes which have been followed for many years for executing these projects offshore or onsite.Some of the types of software services executed for GE are as follows:

Custom development and re-engineering
Application Maintenance
Year 2000 services
Application implementation
Internet applications
Data warehousing

The technology areas covered by these services are as follows:

IBM Mainframe
IBM AS/400
Client/Server
Internet
Real Time Embedded Systems
Oracle applications
Engineering software

In order to develop reliable and usable software that is delivered on time and within budgets, Wipro has made a focused and sustained effort towards building a process infrastructure of effective software engineering and management practices.

FACTORS HINDERING GROWTH OF OUTSOURCING IN INDIA

The pace of the growth of the software industry has been so tremendous, that the growth of infrastructure in India has not been able to keep up. Moreover, the rate of penetration of the personal computer in India has been poor. India's personal computer base is currently around 1-8 million, which is considered too small for a nation of more than 930 million. The growth of computerization in public or private sectors has been slow (Madhavan, 1997, 1).

VSNL and MTNL are looking into providing interconnectivity to educational institutions either free of charge or at subsidized tariffs. India has only about 15,000 Internet connections (Business India, 1996, 200). India could convert to cable internet connections and gain an advantage in the global outsourcing market.India needs to concentrate on providing quality solutions, along with low labor cost. Despite two government collapses, Indian officials have pushed ahead with a 12 billion rupee spending plan in 1997 to build a national infrastructure backbone (Madhavan, 1997, 1).

Another key challenge for multilingual India, which has about 14 official languages, would be to adapt computers to languages other than English. Apple Computer Inc. and Microsoft have developed software that supports the Hindi language applications. Thus, on one hand, India is the outsourcer while on the other hand it is a client when it comes to outsourcing such language application software.

FUTURE OF OUTSOURCING

The survey done by International Data Corporation showed that the global outsourcing market experienced its most successful year in 1995.According to an estimate by the Yankee group, the Us market for information systems is growing at a rate of 15% annually.(Patane, 1994,6). By the year 2000, IDC expects the scene of the outsourcing market to change significantly as a result of two events. First, IT will continue to increase its impact on business performance. Second, IT service vendors, pressured by intense competition and lower profits will put together existing service lines and continue to pursue partnerships. As a result, IDC forecasts impressive growth rates in the coming years.

Today, the global IT market totals $1.3 trillion.(Killen & Associates, 1997,1) In the year 2000, businesses worldwide such as Mitsubishi, Bank Of America, Shell oil, etc., searching for improved efficiencies, competitive advantage and solutions to meet the needs of local and global markets will spend more than $2 trillion on IT (Killen & Associates, 1997, 1). Suppliers, IT customers and governments need a global perspective and a framework in which to make wise decisions.

All phases of software development are not outsourced. For example, systems which provide strategic or competitive advantage, are not being outsourced, regardless of cost considerations. Applications, which are small, complex or low in structure, are also not suitable for outsourcing because the cost of setup time and coordination effort required is too high. The front-end tasks like the preliminary design requires a lot of interaction with users and hence is usually performed in-house. Similarly, back end activities, such as testing, installation and user training cannot be performed well over long distances. The most innovative, strategic applications are not outsourced presently and are not likely to be outsourced to foreign countries in the future. The growth rate of global outsourcing will depend to a large degree on the competitiveness of the American software industry. The demand for programmers for coding and related activities will decline. But, the demand for software analysts and professionals will rise.

Outsourcing may be the key to survival for many firms but some firms like LSI Logic cut short its five year outsourcing contract with IBM Global Services (Information Week, 1997). Companies are bringing IT back in house for many reasons such as to regain control and to react more quickly to rapid business change. Many times outsourcing falls short of user expectations in key areas such as vendor expertise and transitions to new technology.

CONCLUSION

Businesses that embrace the necessity of change are moving forward by applying strategic outsourcing to a wide range of corporate functions. Information technology, administrative processes, and global telecommunications management are just a few of the areas where successful companies are outsourcing.

The constancy of change is evident in the nature of outsourcing itself. Where it used to be a strategy for very large companies, it is now accessible to small, medium, and large companies, regardless of the market. Turnkey systems are increasingly available that design, integrate, improve, and manage whole environments ranging from networking, telecommunications, and information technology, to financial and administrative services. As a living, growing force, outsourcing will continue to assist businesses as they move forward and face new challenges and opportunities.

The 1990s will be known as the decade of outsourcing "Changeware" – the tool that transforms companies into leaner, more competitive, more productive entities. As this paper shows, outsourcing improves performance and enhances operational capabilities, provides new vision and insight, helps to define and achieve new products and strategies, and finally, helps to reenergize and reinvent the corporation to succeed in the next millennium.

"*Outsourcing has gone from purely tactical, to strategic, because it offers increased flexibility in the changing global economy. But to be successful, it demands careful attention to why, what, and to whom you are outsourcing*." Wendell Jones, Vice-President, Worldwide Service Delivery, Digital Equipment Corporation. (Outsourcing institute, 1998, 1).

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A CONTENT ANALYSIS OF THE REQUIRED MIS COURSE IN AACSB ACCREDITED MBA PROGRAMS

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ABSTRACT

This preliminary study examines the required MIS or information technology management course in sixteen AACSB accredited MBA programs. The analysis includes assessment methods, weights for each method, percent of total assessment tied to teamwork, required readings, topics covered, and a comparison of these topics with IT issues found to be important to CIOs and CEOs.

INTRODUCTION

Changes in information technology (IT) during the past decade have caused changes in IT management, in marketable IT skills, and in MIS curriculums. During this decade, business organizations have become increasingly dependant on information technology as an integral part of every functional area. "Half of the CEOs and boards of directors of the world's largest companies now consider information technology when they develop corporate strategies, according to a survey of 100 such executives by management consulting firm A.T. Kearney" (Scheier, 1997, 86). According to a vice president at this consulting firm, "Technology is considered too critical to success to be left solely in the hands of technologists" (Scheier, 1997, 86). Executives now look to technology not just to reduce cost, but to drive growth (Stedman, 1997). The 500 U.S. companies with the highest revenue spend more than $100 billion on information technology (Alter, 1997, 74). However, Howard Rubin, author of the Worldwide Benchmark project on IT spending, finds a "huge discrepancy in how effectively companies spend IT money" (Alter, 1997, 74). According to Deloitte & Touche's Survey of American Business Leaders, including 150 senior executives, "information systems is an investment, say 83% of respondents, rather than a cost to be managed" (Alter, 1996, 90). Ninety-three percent of these executives have PCs on their desks (Alter, 1996, 90).

Knowing how to solve problems and capture opportunities using appropriate IT is a critical success factor for any MBA graduate. However, MIS is a hybrid discipline whose curriculum continues to lack the standardization of many older business disciplines. This preliminary study examines the required MIS or information technology management course in sixteen AACSB accredited MBA programs. A major research concern is whether these required courses share discernible common attributes. Other research questions are as follows:

- What is the course called?
- What are the texts or required readings?
- What are the common assessment methods and weights?
- What percent of the total evaluation is linked to teamwork?
- What are the common topics covered?

- How do these topics compare to those critical IT issues identified by CIOs and CEOs?
- What improvements can be made in the required MIS MBA course based on lessons learned from this analysis?

This study will serve as a pilot study for a more comprehensive survey involving a larger number of AACSB accredited MBA programs.

METHODOLOGY

A combination of phone calls and e-mails were first used to solicit copies of syllabi from twelve selected schools. This effort resulted in three syllabi over a two month period. Following the survey strategy of O. Maxie Burns from Georgia Southern University (1998), a fax was sent to 42 AACSB accredited schools requesting a copy of the syllabus for the required MIS or information technology management course in their MBA program. Three working days later, a second fax labeled "second request" was sent to all non-responding schools. Twenty-six schools responded and of those responding, thirteen syllabi were usable for this preliminary study, giving a total of sixteen. Some schools sent the syllabi for the undergraduate course which is a prerequisite for the MBA program and some syllabi had incomplete information. Following this preliminary study, a larger number of schools will be solicited, and schools with incomplete data will be contacted to request further data. The following schools are represented in the current study.

School	Course Name		Syllabus Date
Auburn University	MN600:	Introduction to Management of Information Technology	Winter 1998
Ball State University	MBA610:	MIS	not given
Clemson University	MBA861/MGT861:	IS Design and Implementation	Fall 1997
East Carolina University	DSCI6143:	no name given on syllabus	Spring 1998
Emory University	Business 552:	Information Technology and Decision Support	Spring 1996
Georgia Southern University	BA742:	Fundamentals of Computer Information Systems	Spring 1996
Michigan State University	ACC821:	Enterprise Information Systems	Spring 1998
Texas Christian University	MANA6043:	Managing with Information Technology	Spring 1998
University of South Carolina	MGSC796:	Information Systems	Fall 1997
University of Maryland at College Park	BMGT620:	Strategic Information Systems	Fall 1996
University of West Georgia	MGT831:	Strategic Management of Information Technology	Spring 1996
University of Colorado at Colorado Springs	IS555:	Information Systems Concepts	Spring 1998
University of Alabama at Huntsville	MIS634:	Seminar on the Management of Information Technology	Spring 1998
University of Alabama at Birmingham	MBA611:	MIS	Fall 1996
Western Carolina University	CIS651:	Decision Support Systems	Spring 1998

Although there is no "common" course name in this small sample, Management of Information Technology and Management Information Systems occur with highest frequency.

ASSESSMENT METHODS AND WEIGHTS

The following assessment methods were used by these schools: exams, quizzes, case study analyses, research papers or topic studies, computer-based projects, class participation, reports on reading of articles and/or books, and other daily assignments (Table 1). All schools used examinations with the average weight being 48% of the course grade. The range for the weight was from 20% to 100%. The second most frequently used assessment method was class participation with nine of the sixteen schools using participation for an average of 17% of the course grade. The range was from 0% to 50%. Examinations and class participation, then, accounted for 55% of assessment on average.

Table 1
Assessment Methods (Percent of Total Assessment)

School #	Exams	No.	Quiz	Case	Topic Study	Project	Participation	Book/Article	Assignments
2	30	1	20	15	20	10	5		
3	30	2		20	20		30		
4	35	2		24	12	17	12		
5	25	1		40		20		15	
6	45	2	20			15			20
8	35	2		15	15	30	5		
9	63	2			5	24			8
10	100	3							
11	45	3				20			35
12	50	2		30	20				
13	20	2		20			10	20	30
15	70	2			15		5		10
16	50	1					50		
17	50	2		25	25				
18	80	2					20		
19	40	2				35	20	5	
Avg.	48	1.94	20	23.63	16.5	21.38	17.44	13.33	20.6
S.Dev	21.34	0.57	0	8.33	6.16	8.11	14.92	7.64	11.91
No.	16	16	2	8	8	8	9	3	5
Max	100	3	20	40	25	35	50	20	35
Min	20	1	20	15	5	10	5	5	8
Composite	48	1.9	2.5	11.8	8.3	10.7	9.8	2.5	6.4

Three methods were used by half the schools: case study analyses, topic studies, and computer-based projects. Of the eight schools using these methods, only two used all three. Of these three methods, case study analyses receive the highest weight on average, 24% with a range of 15 to 40%. Projects are weighted at 21% with a range of 10 to 35%. Topic studies are weighted at 17% with a range of 5 to 25%. Five schools use assignments with an average weight of 21%, ranging from 8 to 35%, while three schools use article and book reports, and two use quizzes for assessment. Although no school used all assessment methods, the composite average for all sixteen schools shows two exams, case study analyses, computer-based projects, and class participation accounting for 80% of grade assessment.

TEAMWORK COMPONENT

Nine of the sixteen schools used teamwork, with only one of those nine making teamwork versus individual effort an option (Table 2). Seven schools made no provision for teamwork in the required MIS course. At three schools, teamwork was linked to over half the grade assessment. The average, however was 34% for those employing teamwork and for all sixteen schools, 19.25%. Computer-based projects were the most frequent method linked to teamwork, followed by topic studies, and case analyses.

Table 2
Percent of Total Assessment Linked to Teamwork

School #	Total %	Cases	Topic Study	Project	Books/Articles	Assignments
5	60	25		20	15	
8	60	15	15	30		
11	55			20		35
19	35			35		
9	29		5	24		
4	24	24				
2	20		20			
15	15		15			
6	10			10		
Average	34.22	21.33	13.75	23.17	15	35
Number	9	3	4	6	1	1
Max	60	25	20	35	15	35
Min	10	15	5	10	15	35

Note: School 9 makes teamwork optional so could range from 0% to 29%

REQUIRED READINGS AND TEXTS

Just as course names lack standardization, so do texts used in this required MBA course. The most common required reading was a customized course packet or list of articles. Six schools (numbers 2, 3, 8, 16, 18, 19) adopted this approach, with half of these requiring traditional textbooks as well. *Building the Information Age Organization*, *Corporate Information Systems Management*, and *Essentials of MIS* were the only books used in more than one school. A list of required texts, as they are listed on syllabi, with school number in parenthesis follows.

Alter, Information Systems, 2nd ed.(15)

Applegate, McFarlan& Mckenney, Corporate Information Systems Management: Texts and Cases, 4th ed. Irwin, 1996. (2,4)

Cash, Eccles, Nohria & Nolan. Building the Information Age Organization, Control and Information Technologies. (5, 12, 17)

Cats-Baril and Thompson, Information Technology and Management, Irwin, 1997. (10)

Hansen and Hansen, Database Management and Design, Prentice Hall, 1996. (9)

Hatfield. Developing PowerBuilder 5 Applications. Sams Publishing, 1996. (9)

Laudon and Laudon. Essentials of Management Information Systems: Organization and Technology (1997). (8, 11)

Lucas, Information Technology for Management, McGraw-Hill, 1997. (13)

Martin, Hoffer, et al. Managing Information Technology: What Managers Need to Know, 2nd ed. MacMillan. (3)

McKeown and Watson, Metamorphosis. (15)

Morgan, Application Cases in MIS, 2nd ed., 1996. (4)

Stair and Reynolds. Prinicples of Information Systems: A Managerial Approach. Course Technology, 1998. (6)

TOPIC CATEGORIES

Topics were taken from the listings available on the syllabi. Therefore, a syllabus which provided a more detailed listing would be better represented than those which provided major topics only. No attempt was made to infer detail from the major topic listing. Some of the more detailed listings, such as outsourcing, obviously overlap with major topics such as information resource management. Topics are listed by order of highest frequency among the sixteen schools.

Total no. of schools	TOPIC	School numbers
10	IT architecture and infrastructure	2,3,5,6,8,12,13,15,17,18
10	strategic applications of IT	2,3,4,8,10,11,13,15,16,19
9	information age organization: IT design and management	3,5,11,12,13,15,17,18,19
8	systems development process (planning, building, managing)	4,6,8,9,10,11,13,15
8	IT enabled process redesign	2,5,10,13,15,17,18,19
7	interorganizational systems/ strategic alliances	2,5,8,12,13,15,17
7	telecommunications fundamentals	2,8,10,11,13,15,17
7	decision support (individual, group, organizational)	4,5,10,13,15,17,18
7	electronic commerce	2,5,8,10,16,18,19
6	information resource management	4,10,11,12,13,19
6	types of systems and evolution of IT(TPS, DSS, GDSS, EIS, ES, etc.)	2,5,6,8,13,18
5	human side of technology/ the individual and IT	4,5,15,17,18
5	database fundamentals	2,6,9,13,15
4	future impacts of IT	2,12,15,17
4	data modeling	6,9,11,13
4	security/privacy	5,9,16,19
4	managing IT risks	5,12,5,16
4	fundamentals of HW and SW	2,13,15,18
4	PC applications: database	4,6,8,11
4	frameworks for IT enablement	5,6,8,15
3	IT and productivity	10,13,18
3	client/server	2,9,18
3	global systems	2,12,15
3	ethical issues	12,15,19
3	outsourcing	2,5,19
2	system failures	2,16
2	PC Applications: Building a Web Page	8,11
2	justifying IT investments	5,12
2	data warehousing	13,18
2	acquisition/ implementation issues	5,16
1	disaster recovery	15
1	emerging technologies	16
1	collaborative work	18
1	end user computing	4
1	project management	5
1	PC applications: PowerBuilder	9
1	multimedia	16
1	PC applications: spreadsheet	4
1	IS career	10

COMPARISON OF TOPICS TO CIO/CEO ISSUES

CEOs and IT executives or CIOs surveyed (Scheier, 1997; Schurr, 1997) placed importance on incorporating IT in strategic planning. Senior executives are also investing heavily in IT infrastructure and using this infrastructure to compete globally (Alter, 1996). These two concerns are clearly reflected in the topics appearing with highest frequency. The topics listed by 10 of the 16 required MBA courses include both concerns: IT architecture and infrastructure, and strategic applications of IT. Another executive concern, using IT to grow sales (Stedman, 1997) may be embedded in strategic applications but is clearly shown in the attention to electronic commerce (7 schools). Global systems appears as a specific topic on only three syllabi.

A Deloitte & Touche survey of 431 North American CIOs (1996) identified the following issues as key ones for CIOs:

- Client/server architecture and networking: percentage of client/server is now greater than non-client/server and expenditures are expected to grow. Visual Basic was "identified most often by CIOs as an important client development tool." However, mainframe purchases and upgrades exceeded expenditures on all other platforms. (http://www.dttus.com/publications/cio/key.htm, 1996,1).
- Business process reengineering or redesign
- Replacing legacy systems
- Outsourcing (particularly the disaster recovery function)
- Integrating domestic and international systems within the organization or global systems
- Electronic Commerce
- Purchasing commercial off-the-shelf software

The shift in IT architectures is reflected in a majority of syllabi as a major topic. Related topics include interorganizational systems, telecommunications fundamentals, database fundamentals, data warehousing, and of course, the specific topic client/server. Business process redesign is a major topic in half the syllabi with electronic commerce appearing on seven syllabi as a major topic.

POTENTIAL IMPROVEMENTS

Considering the topics covered and the critical issues according to senior executives, the course might best be called the "Management of Information Technology." Since strategic use of IT requires attention to multiple perspectives, teamwork in the MBA course seems to make sense for a significant portion of the course. For computer-based projects, Visual Basic might be an excellent choice for some project teams. Textbooks which include strategic applications but also include good coverage of client/server architecture, evaluation and integration of purchased software, global systems integration and support, electronic commerce, and outsourcing, particularly the disaster recovery function, would be helpful. The fact that the most frequently listed required reading was a customized packet and the fact that there is little consensus on the "best" book for the course may reflect the difficulty in finding a text with the desired coverage or may simply reflect the fact that

textbooks are outdated so quickly in IT. Clearly, the courses studied are very different, suggesting the possible need for two courses.

(1) Foundations in Information Technology: technology fundamentals and architectures, computer-based projects
(2) Management of Information Technology: strategic applications, organizational and process redesign with IT, with case studies and topic study.

However, a more inclusive study with a large sample may reveal more commonalities than were apparent in this study of the required MIS course in sixteen AACSB accredited schools. Educating future executives in information technology appears to have a positive impact on the performance of an organization. One CEO survey indicated that CEOs and other top managers who are comfortable with technology initiate one third of the IT projects in their organizations while those who are not initiate fewer than 15%(Caldwell, 1997, 100).

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Deloitte & Touche LLP (1998). 1996 CIO Survey Results. Accessed March 18, 1998. http://www.dttus.com/publications/cio/key.htm

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Schurr, Amy (1997). IT execs find little time for strategic planning. *Network World*. 14(29), 51.

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SOFTWARE: IS WHAT WE ARE TEACHING MEETING THE NEEDS OF BUSINESS?

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Jeff Clark, Middle Tennessee State University

ABSTRACT

The rapidly changing information technology (IT) environment poses a significant challenge not only for the business community, but for educational programs as well. Businesses, eager to stay abreast of the changes or to exploit a change for competitive advantage, quickly move to new or emerging technologies. Departments of Computer Information Systems/Management Information Systems (CIS/MIS) shoulder a major portion of the responsibility to equip students with the knowledge and skills of information technology. How well these departments accomplish this task depends, to a great extent, on how well their curriculum keeps pace with the short term changes and long term trends in the information technology environment. As a consequence, faculty within these departments are constantly upgrading existing software packages or switching to new packages entirely.

This is an exploratory study which seeks to determine what software is currently being used in the various information systems courses actually taught in four-year, undergraduate CIS/MIS educational programs. The goal is to establish a baseline from which future studies can track changes and trends in CIS/MIS curriculum and to provide a point of comparison for existing information technology educational programs. The survey research strategy is being used to collect data.

The scope of this study is limited to colleges and schools of business that offer undergraduate concentrations (i.e., degrees or majors) in CIS/MIS. Programs that offer only a minor in CIS/MIS are not included. No attempt is made to differentiate programs based on AACSB accreditation status.

The survey instrument being used in this study was adapted from the instrument used by Maier and Gambill in their study of CIS/MIS curriculums.

The 1995 Directory of Management Information Systems Faculty published by McGraw-Hill Publishing Company was used to develop a comprehensive list of colleges and universities with four-year, undergraduate programs in CIS/MIS. The sample contained educational institutions representing every geographical region in the United States. The survey was mailed to the departmental chair of each school included in the sample. A total of 174 surveys have been mailed.

To date, we have received a number of responses. The data are being entered into the system as they arrive. Because of the nature of the data, final analysis of the data will accomplished using basic descriptive statistics.

AN ANALYSIS OF THE RELATIONSHIPS AMONG PERCEIVED ENVIRONMENTAL UNCERTAINTY, INFORMATION SYSTEMS DESIGN, AND BUSINESS STRATEGY

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ABSTRACT

The relationships among perceived environmental uncertainty, information systems design, and business strategy have not been rigorously examined. This study shows that perceived environmental uncertainty has a significant effect on both information systems design and business strategy. Also, information systems design is shown to have a significant effect on business strategy.

INTRODUCTION

While the relationship between business strategy and perceived environmental uncertainty (PEU) has been the subject of analysis, the relationship between PEU and information systems design has not been subjected to the same level of empirical research. Also, the relationship between information systems design and business strategy has not been rigorously analyzed. The dearth of empirical research in this area is somewhat surprising considering the significant role information systems play in organizations today.

HYPOTHESES

This study examines the relationships addressed above. In particular, it is hypothesized that perceived environmental uncertainty has a significant impact on both information systems design and business strategy. In addition, it is hypothesized that information systems design, conceptualized in terms of the characteristics of the information obtained from it, has a significant impact on business strategy. The model positing these relationships is shown in Figure 1.

SAMPLING FRAME

The sample was 148 chief executive officers of publicly-traded firms which limit their operations to a single industry, as determined by four-digit Standard Industrial Classification (SIC) code. Firms limiting their operations to single industries were chosen due the difficulty in analyzing the strategic responses of firms operating in multiple product/market segments. These 148 respondents represent 90 different industries.

MEASUREMENT OF THE VARIABLES

The variables of interest were measured using multiple-item psychometric scales which have been used in previous research. All of the scales exhibit acceptable reliability with a Cronbach's Alpha in excess of .70.

Information systems design was assessed through the scales developed by Chenhall and Morris (1986) measuring the four characteristics of information provided through management information systems. The characteristics are scope, timeliness, aggregation, and integration. These characteristics are broad enough that they are considered descriptive of an organization's overall information system.

Business strategy was assessed through the scales developed by Venkatraman (1990) measuring management's assessment of the firm's operations in three strategic areas. These areas are marketing, operations, and administration.

Perceived environmental uncertainty was assessed through a scale developed by Miller and Droge (1986) measuring management's perception of the degree of change and unpredictability in various market and technological dimensions facing the organization.

DATA ANALYSIS

Structural equation modeling was employed as the analytical technique. The proposed model shown in Figure 1 was evaluated using accepted goodness-of-fit measures. The model showed marginal goodness-of-fit, at best. An evaluation of the pattern of the standardized residual pairs revealed ten exceeding acceptable limits. Six of the ten residual pairs involved the aggregation characteristic of information systems design. This variable was eliminated from the model and it was re-estimated. This modified model is shown in Figure 2. The re-estimated model exhibits excellent goodness-of-fit. All hypothesized relationships were found to be significant.

DISCUSSION

The impact of the results for strategists and information systems designers is significant. Perceived environmental uncertainty impacts the strategy firms follow and the design of the information systems used to implement that strategy. Also, the design of the information system, as defined by the characteristics of the information it provides, serves to influence or constrain the business strategy that a firm pursues.

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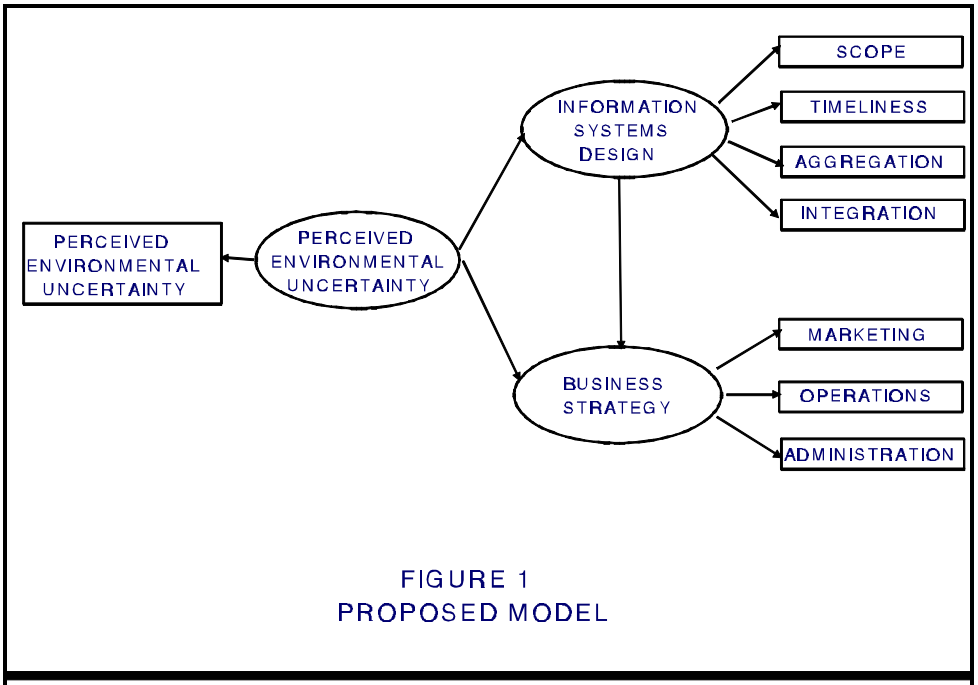

FIGURE 1
PROPOSED MODEL

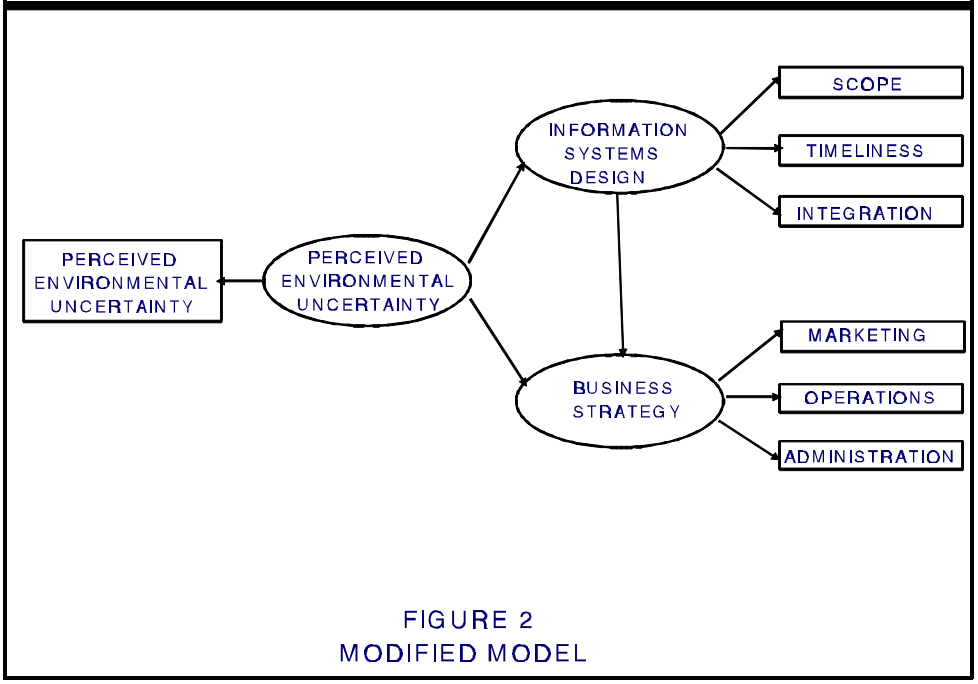

FIGURE 2
MODIFIED MODEL

MARTHA TICK
DAUGHTER OF MARK TICK, AUDITOR EXTRA ORDINAIRE

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Arthur C. Joy, Columbus State University

ABSTRACT

When we observe the humorous mistakes of others the lessons learned are often more lasting than a host of examples of how to do the jobs right. Paul D. Johnson used this concept effectively in his 1974 case, "Mark Tick's Data Center Audit," to effectively teach control procedures by humorously illustrating Mark's failures as an auditor As an example, Mark noticed the employees playing a game of ring toss with the read/write rings from clearly labeled magnetic tapes stored in hallway to the cafeteria and observed that they were, "Ingenious people, finding use for those worthless little rings." We can learn lessons about physical control procedures, proper storage facilities, labeling procedures, and the need for a data librarian, among others, from this simple paragraph. It is an excellent example of teaching by counter–example. Unfortunately, the proliferation of micro computers has dated the application of read/write rings except for the largest companies and punched cards are completely outdated. In short, the antiquity of some of the examples partially negates its utility as a teaching aid in today's micro computer environment. The purpose of this case is simply to celebrate Paul Johnson's excellent work by bringing it into today's environment.

MULTITHREADED ARCHITECTURE SYSTEM: THE NEXT COMPUTER INFORMATION SYSTEMS REVOLUTION?

Kenneth E. Knight, Seattle Pacific University

ABSTRACT

"We're different. Whether that translates into success in the market, we'll see. But certainly, the same old approach won't work"

Burton Smith, Chairman & Chief Scientist, Tera Computer Company

The brief 50-year history of the computer information systems has dramatically altered how our businesses operate and the tasks and jobs that each of us work. In that 50-year history, there have been three primary architectural paradigms involved: the mainframe (large centralized systems, or our personal PC), vector and massively parallel processing supercomputers, and distributed computer networks. As the speed of processors doubles and costs are cut in half every 18 months, the existing paradigms are creating problems in the management information systems implementation. The performance (speed and cost) advances are not being realized. A new computer information systems architecture is required to take advantage of the rapid technology improvements. Tera Computer Company has spent the better part of 10 years developing a unique technology, which Tera believes will result in a significant breakthrough in the design and implementation of management/computer information systems.

STEREOSCOPIC MULTIMEDIA: MARGINAL PROPENSITY TO PERCEIVE

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ABSTRACT

This paper explores the possibility that stereoscopic perception may be a logical next step in the progression of multimedia developments. Although there are obvious technical problems with its adoption by both consumers and software producers, the benefits may be worth the effort and cost. The paper reviews development of stereoscopic perception, indicates the benefits of its use, and discusses some of the problems associated with implementation. Finally, the paper includes a list of current resources for the development of stereoscopic multimedia.

INTRODUCTION

Many efforts in recent years have been targeted at converting the computerized record of events and circumstances into an experiential process. Under this paradigm, a user can access records involving words, graphics, sounds, and animated media to increase perception beyond the ability of any single medium to transfer perception.

There appears to be somewhat of a hierarchy of perception. Words are a very precise, if inefficient way of communicating. They do, however, provide a means of instantaneously reviewing the communication (rereading), and they are present for more than just a fleeting instant. Graphics add a new dimension in communication, often generating greater amounts of information in the same 'view' than words can. Combined, words and graphics are often more effective in transferring perception than either one alone. A time dimension can be added with moving graphics, or animated media, such as computerized moving graphics or video imported from analog sources. Add sound to these moving monoscopic images, and perception becomes enhanced even further. Stereo audio enhances the perception of sounds to a more natural position, providing the channel separation rather than limiting the perception to a unidirectional monaural signal.

Multimedia is slowly incorporating more and more of the senses in its ability to transfer information. In its present form, multimedia is designed for a dynamic, two-eared, one eyed perceiver. It is dynamic in that progressional still pictures can be perceived by the brain as movement. It is two-eared in that stereo audio is incorporated. It is one eyed, however, in that monoscopic images dominate the applications in use today.

Stereoscopic perception appears as a recreation of an actual scene, rather than as just a graphic representation, as in a photograph. The idea of stereoscopy is far from new, and the

technology surrounding stereoscopy has been around for a century and a half. The contribution of stereoscopy to perception is that a user can perceive depth. Although this may seem a minor contribution, the perception of depth carries with it some very nice advantages. Primarily, perception is increased by the viewer's ability to locate graphical objects relative to one another. It also allows for the perception of texture and solidity, as well as curvature and size. This establishes a situation whereby the reproduction is more likely to convince the brain that the actual circumstance is being reproduced.

The increased perception has produced startling results in its applications to date. The stereoscopic experience is probably best known in modern times by the 3-D IMAX theater presentations shown in theme parks. The perception of an event is so dramatic that viewers have been known to fall out of their seats in a disoriented daze (which was the objective of the movie producer). Some theaters even provide seat belts for safety purposes.

Stereoscopy has been utilized in specialized scientific endeavors in order to greatly increase the effectiveness by which many processes are carried out. For example, stereoscopic images capture by deep space probes have provided scientists with the ability to 'see' surface textures on other planets without actually traveling to and measuring these surface features. In the ophthalmology profession, stereoscopy has been used to make stereo images of the interior structures of the eye. In surgical procedures, stereoscopes are used to enhance the surgeon's perception of texture and solidity of internal organs as well as providing a two-point perspective of depth.

Why has stereoscopy been used in these applications and not interwoven into modern day virtual reality? The most likely reason is that in those applications, the degree of success of the user of the stereoscopic view is crucially dependent on a high degree of perception. The experience of 'viewing' a planetary body is not very practical from a human standpoint, but a 'virtually real' view is accomplishable using stereoscopy. The perception of depth is crucial to the ophthalmologist's effectiveness in treating some eye disorders. And finally, the surgeon's ability to perceive texture and solidity is often crucial to the success of the surgery. A second possible reason for the current lack of stereoscopic applications is that the viewer must perceive the stereoscopic view by separating right from left view and placing the appropriate view with the correct eye in order to perceive depth. There are obvious problems in the implementation of this second barrier to use of stereoscopy in virtual reality.

The Purpose of this study is to explore some of the issues inherent in the adaptation of this additional perceptive ability in virtual reality, to provide some guidance as to the direction that development of this technology should go, and to present some of the ways in which current applications could be improved by the adaptation of stereoscopic viewing.

BACKGROUND OF STEREOSCOPY

Stereoscopy is far from a new technology. The increase in the ability to use binocular vision in the perception of photographic media was recognized well before the turn of the century. "In the 1850's people were exclaiming over stereo daguerreotype and debating the relative merits of Sir Charles Wheatstone's and Sir David Brewster's viewers for looking at them." In the United States,

"Oliver Wendell Holmes designed a hand model for parlor use." He was quoted as saying "We are looking into stereoscopes as pretty toys and wondering over the photograph as a charming novelty...but before another generation has passed away it will be recognized that a new epoch has started in the history of human progress." (Kreibel, 1964. P. 3527) Holmes was at least partially correct. By the early twentieth century stereo photography was as popular as monocular photography, and the photograph itself became known as a valid and relatively permanent means of preserving instances of sight.

Viewers were specially designed for viewing of the daguerreotype. These separated the left from the right eye views so that depth could be perceived the way a person physiologically perceives depth. In the early 1900's, a variety of means of effectively blocking out, or partitioning different view angles were developed. Among the most effective of these was Edwin H. Land's polarizing filters used to view motion pictures and still projections in three dimensions, in full color. Anaglyph (red-green or red-blue) reproductions allowed each eye to see only the colors not blocked by the colored lens in front of each eye. Since anaglyph viewers (glasses) blocked portions of the color spectrum, the result was far from satisfactory. The polarizer became the accepted means of viewing en masse, because two images of opposite polarity could be projected onto the same screen while each eye could (with the lenses of the glasses appropriately polarized) 'see' only the correct view for proper perception. "...the retina of each eye..."is placed on"...the same image that would be focused there if the observer were actually present at the scene. Thus, as in actual on-the-spot observation, the brain can interpret all the disparities between the two views in terms of depth, space, and texture." (Kreibel, 1964. p.3529)

The average American has probably experienced three dimensional perception in less than ideal circumstances by viewing 3-D movies at the theater that utilizes polarized 3-D glasses (the very same technology of the 1930's). Most viewers recall those experiences with less than rave reviews. Often, the theater itself is flawed to the point of lessening the effect of the stereoscopic vision. Because polarizing glasses effectively block out half of the total light projected, the image is often dull in color and dim in brightness. The medium viewed is often not produced in a high quality and perfectly synchronized way, so that the ability of the brain to make up for poorly produced movies is strained. Indeed, many viewers complain of a headache upon leaving the theater. The problem in these cases is not one of a flawed conceptual construct; rather, it is one of effective reproduction of experience. Because of these facts, however, 3-D viewing has been suppressed to a 'novelty' status.

A recent improvement in quality of reproduction of experience and of viewing quality has appeared in the IMAX 3-D theater. A select few have actually had the experience of the IMAX 3-D. These attractions are the most popular exhibits in places where they operate. The idea is still a novelty, however. 3-D still photography was popular until about the late 1950's. One possible explanation of the virtual disappearance of binocular perception's development is suggested by Issac Blonder. "The inconvenience of taking and viewing may be the simple answer." (Blonder, 1995. p.19)

As the computer age developed, the standard video display was logically adopted. Until recently, the graphical resolution of computers was insufficient to effectively display sharp graphical images. Also until recently, the idea of digitizing video signals was a futuristic dream because of the excessive processing speeds and large memory requirements necessary for effective video editing on

computer. So, until recently, there has been little hope that stereoscopic media had much of a chance for development in personal (or other) computing.

The technological issues at hand are basically twofold. First, the production of stereoscopic media represents a rather strenuous challenge. In order to have effective binocular perception, the problems of dull, dim images, imperfect synchronization of left and right eye frames (for motion), nonsynchronous exposure (brightness), focus, and depth of field, and individual versus group viewing must be resolved. The second challenge is the reproduction of the virtual experience. Although a variety of 'ideas' for more effective reproduction are in the works, and several older technologies exist, the future of stereoscopic viewing rests with effective means of view processing and reproduction that either is extremely costly at present or not even prototyped at present.

TECHNOLOGICAL DEVELOPMENT ISSUES

One of the primary concerns that the producers of user applications (entertainment including video, communication, education, experiential applications) should have at this point is that in order for the production of stereoscopic media to be profitable, quick adoption is necessary. That adoption is not presently feasible, because the present machine technology does not exist for adoption to take place. This technology development, however, is only a matter of working out dynamics and production of physical products. Technical concerns are addressed in this section. Under the assumption that these technologies could exist in the near future, the question remains as to the particular concerns of the media (software, video entertainment) producers. A variety of areas of concern are suggested here for consideration.

Primarily, the problem faced by a medium producer is that of accuracy. This is a substantially different problem depending on the type of production. In order to highlight this, consider two contrasting types of medium: graphical production and video sequences.

Graphical production faces a far simpler problem. In fact, the technology exists at present to adapt so called '3-D' graphics packages to true stereoscopic viewing. For example, suppose a graphics software user is viewing simple spherical object as it rotates on a vertical axis. Essentially, every frame of the sequence represents a separate view of the object from a slightly different angle of view. If two frames are viewed, one with the right eye and one with the left eye, representing the normal angular difference between viewpoint a (the right eye) and viewpoint b (the left eye) then a true stereoscopic computer generated graphic results. Animation is a relatively simple step beyond this humble beginning. After the normal angular difference between the two viewpoints is determined (which varies as the rotational speed varies), then a time lag between the sequential viewing of the left and right eye views results in a true animated stereoscopic sequence. Although the actual conversion of everyday graphical representation would be considerably more complicated, the same principle of viewing from different angles still applies.

Video media production is considerably more complicated, especially with the limits of today's video technology. With the advent of digital video and digital editing capability, however, the problems may gradually be alleviated. Essentially, stereoscopic video requires simultaneous recording of an event from slightly different angles. This can be accomplished in a relatively simple way by using

two video cameras, with the focus, apertures, shutter speeds, and other settings 'genlocked.' The signals can then be recorded onto either two synchronized videotapes or digital media, or recorded onto some medium that will handle two channels of information, or by using a field sequence (every other frame of the scene is from one camera). Viewing can be accomplished by playing back the video onto left and right eye monitors, or by the use of polarizing filters for projections. In the former case, the viewer would have to wear a virtual reality helmet or some similar image separating method such as LCD shuttering glasses. In the latter case, the viewer would wear polarizing glasses.

Unfortunately, shutter glasses and polarized glasses block essentially half the light (the half not meant for that eye). Virtual reality helmets thus far are not of very high resolution, unless they are among the new high resolution prototypes. Of course, these tend to be on the costly side. One could expect, though, that further development of these technologies and perhaps some new ones could occur quickly. As the next section suggests, commercial development of these ideas has grown rather rapidly.

RECENT DEVELOPMENTS

The future of stereoscopic media production and applications is promising. It appears that firms and customers are developing the perception that the added dimension of depth is both useful and entertaining. Computer applications have recently become cost effective through the production of low cost field sequential media for use with shutter glasses. The use of polarizing technology continues to be prevalent for projected presentation, and the resolutions of virtual reality helmets and similar viewing paraphernalia are improving and becoming more affordable. It remains to be seen whether or not these technologies are adopted on a large scale, but it appears that consumers do indeed have an increasing marginal propensity to perceive.

A partial list of organizations and business firms that promote stereoscopic pursuits and produce equipment and media is presented below. The list includes informative websites.

NSA - National Stereoscopic Association
http://www.nsa-3d.org

Stereoscopy (International Stereoscopic Union)
http://www.stereoscopy.com (Http://www.stereoscopy.com/isu/index.html

3-D Majic (Shutter Glasses Systems)
http://www.3dmajic.com

VREX

http://www.vrex.com

Multi Dimensional Studio

http://mds.com

Video Synthesis

Http://www.vidsyn.com

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Kriebel, Richard T. 1964. "Stereoscopic Photography." *The Encyclopedia of Photography* (19), pp. 3527-3534.

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