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Proceedings of the Academy of Information and Management Sciences

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IMPROVED HIRING FOR THE INFORMATION SYSTEMS FUNCTION

Carol M. Bruton, California State University San Marcos
cbruton@csusm.edu
Gary P. Schneider, University of San Diego
garys@acusd.edu

ABSTRACT

Information Systems (IS) departments are fairly new to organizations and tend to have less structure and fewer formal procedures than the more traditional departments in an organization such as accounting or marketing. This lack of structure can hamper the hiring process. This paper presents a set of tools that can help IS managers hire more-competent employees.

INTRODUCTION

IS departments are relatively new compared to other organizational departments and, as a result, the IS department is often seems to be an extra appendage of an organization that does not have complete integration into the organization (Garner, 1995). The personnel function, therefore, is not always effective in screening IS candidates (Hoffer, 1997).

Hiring is sometimes based more on personality and appearance than on the specific skills needed in the position (Spencer and Spencer, 1993). The solution we propose in this paper is that firms use competency-based hiring techniques.

COMPETENCY-BASED HIRING

Competency-based hiring uses specific predetermined competencies to evaluate potential IS candidates. In this approach, the job is defined in terms of specific tasks (Lawler, 1995). Hiring is based on the ability to perform these tasks and not on race, gender, or other inappropriate criteria (ACA, 1996).

DETERMINING THE SPECIFIC COMPETENCIES

To implement a competency-based hiring approach, a firm must define a list of specific skills required to perform the duties involved (Lawler, et al., 1992). The firm can obtain specific competencies in several ways. Interviews and surveys provide initial information. Discussions with the supervisor as well as employees performing similar tasks are necessary. The organization's employees that interact with the IS department should also be interviewed (Hoffer, 1997). Group departmental discussions can be helpful. The personnel department can provide a general check list that contains a variety of competencies. These initial interviews provide check lists that HR interviewers can use in subsequent interviews and in group meetings to develop a final comprehensive list (Lawler, 1995).

Competencies might include technical items such as knowledge of UNIX, networking protocols, and even specific software package knowledge, such as SAP. The technical competencies must have sub-classifications to ensure the applicants knowledge matches the organization's needs. Sub-classifications may include such things as database skills or experience with a particular database implementation, for example, Oracle Financials.

The list of competencies should also include other skills such as the ability to communicate effectively with employees within the department and out of the department, and the ability to work in a conflict situation (Mansfield, 1996). Competencies generally include organization skills and the ability to deal with multiple tasks at once. Competencies may also include skills such as the ability to drive a car and the ability to lift fifty-pound boxes. These

competencies would be necessary if driving is a requirement of the position and if heavy lifting is involved transporting equipment.

Employment laws favor competency-based hiring that selects the employee best qualified for the position regardless of race or gender. Without competency-based hiring, the IS department risks hiring based on personality and comfort level between the interviewer and interviewee. The applicant selected may not have the IS skills necessary for the job.

COMPETENCY-BASED INTERVIEW

Candidates' technical skills may be determined through a questionnaire and demonstration. The questionnaire should include a list of software and hardware skills required. The questionnaire should include a seven point scale ranging from zero skill to complete mastery of the skill that allows employees to provide their own assessments of their abilities. To confirm the candidates' self assessments, each candidate should complete a set of predetermined tasks at the interview. The tasks might include debugging a specific computer problem or setting up a computer workstation. The tasks should be exactly the same for each candidate to ensure a fair and unbiased selection. The interviewer should then evaluate the candidate's performance on these tasks. The interviewer needs a specific list of criteria for evaluation of the candidate with a seven point scale to ensure minimum bias in the selection process.

Oral communication skills may be tested using role playing exercises. A role playing exercise provides the job candidate a situation and asks the candidate how he or she would respond to that situation. A typical work scenario might be illustrated. The applicant would respond with how they would deal with that situation. The interviewer must have a list of specific criteria for evaluation of the candidate.

Written communication skills may be tested by having the candidate write a memo or report that is normally required of an IS employee. Again, the writing assignment must be evaluated using specific criteria. If appearance of the memo is important, appearance should be a criterion. If spelling and grammar are important, they should be criteria. The ability of the memo to convey the message intended should also be evaluated.

If the candidate's ability to deal with multiple tasks and organization skills are important, a test that gives the candidate a full in-box and asks the candidate to dispose of each item (an in-box exercise) can provide useful data. The candidate can be asked to respond in detail to each item. From the detail provided, one can evaluate the level of the candidate's multi-tasking and organization skills.

If keyboarding skills or other routine skills are needed in the position, a simple standardized test may be administered to determine the applicants skills. The candidate's physical abilities may be evaluated by completion of tasks. If lifting and manipulating computers and peripheral devises are involved in the job, the candidate should move a system during the interview process to demonstrate the skill.

If the position involves supervision the organization should assess the candidates supervisory skills. A role playing exercise in which the candidate gives instructions to a subordinate can provide measurable observations. Another useful competency evaluation tool is to have the candidate evaluate a subordinate's work. Ask the candidate to evaluate a subordinate that has performed a task poorly. Asking the candidate how he or she would have handled the situation can provide, again, measurable observations.

If the position involves training subordinates or other employees within the organization, you may ask the applicant to teach the interviewer a specific skill and observe the candidate's style and effectiveness. A specific set of criteria should be used to evaluate each candidate's teaching ability.

The competency-based approach requires a lengthy, comprehensive interview process; however, most firms are pleased with the results. Using a competency-based hiring process helps prevent hiring a candidate that is less-qualified for the position but that is similar in socioeconomic background to the interviewer. Without objective criteria, interviewers tend to favor candidates that are most like themselves (Lawler, et al., 1992). Human resources employees interviewing IS candidates simply do not know how to evaluate candidates because they are not familiar with the specific skills required of the candidate. Competency-based selection techniques are especially useful in this application.

STARTING A COMPETENCY-BASED PROGRAM

A competency-based program is a major undertaking for an organization (ACA, 1996). The implementation must have the support of management. Time and resources are necessary to develop the competencies and implement the performance evaluation system based on the competencies. The competency-based program can have a negative impact on the organization if the competencies are not adequately developed. Individuals will be hired for positions with inappropriate skills.

The start up of a competency-based program can be complex. Care must be exercised for the program to be effective and accepted by the employees. Staff at all levels in the IS department need to become involved in the program and help develop the competencies. A good way to develop competencies is through interviews and group meetings. The IS department must understand and accept each position's competencies and how they relate to accomplishing the tasks of the department. The program must be marketed to employees to obtain consensus for the implementation.

MAINTAINING CURRENCY

Required competencies will change over time. After implementing competency-based programs, firms will find it necessary to update competencies. With the changing nature of both hardware and software technology, IS department competency revision will likely become a continual process.

SUMMARY

Competency-based programs can be effective tools for hiring in IS departments. Competency-based programs provide objective criteria for hiring that can help the organization obtain the most qualified individual for each position. The program reduces the possibility of personnel screening out good candidates and can improve the supervisor-employee relationship because it provides specific, objective criteria to measure the congruence of employee performance with organizational expectations.

Implementing a competency-based program in an IS department takes time and resources. It needs the support of management and the department. Typically, the benefits of implementation outweigh the cost. A competency-based program can be an excellent way to ensure productive hiring, evaluation, and salary reviews in the IS function.

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HOLONIC MANUFACTURING SYSTEMS: DISTRIBUTED MANAGEMENT IN NETWORKED COMPANIES

Robert Leinwand, Unitec Institute of Technology
rleinwand@unitec.ac.nz

ABSTRACT

The holonic network dates its origins to the Hungarian author and philosopher Arthur Koestler. Approximately 25 years ago Koestler proposed the word "holon" to describe a basic organisational unit in the context of biological and social systems. Holon is a combination of the Greek work holos, meaning whole, and the suffix on meaning particle or part. When deriving this term, Koestler observed that in living organisms, and social organisations and systems, there was a total absence of autonomous, non-interacting entities. All units of identifiable organisations, such as individual cells in living organisms, or a family unit in the social structure, are comprised of other basic units (nucleus and surrounding plasma, parents and siblings) while at the same time forming a part of a larger unit of organisation (tissue, or a community) . A holon, as Koestler derived the term, is an identifiable part of a system that has a unique individuality, yet is made up of sub-ordinate parts, while also forming a part of a larger whole.

When Koestlers' term is applied to a manufacturing system, the concept takes on a more applied focus. A holonic network would be composed of a group of totally autonomous companies, each having a range of unique skills and capacities needed to allow delivery of the end product. Each of these organisations is an independent business, having in place its own management structure, systems and procedures. Equally important is the ability of the network to dynamically configure itself to meet the specific requirements for each order. Only those holons with the expertise required will be summoned for each individual order placed with the network.

INTRODUCTION

A formally structured, or unstructured network of independent businesses has the potential to provide a low cost, highly dynamic manufacturing environment. Each holon within the network is an independently operating company with its own management structure and systems. The management structure of each holon deals with disturbances in its own sphere of influence, without reflecting this disturbance to the rest of the network.

The fundamental constraint of the network is that there is no management structure for the network as a whole, presiding over the top of all holons. This both simplifies and complicates the system, creating the significant problem of how the system will be managed. It is the lack of management structure upon which this paper focuses.

FUNDAMENTALS OF THE HOLONIC ENTERPRISE

A holonic network would be composed of a group of *totally autonomous* companies, each having a range of unique skills and capacities needed to allow delivery of the end product. Each of these organisations is an independent business, having in place its own management structure, systems and procedures. When functioning within the network, the combination of skills and capacities allows the production of finished goods that individual holons could not individually manufacture. These organisations are integral companies in their own right, having established markets, product areas, manufacturing capabilities, capacities, and customer bases. Each company becomes a *holon* within a functional holonic network. An example might be a network made up of organisations desiring to produce a piece of electronic equipment. One member of the network is a specialised engineering company, another a distributor of electronic components, another produces printed circuit boards, another wiring harnesses and cabling,

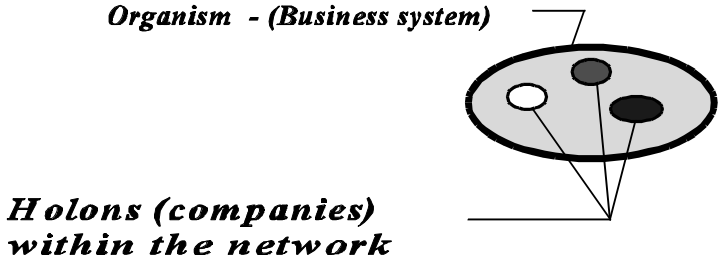

Figure 1

another builds sheet metal chassis, and cabinets, while the sixth has capabilities for testing and repair of completed units. Each of the holons then provides unique capability within its own field of expertise.

STRENGTHS OF THE HOLONIC NETWORK

The strength of the holonic organisation is that it enables the creation of very complex systems that promote the following attributes:

Efficiency in the use of resources

There is a true synergy achieved by allowing the best capabilities of each of the nodes within the network. Smaller companies can appear far more powerful and diverse in their marketplace than their structure would otherwise allow. Market penetration, consumer awareness, and utilisation of distribution channels by utilising other network members.

Speed of response

A network which by definition removes tiers of management can make decisions faster and more accurately. A holon within the network contains a core competence, which it retains and manages independently.

Resilient to both internal and external disturbances.

Each node is responsible for its management as an independent entity. Each contributes based on its ability to perform as a separate company, and does not reflect problems back to the network.

Highly adaptable to change in the marketplace, technology, or unique customer requirements.

Flexibility is promoted by the range of competencies and capacities of each node in the network.

Dynamic allocation of resources with the network, as a function of product or customer requirements.

A given product may utilise any combination of the nodes in the network for its ultimate production. Nodes will be allocated depending on their core competency, and availability.

Exceptional capacity free of encumbering capital investment, and overhead losses.

Each node provides and utilises equipment that is specific to its core competency. This removes the requirement for equipment that is not related to the business core competency, as this will be contained in

other nodes. Higher manufacturing capability with significantly lower capital investment is a major asset of the holonic network.

Customer acceptance

Customers of the network will become accustomed to the short lead times, flexibility, enhanced capacity it provides. A supplier having these advantages will keep their customer base, and make it hard for entry by competitors. (McHugh, 1995)

The association with a holonic network may not account for the entire customer base, or production output of each holon. This is an important aspect, as the holon does not depend upon the network for its revenue, nor is its capacity totally dedicated to network activity. Network members continue developing their business, product capability, and internal systems and procedures. They bring this continued improvement in their core business to the network further improving its capability.

Equally important is the ability of the network to dynamically configure itself to meet the specific requirements for each order. Only those holons with the skills and capacity required will be summoned for each individual order. The holonic network provides the potential to provide a low cost, highly dynamic manufacturing environment. This dynamic behaviour stems from the range of capabilities' resident with holons. This range can be extraordinary compared with even the largest manufacturing organisations, as there is no overhead incurred by having organisations joining the network, yet not participating in the production of specific products. The network as a compilation of individual companies can have a massive capacity available, as the sum of that contributed by all of its' members The management structure of each holon deals with disturbances within its own area, or sphere of influence, without reflecting this disturbance to the rest of the network.

It can be seen that this type of network provides significant potential in the manufacturing arena. The potential for rapid product design, and short customer lead time provides a competitive edge in any product area. This potential is especially true when dealing with emerging technology where rapid development and deployment of products to the market place must be achieved for competitive advantage.

NETWORK CONFIGURATIONS

The network of business enterprises can be configured in several different ways. Some possible configurations are:

Vertical Network

This arrangement closely resembles a customer-supplier relationship. Each node in the network supplies the node above it, with each adding value in turn.

Horizontal Network

This is a grouping in which all nodes have the same fundamental capabilities, and form the network to share capacity. Horizontal networks often form within industries, allowing large orders to be met when one supplier does not have the required capacity to meet the customer requirements.

Regional Network

Formed from groups of small companies, each having developed a defined speciality. These companies are often close geographically, each node adding a small but important link to the value chain for the product.

Technology Networks

These networks are partnerships between high technology organisations requiring heavy capital investment in specialised equipment. The network then has extensive, and often unique capability, without the need for capital to penetrate a market or perform new product development. (McHugh, 1995)

The holonic network can be derived from any of these configurations, or a mixture of them as appropriate. For example, a mixture of both Regional and Technology may be fitting for a product that is a combination of very high technology components and other specialised materials or assemblies.

COMMUNICATION BETWEEN HOLONS

The holons within a given network may be geographically disperse. Modern communication systems allow a network to be formed that transcends national boundaries. It is obligatory that holons have communication channels between them that allow instantaneous transfer of information critical to the specification, and design of new or existing products. The types of communication required will include text for normal inter-company communications, high resolution graphics for display of Computer Aided Design (CAD) developed engineering or product drawings, and video conferencing between multiple holons. Requirements exist for video conferencing as there are circumstances when direct interaction between holons will be required, and written communication will not be sufficient. This may be especially true during product design and development periods, tendering, and contract negotiations. The technology to meet these requirements exists today in several forms, including the Internet. The reliability of the channels between the holons must be extremely high. Any degradation of reliability degrades one of the most important characteristics of the network, which is rapid response to customer requirements. Compatibility of communications systems used by each holon must also be guaranteed, especially those that provide international links. It is suggested that dedicated ISDN, or newer faster technology links will be mandatory between the most active holons, while non-dedicated, lower cost links may be more appropriate to those holons who level of network activity is somewhat lower. In all cases, the responsibility for the reliability and compatibility of the channel lies with the individual holon, and should be a factor in his continued acceptance as a network member.

It can be shown that organisation of the holonic network follows some of the established methodologies of communications networks, and that similar protocols can be utilised to manage and control the manufacturing network, as the analogies of the following section demonstrate.

MANAGEMENT OF THE HOLONIC ENTERPRISE

The theoretical holonic network displays significant potential as a viable organisation to be given serious consideration as a practical business enterprise. The concept begins to display flaws when management and administration of the network are considered. Functions such as Sales, Marketing, Accounting and Finance must be performed and managed in any profitable organisation. Functions such a customer support, warranty claims, repairs, goods damaged in transit, and product liability issues in a standard organisation are handled by management at various levels and the administrative arm of the company. The holonic enterprise does not have this structure. There is no general management tier sitting above those holons that provide the manufacturing functionality for the enterprise. This lack of administration and management structure also fails to provide a most important function within the enterprise, and that is a contact for the customer. When describing the holonic network to a colleague, he responded by asking “to whom do you give the order?” The question is a leading one, and graphically points out the weakness of the theoretical model.

This weakness can be overcome in three distinct ways - each having unique advantages and disadvantages. The following three models describe approaches to management of a networked enterprise which can be adapted to the requirements of any collaboration of companies.

THE "SUPER HOLON" MODEL

In the first of the methods to be proposed and discussed, the holonic network does have an actual management & administration organisation as one holon within the network. This "super holon", for lack of a better term, performs all necessary administration functions such as marketing, sales, accounts receivable, capacity management, and distribution of work to each of the other holons. The super holon organisation becomes a single point of contact for customers. When an order is received, the super holon analyses the order, co-ordinates detail design, work flow, quality and test specifications, and distributes assignments to each of the holons involved in the order. The super holon then steps back, letting the manufacturing holons communicate directly with each other as necessary. Prior to releasing the work to the manufacturing nodes, flow chart of the work to be performed, routing sheet, test procedure(s), and quality specification(s) is sent to all holons involved with this order. As the order reaches the completion stage, it once again steps forward to administrate the shipment, invoicing, accounts receivable, distribution of value added funds to the holons involved, and onward product support functions. In this model, there is one central functional group that customers have contact with, while the engineering, production and test functions are distributed.

The communications requirements for this model would be best served by two functional networks. The first requirement is for a series of channels tying the super holon to each of the other network members. The super holon emulates the Master, and the other network nodes emulate the slaves. It can be predicted that traffic to and from the super holon will comprise approximately 90% of the total traffic between all nodes and thus these channels must be dedicated, high speed and reliable. A second requirement for this model is the ability for each node to be able to communicate with any other node. This requirement is met by means of an open architecture network, which can be lower speed, and potentially non-dedicated. Network nodes whose involvement is low level or sporadic may choose to avoid the expense of a dedicated channel, and may utilise dial up connections, or simply pass traffic to the super holon for retransmission to the intended receiver.

THE PROJECT MANAGEMENT MODEL

In a second proposed method, the holonic network functions as if each individual customer order was a project. For each order, one of the holons becomes the "Project Manager." The organisation that takes this role may have significant expertise in the particular product, may have the majority of the required manufacturing capability, or may simply have the available capacity at the time the order was placed. This holon then assumes the necessary management, and administration functions as required for that particular order, for that particular customer. When the order is completed and shipped, the project is considered completed, and the holon is relieved of the status of Project Manager. This holon becomes the single point of focus for customer contact for that order, while in this model it is possible that the customer contact will change for different products and depending on current capacity available, possibly for the same product on succeeding orders.

An interesting question in this model is who does the customer contact initially, and who is responsible for ongoing support of the product, if necessary. The model thus requires that there be network nodes that whose network function is to provide marketing, sales, financial and other administrative services. The "management" of the enterprise in this model is a distributed function, provided by several holons, rather than the single node of the previous model. Obviously the advantages of this arrangement are similar to those developed for the network itself, having each node promote its core competence, and bring highly developed, specialised functionality to the network. The disadvantage is the potential prerequisite for greatly increased systems and procedures to define each nodes functional, administrative and financial involvement and benefits.

A negative aspect of this model is the requirement that all holons have the necessary administrative and managerial expertise and proficiency for the Project Management role. Some of the smaller, highly specialised manufacturing companies in the network may not have either the propensity or the desire to assume the role of manager and administrator, and necessary personnel and skills could lower the overall performance of the network.

The communications network analogy to this model is that of a system having no dedicated host or master, and no slave stations. In this system any station can become the Master, and then send traffic to any other station on the network. In practice, each station senses the absence of traffic on the line, takes' control of the network, establishes contact with the receiver, and sends its traffic. After completion of the message, control of the line is relinquished. The

totally open communications architecture is deemed most appropriate. Traffic flows to each node will be heavy during the periods that they assume the Project Manager role, and are expected to be lighter when that role is relinquished.

THE DISTRIBUTED MANAGEMENT MODEL

In their book, "Beyond Business Process Reengineering… Towards the Holonic Enterprise" McHugh, Merli, and Wheeler talk about a series of holons in the network, each having an individual management or administration function. (McHugh, 1995) For example, Federal Express is referred to as a holon in the network which handles all shipping functions for all other holons, and American Express as having the financial management and accounting functions for the entire network. American Express will disperse funds to each holon as their value added component of the work is completed, invoice the customer and perform the accounts receivable function. The distribution of work and sequence of operations is carried within a routing sheet, developed by an administrative or design function within the network, similar to standard manufacturing situations. This model more closely fits the theoretical aspects of a holonic network, with all functions being distributed. While lacking an apparent single point of focus for customer contact, this arrangement would mandate that one of the holons act as the sales and marketing arm of the network. In this model the network agreement would have to be carefully worked out to provide after sales support, the warranty and repair functions for each product produced.

The communications analogy for this system is also that of a network with totally open architecture, where any station or node is free to communicate with any other station on the network at any time, subject only to the constraints of network loading. It is hardest to predict traffic patterns and loading in this system, having the greatest distribution of functions of the three proposed models. It is clear that traffic will be greatest between those nodes that provide functions common to all products and orders, such as the financial and administration nodes. Each of the models presented has the potential for successful implementation., with each containing advantages and limitations.

Models 1 and 3 lend themselves to product lines in which there are is a high level of standardisation with the product range. An example of this might be a network producing products as sophisticated as integrated circuits or as standard as shoes In this mode the work to be performed by each active holon is well defined.

The Project Manager Model lends itself to organisations producing totally dissimilar products for each customer, i.e. an engineering job shop. The Project Manager can be chosen as the node best suited to control the particular design and manufacture required by the customer. This model does not favour the standard product with a variety of options as well as the first and third models presented.

The technology network clearly lends itself to this model, with that node possessing the high technology capability assuming the project manager role for that product. An example might be a company which has very specialised manufacturing capability, such as electron beam welding or water jet cutting, but which provides job shop services rather than dedication to a specific product.

The first model presented places all the administration functionality in a single organisation; the super holon or administrative/network manager. A single organisation may fail to provide and maintain core competency in each of the areas of accounting, finance, marketing, sales, distribution and other administrative functions. Dispersing this diverse functionality to specialist organisations has the potential to provide improved performance, while increased communication between nodes will be required.

The second model asks each node to have both administrative and managerial expertise as well as maintaining its core competency. In this case we are again are diluting the requirement of the node organisation to maintain its strong area of competency and assume the role of manager and administrator. Not all holons will have either the interest or expertise to deal successfully with other nodes, and with network customers. In this model, a node could chose to become the project manager, accept the task if requested by another node, or decline.

The third model distributes the management and administrative tasks among several nodes, each maintaining its' singular field of expertise. Organisations whose competency is in distribution and transportation handle only that task, while the accounting function is handled by a specialist in that area. The negative aspect of this model is the point of contact for the customer. As with many organisations, the sales and marketing arm will pay strict attention to the customer and his requirement and expectations until the order is placed. At that point the sales organisation loses interest, and concentrates on its next potential order. A focal point for the customer needs to be maintained during the design, manufacture and distribution process. It would appear that the tasks to be performed are so thoroughly

distributed that a single point of focus for the customer is missing. It is the opinion of the author that this model will impose greater requirements for communication between nodes. This is simply because there are more nodes involved in each item being shipped due to the distribution of administration functions. Well defined administrative systems and procedures, that are accepted by all companies in the network will be required to maintain smooth work flows, orderly transaction management, and cash flows.

AGREEMENTS AND CULTURE WITHIN THE HOLONIC NETWORK

In Australia, research into 60 business networks has shown that 50% of the groups had completed a formal agreement. (Holmes, 1997) Larger, and more complex networks require a contractual arrangement, while all networks surveyed containing 10 members or more did have an agreement in place. It was also shown that networks were fluid, as over half (51%) having had membership changes during the period they were in operation. The survey also revealed some interesting characteristics regarding trust between the network members. In the networks which were organised with a simple hand shake arrangement, there was a higher degree of trust between members, and a larger degree of frequent communication. The most popular type of agreement (44%) shown by this survey was that generated by an interactive meeting between prospective partners completed during the early stages of network operation. (Holmes, 1997)

Priority issues for network members were decision sharing, and management /supervisory systems. Goals for the network, benchmarking, and quality assurance were given lower priorities by networked companies in this survey.

An interesting aspect of the network relationship developed by Holmes et al is that of trust between network partners. The networked business produces complex relationships and associations outside those of a formal chain of command. In the three models suggested there is no chain of command present in the completely flat organisation structure. Trust, as measured and defined by Butler (1991) contained a series of factors: availability, competence, consistency, discreteness, fairness, integrity, loyalty, openness, and promise fulfilment. It appears from the work in Australia that higher levels of trust appeared in those networks in which a formal agreement was present. It might be interpreted then, that the presence of the legal agreement was the basis for the trust, in that there was a contract in place which could be used as an enforcement tool.

Work by Ring and Van de Ven (1994) suggest that the formal agreement is modified over time by, and replaced by social and psychological relationships. They suggest that supplementing the formal agreement does not necessarily indicate a lower level of trust in the network, but can suggest a maturation process as the companies develop both business and social interactions over time.

The holonic network, and those companies that form nodes within it, are singularly characterised by flexibility, speed of response, and creativity. The relationships formed within a holonic network require that managerial decisions are often delegated to operational personnel and removed from top management. Many corporate leaders and CEOs operate from a base of keeping control of all aspects of the companies functions. It is not comfortable to become part of a larger organisation with its implied loss of control. In addition, it is common for managers to have the perception that other companies work is somewhat inferior, and to harbour an innate distrust of work performed outside their area of authority. This distrust and need to keep control within the companies boundaries disperses the companies focus on core competencies, increases the need for equipment and personnel, and therefore increases overhead . (McHugh, 1995)

The appropriate culture for nodes within the network, which will be reflected to the customers of the network, is totally entrepreneurial. The willingness to make quick decisions, not crunch numbers excessively, and maintain openness to new concepts will be mandatory. Management of individual nodes reflects the character of the network, which is focused on the process rather than by form or function. In fact, in two of the models suggested, the super holon and distributed management models, management is simply another node within the network, rather than an authoritarian group sitting on top of functional groups imposing full dominance on their daily activities. Thus the culture of the holonic network is to accept new challenges, seek opportunities, create technical expertise, and in general perform in a manner that can be described as innovative and entrepreneurial.

REQUIREMENT FOR SYSTEMS AND PROCEDURES

The ultimate success of the holonic enterprise will be determined by how well the functionality of the network is implemented. A loose association of organisations, no matter how competent each may be, will be prone to chaos when faced with a series of demanding customers. A group of systems and procedures that are agreed upon by all companies operating within the network will be required to resolve potential chaos. These systems and procedures provide a means of allowing the administration and management of the holonic organisation to be accomplished in a consistent manner, that will be in the best interest of all nodes. The application of documented administrative systems and procedures will allow any node to participate in an administration role without the need to "reinvent the wheel." The intent of these systems and procedures is not to reduce the autonomy and independence of network nodes. Instead they serve the purpose of tying the network together into a well co-ordinated, operational unit. Each node retains its' independence with regard to how it operates, and whether it chooses to participate in network activities at all.

The systems envisaged are primarily those which define the scope of work for each node in the holon after an order is received. Customer order definition, acceptance of specifications, acceptance of terms and conditions, agreement on quoted price and schedule must be clearly agreed to prior to order acceptance. Standardised methods for "holding meetings" and obtaining consent to proceed with the order must be in place for the network to function properly. The greater the distribution of the work among nodes for a customer, the greater the need for systems and procedures to be in place.

The requirement for administrative systems and procedures will be particularly important in the Project Management, and distributed management models discussed. As in any well managed organisation the application of consistency to the decision making process smoothes the humps in the road to higher profits.

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INFORMATION SYSTEMS INFRASTRUCTURE: A FACILITATOR OR CALCIFIER?

Kenneth E. Knight, Seattle Pacific University
Kknight@spu.edu
Barbara E Popovsky, Seattle Pacific University
Endicott@gte.net

ABSTRACT

Increased global competition forces speed and flexibility into our organizations. Today it is extremely important that robust and scalable strategies be developed for both organizing data in databases and for establishing the infrastructure to allow ease of information sharing.

Current data and information in functionally-structured organizations are exchanged through systems organized, owned and maintained by these same functional silos. Cross-functional structures are being introduced to meet the needs of today's complex products and services. These structures mean the elimination of layers of management, the need to speed new products and services to the market place, and a growing emphasis on teaming. All of these changes are being implemented to increase the efficiency and effectiveness of organizations. Each of these required that data and information be exchanged horizontally as well as vertically.

The very systems that 20 years ago allowed for increased profitability, by automating labor intensive functions, are now perceived by many as the organization calcifiers that impede new management initiatives. These functionally-structured information systems inhibit cooperation and teaming across disciplines and obstruct decision making in the organization.

INTRODUCTION

The insights for this article come from a major corporation's productivity improvement program in the early 1990's. Manufacturing Business Unit was created and implemented to develop a world class production system and business processes.

In support of the Company's strategies, the Manufacturing Business Unit (MBU) developed a multifunctional, collocated organization, implemented a new accounting system, a new production information system and within the MBU integrated new production and business processes.

It is the purpose of this paper to put the achievements of the Manufacturing Business Unit into perspective by stepping back to analyze the results objectively, assuming the vantage point of senior executives attempting to deploy results across the entire company. Having observed the impacts of creating MBU's from larger siloed organizations, a number of key areas call for further exploration as reengineering is considered by many companies.

The architects of the MBU drafted the original documentation establishing a process-driven MBU. This implied that all of the functions required to manage that MBU will be collocated under a single manager. In addition, decision making was driven to the lowest levels, eliminating the need for excessive layers of management.

Establishing Manufacturing Business Units (MBUs) is not a unique concept and has been accomplished at other companies. Many of these companies have been functionally siloed like the Company is this study. Collocation and downsizing management are hallmarks of these efforts.

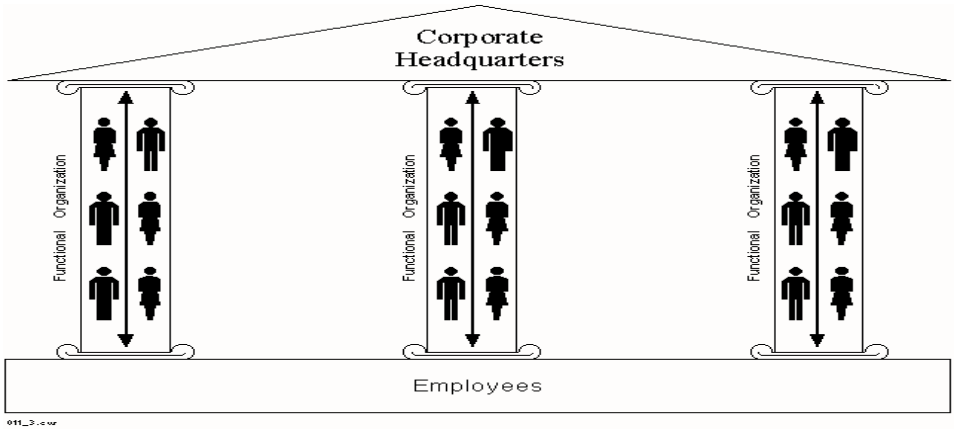
Following their MBU experiment, they are now approaching the next step: to move these ideas and experiences into the mainstream of their company as appropriate.

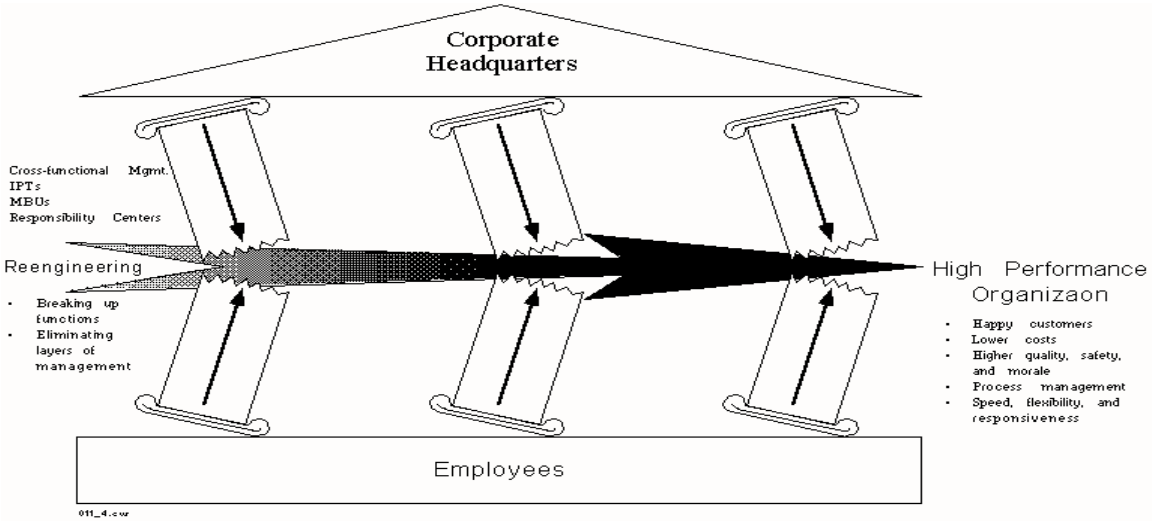
As the MBU experience revealed, properly supporting the resulting process-driven organizations is no easy task. However, the efforts can be enhanced by focusing on two critical elements: the impacts on information flows, and the impacts on people.

IMPACTS ON INFORMATION FLOWS

As indicated in the graphic that follows, in hierarchical organizations information flows vertically through functional "stove pipes." Cross-functional exchange of information primarily occurs at the highest levels of such a company. For purposes of this discussion, information flow is intended to include the deployment of corporate policy; broadcast of information of general interest to all employees--i.e. company newsletters, bulletins, etc.; relaying of assignments and daily work instructions, and corporate procedures; as well as the delivery of facts and data necessary to accomplish work. Infrastructure to support the flow of information - cascading staff meetings, training structures, or computer information systems - is structured along hierarchical functional lines.

Figure 1. Information Flow in Siloed Organizations





Collocation of employees, their transfer into MBU's, and reduction in the layers of management are all imperatives of the new Company we are trying to create. The design includes a cross-functional, teaming environment. However, the reengineering disrupts established information flows as employees are cut loose from their usual lines of communications.

Recognition that this disruption will occur and appreciation for the consequences to both the success of reengineering and the simultaneous conduct of daily work activities leads the authors to make the following observations and to recommend incorporating the following strategies into the design of MBU's.

THE ORGANIZATION A NETWORK FOR INFORMATION EXCHANGE

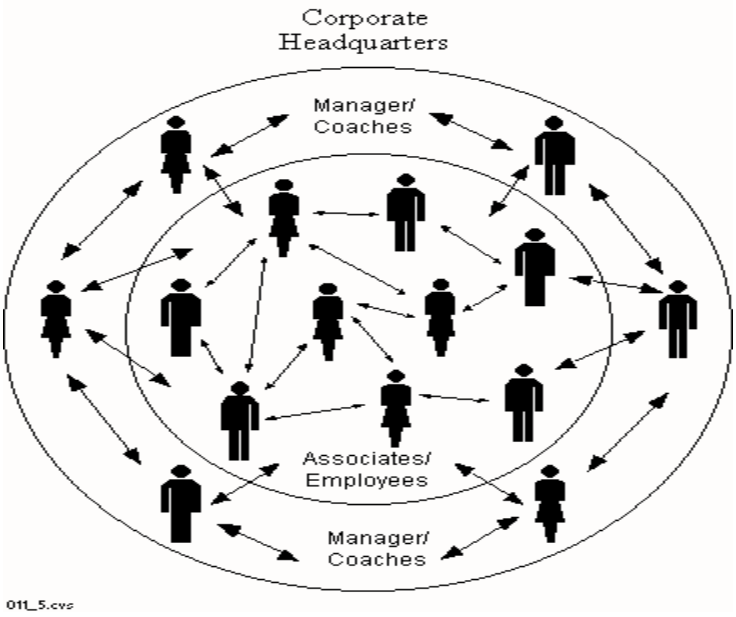
The goal of reengineering is to create a high performance organization, characterized by speed and flexibility; lower costs; higher quality; safety and morale; process management; empowered employees; and satisfied customers.

The high performance organization design created in this MBU collocated, and assigned-in, all of the appropriate functions required to successfully run a business. Management functioned as coaches, i.e., trainers, advisors, road-block eliminators, while employee associates took on greater responsibility for getting work done.

Freed from their functional silos, expected to function as entrepreneurs in this new environment, employees and managers required rich information exchange to make decisions and to accomplish work.

Viewing a stand alone Manufacturing Business Unit (MBU) as an information exchange network, each employee then becomes a "node" in the network.

Figure 3. Information Flow in Cross-Functional Environment



Statistically, the number of possible one-on-one exchanges that can occur in a network is a function of the square of the nodes. This means that as the number of nodes increases information exchange complexity increases geometrically. In the old structure, management served as network nodes, disbursing information downward to their employees. Now we have dramatically increased the numbers of those nodes by flattening the organization and empowering people. Information exchange occurs everywhere at once on--a myriad of subjects in a variety of ways.

Thus internal communications in MBU's becomes complex compared to functional organizations. Several additional factors serve to further compound the difficulties implied by this complexity.

Cross Functional Isolation: Traditionally, functional organizations have not come together, except at the highest levels. Rarely do employees have the opportunities to learn how to work with one another cross functionally, nor do they have the opportunities to learn the value of each other's disciplines. The result is that they have a limited understanding of the nature of each other's work and a limited knowledge of the requirements each function has to get its work done.

Examples occurred in our MBU "experiment". Too often the exactness of Finance employees resulted in " bean counter" label. Likewise, the schedule-driven nature of Facilities employees earned them descriptions of "heel-draggers" because they could not respond immediately to emergent requests for change to the things in the environment that bothered employees the most--their desks, their chairs, their phone hookups.

In order to team effectively and to gain trust and respect, these groups needed to understand the value each had in producing the business's product. This took time, meanwhile blocking effective information exchange, thus interfering with getting daily work accomplished.

Observation: Isolated functional organizations do not know how to talk to one another or how to value one another.

Recommendation: Create a program to develop cross-functional business literacy to ensure that all relevant information required for good decision making is available and used by empowered employees.

In addition, barriers between functions help create specialized languages that impede understanding. As an example, in the MBU six different definitions of "PC" were discovered. To computer people, it meant "personal computer", but to those from a Material function, it meant "purchase contract" or "part-card."

The need for a common language was partially addressed through accelerating training for everyone. At the time, it was not realized the extent of the functional differences in jargon.

One telling confrontation occurred when a manager told another he needed an "intervention" in his group. To the initiating manager, with a human resources background, "intervention" had a specific organizational development meaning associated with breaking up destructive behavior patterns in a work group. To the Manufacturing manager, an "intervention" meant being "taken behind the woodshed" for a 'serious talking-to" followed by possible removal from responsibilities. His ability to hear the rest of the conversation stopped when he heard the term "intervention." The balance of the meeting was spent untangling the miscommunication. This was not an isolated incident; similar situations arose often.

Observation: Isolated functional organizations develop their own jargon, further inhibiting communication.

Recommendations: Develop a common language through training that introduces new vocabulary.

Effects of Flattening the Management Structure: Not only are we isolated vertically by function, we are also isolated horizontally by rank. Therefore, it is important to understand that simply eliminating layers of management is not enough. Over time, different layers of the organization develop different styles and different ways of doing work.

The traditional structure supports, and often demands, that upward and downward filtering of information occurs. This is the bureaucracy effect reengineering is designed to eliminate. As a byproduct of reengineering, members of the existing hierarchy are suddenly thrust into contact with members from other management layers. This occurs throughout the organization.

However, there is a danger in simply eliminating the "interpreting function" often performed by middle management. Often, this is where the critical knowledge of how work gets done resides and this is the translating function converting policy into work tasks.

The authors observed instances of distortion of information as newly elevated managers attempted to hear and understand instructions of managers functioning at levels higher than those with whom they were accustomed to dealing. Both levels of management assumed knowledge that each expected the other to have. Lower management assumed knowledge of detail factory floor experience; higher management assumed a level of experience, judgment,

sophistication, and business literacy lower level management did not have. New bridges need to be built between the two to ensure proper transfer of information.

Observation: We are siloed horizontally by reporting levels, as well as vertically by function.

Recommendation: Be alert to distortions in communication created by the elimination of management layers.

Effects of Empowerment: As a term, "empowerment" can be defined over a broad spectrum, thus generating a multitude of expectations. In the MBU, creation of an empowered workforce was one of the prime initiatives. However, the exact manifestation of empowerment was never defined in terms of specific behaviors--either by managers or by employees.

In the extreme, some associates defined empowerment as granting unlimited control to the workforce. The author observed managers abrogating responsibility to workers, and workers interpreting appropriate management direction as intrusive. This created unanticipated difficulties, compounded by the collocation of hourly and salaried payrolls that traditionally are managed under radically different rules.

Without a framework of accountability, without guidelines, without a circumscribed structure, employees freely interpreted empowerment (often to meet their personal needs). There was a rush on the part of hourly employees to gain the perceived freedoms granted their salaried associates, particularly since they were told from the outset that all associates were equal.

An example was the area of timekeeping. Hourly employees, accustomed to a stringent method of accounting for their time, suddenly were given the freedom to be personally responsible for putting in their 8-hour shifts. No training was given them to prepare for this responsibility. Some could handle it; others took apparent advantage.

Observation: Empowerment without clearly defined responsibilities and accountability can lead to abuses. This is unfair to both the employees and the company.

Recommendations: When introducing empowerment, care must to be taken to establish limits, boundaries, guidelines and clear lines of responsibility and accountability. This is particularly important when collocating hourly and salary payrolls.

IMPACTS UPON PEOPLE

In addition to impacts on information flows, reengineering affected people in the organization in a variety of unexpected ways.

The chart that follows maps our Manufacturing Business Unit's performance managing its "people" resource against the characteristics of a high performance organization.

CHARACTERISTIC	DISCUSSION	MBU RESULTS
1) People are trusted.	Management sets the tone for trust. Trust is the cornerstone of the new work cultures. It takes time to build. It requires constant commitment to keeping your word. The MBU did not devote a lot of time to gaining commitment and trust up-front. Some managers were better at this than others. Training of managers may be required.	Mixed environment due to a range of management styles.
2) People are self-directed.	Some were "at sea" or abused the independence they were given. Traditionally, employees were trained to follow orders. Self-directed people must be entrepreneurial. To shift them to becoming initiators requires a change of mindset. Managers were trained to become coaches. Likewise, the employees needed training to become good subordinates in the new environment.	Mixture of results dependent upon individual employee mindset.

CHARACTERISTIC	DISCUSSION	MBU RESULTS
3) Leadership is shared	Some managers had more difficulty that other trusting employees to do good work without constant oversight. Some confused shared leadership with abrogation of responsibility as they abandoned more directive styles of managing people.	Present in some cases, based on degree of trust among employees and management.
4) People work enthusiastically.	In a reengineering environment, people are being asked willingly to work themselves out of their job for the good of the Company. In a downturn, that is difficult to sell. The MBU needed to take more time to bring more people aboard the team.	Mixed environment from enthusiasm to extremely poor morale.
5) Communication is open, honest and pervasive.	The MBU learned that information flow is disrupted by breaking up silos and lowering management chains. In this environment, communications requirements grow geometrically. Management, in many cases, was not accustomed to their expanded communication responsibilities.	Attempts were made and the results were mixed. A view remains the environment is not threat-free.
6) People understand expectations.	One MBU trained everyone to help employees understand the direction of the company. Systems and metrics need to be developed that convert policy to practice so that each employee knows exactly what to do. And these need to be agreed upon across all MBU's to ensure consistency of interpretation of results.	At the theory level, yes. At the task level, not always.
7) People are accountable.	Some managers and employees confused accountability with the old Theory X environment. While some of the old accounting methods and enforcement techniques may not be desirable today, some means of tracking performance needs to be in place. Training is needed in overall business literacy.	Experimented with new approaches to accountability. No systems or metrics in place yet.
8) People are acquired, developed, rewarded, and recognized for skill and team performance.	Many of the "people" systems are company-wide and do not reinforce the new environment and behaviors being created. One MBU ran into many roadblocks in this area. This hampered some of their efforts.	Limited by Company corporate systems.
9) People are multiskilled, multifunctional, and diverse.	In this large company, such people are hard to find. As a result, collocated functions, unfamiliar with each other, had great difficulty working together. They lacked mutual understanding and respect, creating organizational and individual conflict. The management team was not able to take advantage of the available talent in areas where they lacked expertise. It was discovered how perfectly siloed the organization was, even in their jargon. Training, exposure to other disciplines, learning how to learn, and general business literacy were needed. Also union contractual issues were beginning to slow down process improvement.	Limited to what is available within the Company and by union contacts.
10) Learning is continuous.	One MBU created a training-rich environment that included formal training, OJT, JIT training created internally, lunchtime & off-hours learning experiences. It appeared that much training was required to get employees aboard. Work done here was useful to future MBU's.	Excellent learning structure created and evolved. Should be a Company model.

Having observed the reactions of people to change instituted in these MBU's, the following recommendations were made:

General Business Literacy: Employees empowered to make decisions for a corporation need to have a level of business literacy that ensures good judgment across all functional areas included in their business unit. If they themselves do not have the requisite knowledge to make an informed decision, they need to have sufficient respect and understanding of a wide variety of disciplines to know to ask for input and know who to ask.

Training in business literacy across the functions found in an MBU should be provided both to management and employees. The complexities of doing business today expose the Company to legal liabilities in ways not clearly understood by lower levels of management isolated from that knowledge in functional silos.

In addition, to ensure commitment, employees need to believe their MBU manager, although not always from their functional home, knows enough about their work and the value of their specialty to be able to use those skills wisely. They need to be assured of receiving fair evaluations for ranking and raises, and that someone is committed to developing and nurturing their growth. These employee concerns were expressed liberally in one of the MBU's.

Training to Become a Good Subordinate: Employees need to be taught how to work in these new environments. While attention was focused on training managers to become good coaches, more needed to be done to teach employees to become good subordinates. The new culture sought required employees be entrepreneurial. With experimentation allowing employees to self-manage, some employees were unable to adjust to the increased responsibility. More preparation could have been done.

While various course offerings addressed the need to improve manager's skills, similar offerings were needed for employees. In addition to helping them step up to increased responsibility, they also needed to be helped to change their perceptions about their work. Many identified with their specific jobs, appreciating themselves as skilled craftspeople. Feeling ownership of their jobs was good; being unwilling to step back critically to change processes or to work their specific job out of existence was understandably difficult for many. Employees need to see themselves as self-employed in the new environment, responsible for keeping their skills current and themselves relevant to their company.

Understanding the Differences between Shared Leadership and Abrogation of Responsibility: Some managers mistook the subtleties of shared leadership and empowerment to mean backing away from responsibility to become totally hands-off with employees.

Some employees took empowerment to mean they were totally in charge. Little, if any, of the training materials clarified responsibilities for both groups to accompany the expression of entitlements.

This lack of clarification reflected an important missing piece in the MBU training effort. The dramatic shift in employee mindset required by the concepts of shared leadership and empowerment cannot be left to individual interpretation. To facilitate their change effectively requires a comprehensive training approach. This approach must be direct to all employees--coaches and associates alike--and must address the relevant issues surrounding such a significant change in the workplace.

Support for Creating a Learning Environment: Although there were some missing pieces to the training effort, the MBU's were very successful in creating a learning-rich environment which could be modeled elsewhere. Management provided support and encouragement for a wide variety of training vehicles, including on-the-job training, lunchtime and off-hour sessions, as well as Just-In-Time (JIT) classes that were self-administered. The number of changes attempted in these MBUs required a significant commitment to employee re-education and a lot of reinforcement. Once was not enough.

CONCLUSION

At the onset, it appeared a reasonable expectation that focusing on processes, first, would drive out the use of information technology and the accompanying deployment of people. Although this approach resulted in a number of successes, the magnitude of those successes often was limited by the unanticipated impacts on both information flows and people.

CERTIFICATION OF INFORMATION SYSTEMS PROFESSIONALS: CURRENT TRENDS

Sheila Collins, AFLAC
SheilaEC@MSN.com
Charlotte Stephens, Columbus State University
Stephens_Charlotte@colstate.edu

ABSTRACT

Historical and current trends in IS certification are presented, as well as different approaches to training for certification. Benefits to the individual and employing organization are discussed.

INTRODUCTION

Historically, professional organizations have provided certification for information systems professions. The group now called the Association for Information Technology Professionals (AITP) was first established in 1951 and called the Machine Accountants Association (MAA). It became the National Machine Accountants Association (NMAA) in 1952 and in 1960, began offering Certificates in Data Processing (CDP). The first CDP exams were held in 1962 in New York (AITP, 1997). In the same year, the organization changed its name to Data Processing Management Association (DPMA), which established the Institute for Certification of Computer Professionals (ICCP) to "stimulate more widespread interest and industry acceptance of the examinations"(AITP, 1997,1).

Since 1962, the number of certification programs for information systems professionals has increased, yet certification still does not have the widespread acceptance of accounting certification. However, the current benefits of certification, particularly vendor specific certifications, are providing an incentive for more wide spread certification and the incorporation of certification into university MIS and computer science curriculums. Newer certification programs sponsored by software vendors are currently having a major impact on entry salaries, professional marketability, and both the availability and price for contract work. Delivery methods of certification instruction have also changed with classroom-based instruction being supplemented by or replaced with multimedia self-directed instruction.

Benefits of certification, current popular certifications, and the steps for obtaining these certifications along with innovative methods for obtaining certification will be presented. Tangible and intangible benefits will be described for the employee and the company which employs certified professionals.

Historically, three approaches have been used for certification training: vendor neutral but conducted for profit, vendor-neutral sponsored and created by a nonprofit associations, and vendor-specific, the newest trend (Leinfuss, 1997). "Vendor -neutral certification shows a level of professionalism and a broad knowledge as opposed to vendor- specific views of the world" (Leinfuss, 1997,2), says Linda Taylor, an ICCP board member. However, two of the three most popular certifications today are vendor specific (WaveSource, 1997). One is offered by Microsoft and the other by Novell. Both Microsoft and Novell certifications will be presented. Vendor-neutral certifications presented include those from ICCP and A+ Certification.

Historically, the traditional classroom with instructor delivery method was predominant. Newer methods, employing multimedia self-directed instruction via CD- ROM, an intranet, or the Internet, are becoming more available. The approach and future plans of one such certification training provider, the National Education Training Group (NETG), will be presented. This company has an aggressive plan to incorporate its materials into the MIS and computer science curriculums in higher education, as well as the corporate market where it is currently successful. Finally, recertification for vendor- specific programs is a major issue since continuous modification to software necessitates continuous recertification.

BENEFITS OF CERTIFICATION

Certification has tangible and intangible benefits for both the individual who gains certification and for the company which employs certified professionals. The biggest benefit for both the individual and the company he/she works for is monetary. The certified individual gains access to new and advanced career opportunities. Increased earnings will follow this advancement within the chosen area of certification. An individual can expect to make up to $7,000 more annually than a non-certified individual. This continuing wage increase compensates one for the one-time cost of the training, which can $8,000 (Wave Technologies, 1997, 1). The maximum benefit of a particular certification is reached when the chosen career directly relates to the certification.

Furthermore, an individual can gain several other promising benefits through certification. According to a survey done by the Applied Experimental Psychology Group of Southern Illinois University at Carbondale, supervisors of solution developers considered Microsoft Certified Solution developers more competent than non-certified solution developers with the same company (Microsoft, 1997). Most certified employees are considered an expert in their field. Certification makes it possible for one to be an expert without ever attending college, although college credits can be earned. Some training companies, like NETG, offer college credit during the certification process. This credit benefits an employee who works for a company that offers tuition reimbursement. The certified individual also receives perks from the vendor or association that offers the certification. The large vendors usually offer more benefits than small vendors or associations. Vendors and associations allow the certified individuals to use their logo with the certification earned noted, for use on business cards, stationery, and résumés. Vendors provide certified individuals with free or discounted technical support. The vendor notifies the certified individual of updates to the certification as well as new technology through exclusive web sites and seminars. Some vendors and associations offer free or discounted technical magazine subscriptions, free new software, and communication devices for certified individuals to converse with their peers (Microsoft, 1997, Novell, 1997).

On the other hand, certification also benefits the company that employs the professional. The company can save large amounts of money due to the certified individual being more competent in the specified job area and the reduction of downtime and overall support costs. According to a survey of 253 information system managers, conducted by the International Data Corporation (IDC), the dollars saved through increased network availability and help-desk efficiency quickly surpassed the costs associated with certification (Leinfuss, 1997, 1). Certified employees tend to perform better than non-certified employees (New Horizon, 1997). A study done by Dataquest, the San Jose, CA, research wing of Dun and Bradstreet, indicates that managers feel that certified employees provide higher levels of service, learn new technologies faster and are generally more productive (Filipczak, 1995, 2).

Even if the employer pays for the training, the company can expect a return on investment within nine months (Filipczak, 1995, 1). Novell has developed a program that calculates an estimated return on investment a company will receive by increasing the number of Certifed Novell Engineers (CNEs) on the network support staff. This Windows-based program, called Novell Authorized CNE advisor, prompts the manager to enter various information about the company. The result is a report that graphically shows the estimated savings produced by increasing the number of CNEs on staff. The program uses a series of formulas, based on research by International Data Corporation and Strategic Research Corporation, to determine results (Brown, 1996).

CURRENT POPULAR CERTIFICATIONS

Current popular certifications of two nonprofit information technology associations and two software vendors will be discussed. The first nonprofit association discussed is the ICCP, which offers two certifications. The Certification for Computing Professionals (CCP) and the Associate Computer Professionals (ACP). CompTIA offers the vendor-neutral A+ Certification. The vendor-specific certifications discussed are sponsored by Microsoft and Novell. Microsoft is offering Microsoft Certified Systems Engineer (MCSE), Microsoft Certified Solutions Developer (MCSD), and Microsoft Certified Product Specialist (MCPS). Novell is offering Certified Novell Engineer (CNE), Certified Novell Administrator (CNA), and the highest level for Novell, Master Certified Novell Engineer (MCNE). Following is a description of each certification and some details about the vendor or association that sponsors it.

The ICCP is an international nonprofit organization that was established in 1974, by the AITP (AITP, 1997). "The ICCP's mission is to define the common body of knowledge for the computing industry," says ICCP Executive

Director, Perry Anthony (Leinfuss, 1997, 2). The ICCP offers two vendor-neutral certifications, one for the entry-level professional and one for the professional with at least four years experience in the information technology field (ICCP,1997). The ACP is the certification for entry-level professionals. These professional must pass one core exam that demonstrates a broad understanding of systems and one of six language exams (ICCP, 1997). The CCP is much more intense and is intended for senior level personnel. An individual must pass a core exam and two specialty exams, plus have at least four years of full-time experience in the information technology field (ICCP,1997). The core exam covers the basic topics of the information technology profession: management, interpersonal communication, systems types and applications, data management and architecture, systems development, hardware and software, financial management, and statistics (ICCP, 1997, 5-6). The specialty exams are similar, but much more in depth. One may complete the exams at anytime but the certification will only be issued once one has completed the four years of experience in the information technology field. There are approximately 50,000 CCPs worldwide (ICCP, 1997, 16).

CompTIA , which has offered the vendor-neutral A+ certification since July, 1993, is a nonprofit international trade association of close to 6150 members (CompTIA, 1996,3). The A+ certification is one of the three most popular certifications out today with 37,000 certified technicians to date. (WaveSource, 1997,5). A candidate for the A+ certification must pass a core exam and a specialty exam within ninety days of each other. The core exam covers topics related to a service technician's area of job responsibility: configuring, installing and upgrading microcomputers, repair and preventive maintenance, safety, and interaction with the customer (CompTIA, 1996,6). The candidate must specialize in either Microsoft Windows/DOS or Macintosh. The average income of an individual with an A+ certification is between $25,000 and $35,000 (WaveSource, 1997, 7). Due to the accusations that Novell produced "paper CNEs," individuals who were good at passing tests, but did not have real-world knowledge of the products, Novell has made some improvements. The Novell exams are now more performance-based and the CNE certification is more specialized. The CNE certification is divided into three specialized areas: CNE Netware 4, CNE Netware 4.11, and GroupWare 4 (Nutter, 1996). The first two specialty areas deal with network planning, installation and configuration (Novell, 1997). The GroupWare 4 certification deals the design of the fully integrated messaging system structure (Novell, 1997, 3). All CNEs must pass four target exams, two core exams, and one to two elective exams. A CNE can earn anywhere between $30,000 and $75,000 annually, according to WaveSource (WaveSource, 1997,7). There are approximately 75,000 CNEs worldwide (WaveSource, 1997, 4). The MCNE certifies that one has passed additional training and tests. This certification is also divided into three areas of specialization: Network Management, Infrastructure and Advanced Access, and GroupWare (Nutter, 1996). These individuals are equipped with the skills to deal with complex problems dealing with network protocols and platforms. One can only achieve a MCNE-GroupWare if the individual was previously a CNE-GroupWare (Nutter, 1996). Novell also offers a certification for network administrators, the CNA. This certification guarantees an individual is capable of supporting the products that the CNEs use. The CNA works with both the CNEs and the clients. An individual can build on this certification to become a CNE. The requirements for this certification are to pass one operating system exam (Novell, 1997).

Microsoft certification is on the rise due to the increase of Windows NT. Part of the reason for Windows NT's success is that it is a desktop operating system and a global network operating system, which is less expensive that Novell's network operating system. Novell does not have a desktop operating system (Rothke, 1995,1). It is logical for a company to use the same vendor for both systems, which increases Microsoft Windows NT's chances of success. The most popular Microsoft certification is the MCSE, which qualifies an individual to "effectively plan, implement, maintain, and support information systems with Windows NT and the Microsoft Backoffice integrated family of server software" (NETG-Microsoft, 1997, 2). An individual must pass four operating system exams and two elective exams to achieve this certification (Microsoft, 1997). A MCSE can make up to $70,700 annually (WaveSource,1997, 11). There are approximately 15,000 MCSEs worldwide (WaveSource, 1997, 4). Microsoft offers a certification for solution developers, MCSD, that guarantees one is an expert with "Windows 32-bit architecture, OLE, user interface design and Windows Open Services Architecture components" (NETG-Microsoft, 1997, 4). An individual must pass two core technology exams and two elective exams to obtain this certification (Microsoft, 1997). There are approximately 2,200 MCSDs worldwide (WaveSource, 1997, 4). The last certification is the MCPS, which certifies that on has passed any one operating system exam. The choices are Windows NT, Windows for Workgroups, or

Windows Operating System and Services Architecture (Microsoft, 1997). One can build on this certification and become a MCSD or MCSE.

STEPS TO CERTIFICATION

Planning for certification can make the process easier. The first and most crucial step is to pick the appropriate certification based on one's experiences, interests, and desired career position when completed. Next, an individual must choose which training method will be most effective for him/her. Some people prefer instructor led classes, others prefer self-study, and some prefer a combination of the two. Once the individual decides which method is appropriate, he/she must look for a provider who offers the training materials needed. An authorized provider is one who receives the contents of the material from the vendor and only allows certified trainers to teach at instructor led classes they may offer.

One will be ready for training right after taking a preassessment test, a test that lets the individual see his/her strong areas and weak areas. Some people may be able to skip whole sections of training. Individuals should have "hands-on" experience with the products during training. Training can take anywhere from one to six months (WaveSource, 1997, 6). When an individual feels competent about the material, he/she takes a mastery assessment test. Passing this test does not guarantee a pass on the certification exam, but it does help one become familiar with the testing style. Exams for all the certifications discussed are offered at Sylvan Prometric testing centers. The tests are computer based and one receives test results immediately. If failure occurs, the individual may schedule the test again. Some stipulations may apply, depending on the certification. For example, the A+ certification can be taken thirty days after the failed attempt and only three times a year (CompTIA, 1996,2).

TRAINING METHODS

Currently, a wide variety of certification training materials are available from many companies. The training delivery strategies are instructor led classes, computer-based training, video tapes, self study materials, cassette tapes, and CDs. Distance learning has made the biggest difference in training. No longer is just- in- time training a problem. People can train "anytime, anywhere" (NETG Course Catalog, 1997, VIII). New methods of training will be discussed along with the cost. Training using computer-based multimedia is increasing, according to the increase in revenue for the companies offering these products. NETG, a division of the National Education Corporation, had a two percent increase for the period ending June 30, 1996 compared to the same period in 1995 (IDC, 1996, 3). CBT Group, who is also in the computer based training (CBT) market, had a 66% increase for the period ending June 30, 1996 compared to the same period in 1995 (IDC, 1996, 3). Corporations may want to train their employees, but they can not afford to let them leave the office. Individual studies can be completed using CDs, through a server on an Intranet, or via the Internet. The contents of these training methods can come from the vendor or from the training company itself. Using multimedia self-directed learning aids, the individual can pace him/herself and can review the materials as many times as desired. NETG offers a preassessment test for each module to aid in "Precision Learning", which determines the areas one needs to study and a custom program is designed (NETG Catalog, 1997, XI). The mastery assessment test is a good indicator of how prepared an individual is before taking the real certification exam. These assessment tests are also useful for employers who want to test new hires, claiming to have specified qualifications.

Training costs vary greatly depending on the resources one decides to use. Training for the Microsoft Certified System Engineer exam costs seven thousand dollars when both instructor led classes and CDs are used (New Horizons, 1997, 5). Prices vary with the different vendors. Some may cost a lot less but it may be because they are not an authorized provider, which means the content may not come from the vendors and the trainers are not required to be certified. Some companies offer site licenses for their programs, which would enable a company to use the information delivered via an Intranet or the Internet to train as many employees as feasible during the lease (NETG Course Catalog, 1997).

If one is looking for a new job and is interested in training, one company, WaveSource, trains chosen individuals free of charge. WaveSource requests to place the individual with a company after they are certified and earns fees from placement, usually more than the training charge. The company chooses only people with a high potential to pass the exam, since that is the only way they make their money (WaveSource, 1997).

CERTIFICATION EXAMS

All the certification exams mentioned are administered at Sylvan Prometric testing center. This company is equipped with computer-based test for each certification presented here. Though Sylvan may administer these closed-book tests, each individual vendor or association creates their own exams. The types and number of questions asked, prices of exams, and recertification will be discussed. The A+ certification core exams consist of approximately 70 questions and the specialty exam consists of approximately 50 questions (CompTIA, 1997, 8). These multiple choice questions are situational, traditional, and identification. Situational questions provide a scenario and the choices are the ways to resolve the situation presented. The price of the exam varies, depending on whether one is employed by a member of CompTIA and whether more than one test is taken at a time. The prices range from fifty dollars to one hundred dollars. ICCP exams are also interactive, computer-based exams. These exams cost one hundred and forty-nine dollars each.

Novell and Microsoft offer a more performance-based exam, which tests for real-world experience. These questions can be multiple choice, short answer, or actual performance of a process. For example, a Visual Basic exam may ask an exam taker to write some lines of code. The answers and tasks must be done exactly as the computer indicates. If a capital letter is used instead of a lower case letter the answer will be marked incorrect. The use of authorized providers for training can help an individual to avoid this problem since they will be familiar with the format. Novell exams are eighty-five dollars each and Microsoft exams are one hundred dollars each (WaveSource, 1997, 8). The total cost is determined by how many exams are required for a specific designation, e.g., such as a CNE must take seven exams.

Certifications are periodically updated due to advances and changes in technology. An individual who has already received certification needs to update their certificate within three months of the change. The vendor will notify all certified individuals at the time of the update and most offer a fifty percent discount on the price of the exam. Individuals only need to retake the exams that have been updated, not all the exams for that particular certification. After six months, the individual is considered non-certified if he/she has not taken the updated exam(s). One only has to pass the updated exams to be recertified (Microsoft, 1997). Novell issues a recertification of all CNEs in 1996, due to the improvements made to the program. The CNEs were required to recertify by June 30, 1996, or the certification would be considered void (Tacket, 1996, 1).

CONCLUSION

Many aspects of certification have been presented: benefits, costs, methods of training, current certifications and their sponsors, and the certification exams. The certification process is on going for an individual, one must keep up with updates and changes in technology. Information technology organizations are still working on developing certifications that are vendor-neutral, to eliminate redundancy, and require a certain amount of real-world experience, to gain professionalism. The evolution to a client-server environment has prompted certification to become more popular than ever, but there is still a shortage in many areas (Leinfuss, 1997). "However, that shortage could turn into a deluge given the wide range of training certification programs currently being developed" (Leinfuss, 1997, 1).

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QUALITY AND SAFETY IN AVIATION: IMPLICATIONS FOR THE AIRLINE INDUSTRY

Avinash Waikar, Southeastern Louisiana University
Jack E. Tucci, Southeastern Louisiana University
David Wyld, Southeastern Louisiana University
Bhaba Sarker, Louisiana State University
dwyld@I-55.com

ABSTRACT

Safety is not a coincidental slogan in FAA literature, correspondence and advisory circulars. It is a reminder to all that safety in is a team effort and that each and every individual is responsible for doing his or her part. This paper presents aviation safety in the TQM framework of customer focus, continuous process improvement, and total involvement.

QUALITY DEFINED

Although there are several variations of the way quality is defined, quality is whatever the customer says it is. So, how would the aviation industry define quality? Who would they say the customer is? Passengers, the FAA, Actually, there are many customers in aviation, and not are all passengers. Most passengers would quickly define quality if asked "to survive the flight." Secondary to survival, but still very important, are reliability, comfort, efficiency, timeliness and convenience (Lawrence and Hume 1992). The definition will probably get more complicated with internationalization, European deregulation, and changes in the way the airlines finance newer fleets (Kyle, Strickland, and Bichaka 1992).

Aviation is critically safety sensitive and requires high quality levels and reliability in hardware and personnel skills. Therefore, quality control, and Total Quality Management (TQM) are both integral parts of the aviation sector. TQM first starts with the designing of the aircraft and ends the moment the pilot shoots the last approach for the aircraft for its useful life. Tenner and Detoro (1995) define quality as a strategy utilized to completely satisfy both internal and external customers by meeting their expectations. The model builds on three fundamental principles of quality: 1. Customer Focus, 2. Process Improvement and 3. Total Involvement.

CUSTOMER FOCUS

For every soul who boards an airplane, reliability is likely to be the first term used for defining quality. This reliability comes from a number of sources. The travel agent or ticket provider and ground host or hostess is the first major upstream producer of the service for the end user, who is the passenger. Then, the pilot is a customer to a number of groups; Air Traffic Control, the Flight Service Station System (FSS), the line crew which fuels the aircraft and the maintenance crew, not to mention the manufacturer who built the airliner in the first place. Each person in turn is somebody's customer, and they all have to work together well to satisfy the end user.

IMPROVING THE PROCESS

The Process Improvement Concept can be seen first, as "families" of aircraft progress from the prototype to the fully developed model. Three prime examples of process improvement from the maintenance sphere are: 1. Airworthiness Directives, 2. Manufacturer's Service Bulletins, and 3. Malfunction & Defect Reports. The introduction of formalized reporting marked a milestone in improving flight safety and has become a part and has improved the TQM process. A key contribution to process improvement under the TQM philosophy is the concept of process

ownership. Process ownership can only be effective with authority and responsibility. There is agreement between TQM's definition of process ownership and the FAA's definition. The FAA states that the pilot in command of an aircraft is directly responsible for, and is the final authority to the operation of that aircraft (FAR 91.3[a]). Feedback is essential in the TQM Process for effective results in process improvement. The Malfunction and Defect Reports mentioned earlier are an excellent example.

CUSTOMER / EMPLOYEE INVOLVEMENT AND REGULATIONS

Under the TQM philosophy, involvement integrates everyone's efforts. FAA regulations within the aviation sector ensures that the FAA, pilots, maintenance technicians, controllers, and anyone else involved with the aviation support effort work together for safety. The regulations and quality standards governing U.S. aircraft manufacturers hold safety and airworthiness as their highest goals (Hunt 1995). Individuals in the workplace come under two FAA influences: the first influence being the structure of the employer, and the second, overriding influence being compliance to FAA regulations and philosophy. Regardless of whatever opinions the reader may come into contact with concerning aviation, the bottom line here is that flying and arriving safely is the FAA'a prime directive.

Although widespread and prevalent, upon careful scrutiny, one can see that TQM is scattered unevenly throughout the aviation sector. Aviation can be examined by sector. These sectors are: 1. General Aviation, 2. Sport Aviation, 3. Corporate Aviation, 4. Air Taxi and 5. Air Carriers.

FACTORS FOR CONSIDERATION

Today, air travel still remains the safest viable alternative to meet the ever-growing travel needs of the business world and ever-changing society. Agencies such as FAA and the NTSB (National Transportation Safety Board), should be commended for maintaining a safe flying environment. Nevertheless, we need to consider what cost these regulations impose and contrast and comparisons to similar industries should be made to determine the feasibility of adoption of similar structures of the TQM framework as found in the aviation industry.

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INTEGRATED SUPPLY: AN INNOVATIVE APPROACH TO COST REDUCTION

Donald D. Envick, University of Nebraska at Kearney
envickd@platte.unk.edu
Brooke R. Envick, St. Mary's University of Texas
benvick@stmarytx.edu

ABSTRACT

In today's business environment, there is tremendous pressure to continually reduce costs. Competitive advantage in the market place requires more than having the best product or service. It is also essential to drive costs out of the processes that support the business and from an ability to add value to one's customers through every aspect of the operation. A key strategy to accomplish this is through integrated supply. Integrated supply is a materials management strategy that goes beyond vendor reduction by using multi-line distributors to lower the total cost of supplies.

This paper offers perspectives on the integrated supply strategy, the various benefits it offers, and critical success factors required to manage the relationship and reduce total cost through four cost-saving categories.

INTRODUCTION

Minimizing total costs continues to be one of the primary focal points of business today. In most firms, the acquisition of inventory management functions contain many of the costs. Integrated supply reduces the total cost of supplies for customers through the use of multi-line distributors. For example, Keough (1994) reveals that processing orders using conventional methods costs about $141 per purchase order and requires one to two weeks for delivery. However, a company with an integrated supply program only incurs a cost of $12 per purchase order with only one day or less for delivery.

Integrated supply can include the outsourcing for such things as procurement, inventory management, and accounts payable by the multi-line distributor for the customer. Specific activities performed can include audit verification, bar coding, customized reporting, computer system design, inventory management, logistics management, material handling, plant surveys, preventative maintenance, quality reviews, repair and fabrication, site selection, staffing, and vendor selection and certification. The location of an integrated supply operation can be on or near a customer's business site.

To make integrated supply work, the distributor-customer partnership must be mutually beneficial in terms of cost-saving opportunities. In order to make the partnership effective, the relationship requires continuing trust, open communication, and long-term commitment. It also requires staff competencies and behaviors closely aligned with initiatives, scope, and objectives of each partnership contract.

Most businesses realize how important it is to manage costs. And integrated supply is one of the newest ways to achieve this goal. This paper analyzes integrated supply relationships and the four cost saving categories, which include: (1) the cost of acquisition, (2) information and transaction automation, (3) inventory management, and (4) acquisition of original equipment.

LITERATURE REVIEW

The number of recent articles relating to integrated supply suggests that it is a growing area of interest among both practitioners and academics. Most of these articles are very focused on such issues as, (1) the changing roles in the distribution channel, (2) integration types, (3) problems and concerns among partners, and (4) the future direction of integrated supply.

Integrated supply initiatives target large industries with more than $1M in maintenance, repair, and operating (MRO) purchases a year. Integrators will typically operate at cost-plus 10 to 20 percent arrangement that allows them to stock "A" items that turn six to eight times per year. And they rely on sub-tier suppliers to handle the "C" lower-turn items and perhaps even "B" items (Baden and Lynn, 1996).

Streamlining operations is becoming a greater necessity for today's businesses. For example, Meyer (1997) examines what businesses are looking for in an integrated supply contract. The results show that they want to streamline their supply base, simplify their acquisition process, have more efficient servicing of multi-plant locations, and have access to greater varieties of product. However, the streamlining of the customer's procurement process may complicate the sales process for the distributor (Stainbrook, 1997). Therefore, effective communication is key.

Avery (1997) asserts that integrated supply can cut the costs of MRO acquisition when there is open communication and feedback. And Keyser (1997) contends that methods to communicate information and the systems that link customers, integrators, and manufacturers will gain importance as well as product knowledge, technical assistance, and application.

One important area of communication is costs. For example, Lingenfelter (1997) illustrates that integrated supply programs require much of the distributor's cash and that it is important to avoid misunderstandings by ill-defined contracts. And Sherry (1997) points out that the management of costs begins with information. By understanding the costs for each key activity, the distributor can determine the costs of value-added services. From this information, distributors can determine where time and technology can improve the process.

Baker (1997) contends that when the integrated supply customer evaluates the agreement, the only issue will be price. Therefore, the distributor has to control that price through the reduction in channel costs. The backbone of industrial distribution is its ability to add value to products and inventory. And integrated supply partners benefit by eliminating their own inventory and transaction costs (Harper, 1996).

After several years of ambiguity, integrated supply distributors have emerged in different forms. The structure of the integrated supply strategy is taking shape in the form of stand-alone integrated supply distributors, a consortia of small industrial distributors, alliances of large distributors, integrators that manage the procurement and inventory management process, and information managers who use their computer systems to get a foothold in this market (Baden and Lynn, 1997).

One technology, Electronically Integrated Supply (EIS), has emerged as a practical application of the Internet. As an extension of Electronic Document Exchange, EIS is specific to the business-to-business market and refers to the automated processing of corporate purchases internally between departments and externally to multiple suppliers (Fourneir, 1997).

The success of any business today depends on the quality of its supply chain. Mathers (1996) states that businesses are beginning to realize the importance of integrated supply and the importance of reducing costs for their customers. This paper analyzes the four cost saving categories of most partnerships.

COST SAVING CATEGORIES

The four types of cost savers for most integrated supply relationships include: (1) the cost of acquisition, (2) information and transaction automation, (3) inventory management, and (4) acquisition of original equipment (see figure 1).

[Insert Figure 1 About Here - Not Available Contact Author for Details]

Proposition 1: It is mutually beneficial for the customer and industrial distributor if the distributor reduces the cost of acquisition.

The main focus of most integrated supply initiatives is to reduce the cost of acquisition. Acquisition is the cost of buying which includes sourcing, inquiry, decision making, order placement, expediting, receiving, delivery or storage of the received good, and payment for the goods.

The goal of the customer is to reduce the total cost of ownership of the commodities. For example, an integrated supply contract between the customer and industrial distributor may include a goal to reduce the total cost

of ownership by 5 percent per year over the next five years. This type of cost reduction goal is a one-time savings but continues forever. And the target cost reduction categories can include inventory, labor, material, and miscellaneous cost burdens.

Proposition 2: It is mutually beneficial for the customer and industrial distributor if the distributor automates information and transactions.

Industrial distributors serving customers through total cost reductions are at the forefront of electronic commerce. They employ on-line ordering systems which allow users to check the location and levels of inventory on any item, even if that item is in production or on the production schedule.

Industrial distributors can provide an integrated preventative maintenance management package schedule and generate work orders. It also allows them to manage maintenance tasks, track equipment histories, maintain labor records, allocate resources, and interface with the distributor computer system for complete inventory and purchasing management.

Streamlining freight movement can also be achieved through an integrated supply contract. Logistics software can be used for on-line access to shipping methods and rates to guarantee shipment of goods at the least freight expense.

Automating accounts payable eliminates the waste of erroneous billing. An integrated supply strategy includes a paperless, electronic matching system which scans invoices storing them optically to match on-screen distributor purchase orders. When there is a match, the bill is paid.

Customers also have access to electronic mail, on-line engineering, and interchange information. Documents can be received and sent in electronic data interchange format to communicate invoicing, quoting, quote response, purchase order acknowledgment, shipping notices, and functional acknowledgment. Electronic catalogs are replacing expensive paper catalogs. Customers with Internet access can take advantage of distributor CD ROM catalogs for locating such things as product information, pricing, and purchasing.

Proposition 3: It is mutually beneficial for the customer and industrial distributor if the distributor handles all inventory management for the customer.

Part of the integrated supply strategy is for the distributor to take over the inventory management function for the customer. An example of a service provided by a distributor is in-plant surveys which identify customer needs. Other services include tracking part numbers, duplication reporting, packing slip information, and bar coding.

To reduce inventory costs, tool crib management systems track all items, automate purchasing needs, perform stock balancing, and even handle gauges, kits, and assemblies. One such system designed for Windows 95 includes a toolbar for maintenance that allows the user to view such things as employees, machines, inventory items, and vendors. Another toolbar handles transactions such as issuing, returning, rework items, and item lookup and transfer. And another toolbar is used to switch from one crib attendant to another.

Proposition 4: It is mutually beneficial for the customer and industrial distributor if the distributor manages the acquisition of original equipment.

Original equipment includes parts purchased by customers to go into the product they are selling. Once customers see the MRO cost savings derived from a successful integrated supply contract, they can request that the industrial distributor also manage the acquisition of original equipment.

DISCUSSION AND CONCLUSIONS

Every business strives to reduce costs, and using an integrated supply distributor is one way to meet this goal. As this paper illustrated, an integrated supply partnership is cost effective in four areas: cost of acquisition, information and transaction automation, inventory management, and acquisition of original equipment. It is proposed that these

four areas of cost reduction are mutually beneficial for both the customer and industrial distributor. Empirical study is needed to test these four propositions as well as additional research in the area of integrated supply.

Other cost saving techniques should also be studied. For example, once integrators have streamlined logistics and reduced inventory, they must find cost savings elsewhere. Continuous improvement efforts now shift to investigating the effective use of old and new products. Integrated suppliers must be knowledgeable and skilled to provide product and application expertise that make additional cost reductions. As this area of interest continues to grow, more studies should be conducted regarding cost saving techniques of integrated suppliers.

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WHY SOFTWARE FAILS: QUALITY IMPLEMENTATION AND TESTING

Heather Taylor, Columbus State University
Taylor_Heather@colstate.edu
Charlotte Stephens, Columbus State University
Stephens_Charlotte@colstate.edu

ABSTRACT

Failure and success within the context of software projects are defined. An analysis of four well-known approaches to process improvement and the role of testing and testing methods is presented.

INTRODUCTION

Software failures are one of the most important, if not most important problem, in the software industry today. Many senior executives view the field of software development as an out-of-control process that produces low quality and unreliable performance. To counter this growing view of software development and deal with the very real problem of software failures, the industry has become serious about adopting various standards, process improvements, and "silver bullet" tools. However, in spite of the growing trend toward process improvement and Total Quality Management (TQM) for software, many companies are finding themselves without the quality and productivity improvements they were hoping to gain. Much evidence indicates that software fails because the industry as a whole still approaches the task of software development using ad hoc methods. Even if some methodological structure is implemented in an organization, this structure is usually inadequate to handle the complexity and size of most projects. The industry challenge is to create an efficient, productive in-house information technology (IT) staff that can produce quality software. If this challenge cannot be met, for whatever reason, then the organization itself is at serious risk. Quality has become the key to software success as well as the key market factor for high technology.

Software testing is an important element of software quality. The purpose of testing is to discover errors, faults, and weaknesses in a product. Many organizations spend up to fifty percent of their budgets on testing (Perry, 1995). However, the average organization is only able to remove about eighty-five percent of the errors (Jones, 1997). With fifteen percent of errors going undiscovered, the client will no doubt be very dissatisfied with the product. If the quality of the testing process is improved alongside improvements for the development process as a whole, then the quality of the software will increase dramatically.

First, failure and success within the context of software projects are defined. Further, degrees of failure using Capers Jones definition are presented. Then, an analysis of four well-known approaches to process improvement are discussed. The first approach is the SEI/CMM Model or the Software Engineering Institute's (SEI) model sponsored by the Department of Defense. This model is called the Capability Maturing Model (CMM) and has five levels of implementation from Level 1 where all processes are *ad hoc* to Level 5 where there is ongoing process improvement including defect prevention, technology management, and process change management. The second approach is the ISO 9000 family approach, most widely used in Europe where as CMM is most widely used in the United States. European software houses are working to become ISO certified. The third approach is TQM, a philosophy of incremental improvement and zero-defect quality. TQM seems to experience a fifty- percent implementation success rate and requires dramatic change within most organizations. The fourth approach, the Software Productivity Research (SPR) Assessment model, addresses many social issues not included in other models. Seven sequential stages are involved with each stage addressing a particular software quality issue. Finally, the role of testing and testing methods are presented.

FAILURE DEFINED

According to Capers Jones(1995), the primary concerns of the software community for software projects are as follows:

(1) adherence to the delivery schedules for projects
(2) costs and resources needed
(3) quality and reliability levels of the software
(4) ease of learning and ease of use
(5) customer support
(6) ease of modification and maintenance.

A project is considered "successful" if it meets all of the above criteria. A "failure" has occurred when the project does not meet the first three of the six criteria listed and may neglect to meet all of them. Jones also specifies degrees of success and failure: absolute failure, relative failure, absolute success, and relative success. Most projects are not considered complete failures and far fewer are considered complete successes. The following definitions describe the spectrum of project successes and failures (Jones, 1995, xxvi):

- Absolute Failures are for those projects which are canceled before completion.
- Relative Failures are those projects which exceed their schedules and/orbudgets by relatively large amounts.
- Absolute Successes are projects that succeed technically, encounter no major problems, and provide the business with a substantial ROI.
- Relative Successes are projects that do something beyond what was expected. For example, if the project is tangibly superior to competitive projects, then it is considered a relative success.

Reasons for software failures vary widely; however, many companies seem to create the same, general types of mistakes that lead to absolute or relative failure for their projects. Steve McConnell(1996, 1) has discovered that, "Some of the worst practices in the software industry have been used so often, by so many people, to produce such predictably bad mistakes, they should be labeled, `classic mistakes.'"

These classic mistakes are half social factors and half project technology factors. Lack of motivation, uncontrolled problem employees, and noisy and overcrowded offices are some of the social factors. Omitting or rushing planning, analysis, and quality assurance, as well as lack of control over change requirements are some of the project technology factors (McConnell, 1996). To recognize that failure may be brought about from social factors as well as project technology factors is important. From this point, an organization can begin to accurately assess its relative success level as a software producer.

Many of the social factors that wreak havoc on a software project can be regarded as management issues. In his book, *Patterns of Software System Failure and Success*, Capers Jones (1995) presents social factors he has observed in unsuccessful projects:

- excessive schedule pressure
- executive rejection of estimates
- severe friction with clients
- divisive corporate policies
- poor team communications
- naïve senior executives
- project management malpractice
- unqualified technical staff
- generalists used for critical tasks.

If a project has even one of these factors injected into the development environment, then the probability for failure has increased significantly.

A complete list of project technology shortcomings that induce failure would be extensive. Project technology includes available methods, tools, and infrastructure to design and implement the software system (Lyytinen *et al*, 1996). The main problems with technology-related failures may be encapsulated in the words "failure to use." Currently, there are many standards, measurement tools, techniques, and methods that can be applied to software

projects to reduce the risk of failure. It can then be said that the "failure to use" the appropriate tools, techniques, methods will increase the risk of failure.

FOUR APPROACHES FOR REDUCING SOFTWARE RISKS

Recognizing the causes of failure is critical. However, it is merely a starting point in the study of software quality. Once the general factors of failure are realized, it is the important for an organization to assess the true quality of its own software. After an assessment of its quality level, an organization may then begin to implement a plan to reduce the risks of software development. Many organizations have tried to improve the quality of their software by incorporating standards into the development process. The following sections provide an analysis of four well-known approaches to reducing software risk: SEI/CMM Model, ISO 9000 certification, TQM, and SPR Assessment.

In an effort to advance the practice of software engineering, the Software Engineering Institute (SEI), sponsored by the Department of Defense, created the Capability Maturity Model. The CMM has five levels that describe the processes an organization at each level implements (Montgomery, 1995).

- Level 1 - All processes are ad hoc. There are no real processes.
- Level 2 - Implements processes that are repeatable. Project planning, project tracking, and project management are in place.
- Level 3 - Processes are standardized and documented at an organizational level. Requirements management, project planning, and project tracking are implemented.
- Level 4 - Product and process quality is emphasized. At this level, an organization is able to eliminate the unique happenings that impact quality.
- Level 5 - Ongoing process improvement. Defect prevention, technology- change management, and process-change management are implemented.

One may note that the above list is only a general summary of each level within the CMM. Today, the CMM levels are most widely accepted and used in the United States. Other models for process improvements are employed internationally.

The Capability Maturity Model has its critics and supporters. Most leaders in the software field do consider the CMM to be of at least some value to an organization trying to improve its software quality. Alan Joch believes "the CMM is valuable because it puts importance on the process of software development...If you have a process in place, you have a glue that you can always count on" (Joch, 1995, 5). However, critics of the SEI model stress the lack of empirical data to prove that an organization at level 3 has superior software quality than an organization still at level 1 (Jones, 1997).

The ISO 9000 family is one of the most widely used standards in the European community. These standards describe the quality elements systems should implement, but do not describe how the organization should implement these elements. The five main elements of an ISO 9000 quality system are

(1) code reviews and inspections
(2) software testing
(3) product and process measurements
(4) measurement of quality costs
(5) documentation of quality improvements (Stelzer *et al*, 1996).

Today, many European software houses are working urgently to become ISO certified. According to Dirk Stelzer (1996), "These companies believe that an ISO 9000 quality system will be a requirement for entry into the software and services market in Europe in the near future." However, a recent study conducted at the University of Koeln in Germany, reveals there is little empirical evidence as to what extent process improvements via ISO 9000 are really achieved (Stelzer *et al*, 1996). According to Capers Jones in a recent lecture Columbus, Georgia, ISO 9000 standards must be regarded as a questionable way to improve quality. He also added that an upcoming conference to be held in Britain will dismiss the ISO 9000 standards as good software practice (Jones, 1997). Total Quality Management is the concept of incremental improvements and zero-defect quality. In the realm of software development, it is applying quality standards and zero-defect quality to projects. According to Capers Jones, "the data on U.S. experiences with TQM to date indicates that it is successful about half the time. If you are going to adopt TQM, then it must be adopted seriously and with full commitment to succeed" (Jones, 1995, 131). The concept of total quality

management must be implemented by senior executives and supported by the employees. A poster on the company wall is not evidence of a TQM organization.

A study performed by Dr. Nils Tomes at the University of Edinburgh examined international process improvement approaches. He studied the differences between Japan's software quality and Britain's software quality. The Japanese companies used internal company quality standards while the British companies employed the ISO standards in their development process. Japanese projects performed remarkably well and achieved higher levels of reliability and customer satisfaction (Tomes, 1996). Japan as a nation has been internationally recognized as a leader of the TQM movement. It appears they are beginning to apply their incremental improvements and standardization methods to their software industry as well.

The Software Productivity Research (SPR) group conducted a study of the upper ten percent of organizations in regards to software quality. The group then produced a three-year software improvement plan based on their findings. The plan is very thorough and addresses social issues not mentioned in other standards such as the SEI/CMM model. The improvement plan is estimated to cost the average organization around $30,000 per software staff member and three years of labor-intensive work (Jones, 1997). There are seven sequential stages, with each stage aimed toward solving a particular problem. Stage 0 is the Software Process Assessment. This assessment examines the software tools, organizational structures, processes, office space and layouts, employee compensation, and other factors relevant to the IT technical staff. The SPR assessment has a five level classification model, the SPR Excellence Scale, which is similar to the SEI model. However, the two scales run in opposite directions. An organization that is rated a "5" on the SEI scale will be given a rating of "1" on the SPR Excellence Scale. The purpose of the assessment is to provide an organization with a diagnosis of its current quality level. "The assessment will explore everything that is right and find everything that is wrong with the way an organization builds software" (Jones, 1995, 120). Progress can be judged in comparison to the scoring on the assessment.

Stage 1 focuses on management: "managerial problems are more common and more serious than any other kind" (Jones, 1995, 125). Project managers should be able to adequately size major deliverables, estimate the resources and costs of projects, plan, monitor performance against milestones, and collect data that can be used in future estimates (Jones, 1995) . The purpose of this stage is to educate managers so they will be experts in the areas just listed. It is critical for software project managers to be highly educated with the latest project technologies and quality measurements. An awareness of the important social issues is also critical. Stage 2 focuses on structured methods. The focus of methods in the three-year plan precedes a focus on tools. The SPR group feels that tools should support the methodologies, not than the other way around (Jones, 1995). This stage is designed for an organization to implement quality control techniques, such as formal design and code inspections, along with other project technologies like JAD, TQM, information engineering, quality function deployment, and prototyping. Prototyping has proven itself to be highly effective in communicating with the client. According to an article entitled, "Software's Ten Essentials", " the user interface prototype is "the map that points out the hills and valleys, graded trails, and portions of the software outing that will require special skills" (McConnell, 1997, 1). Object oriented analysis and design is also encouraged, but only if an organization is already experienced with conventional structured analysis and design approaches. Object-oriented methods are considered to be a logical approach to development. The challenge is how to discover objects and structure their classes in a such a way that the best grouping of data and function is represented (Morris et al, 1995). Maintenance is a serious issue that also is addressed in stage two. "High maintenance costs are a symptom of deeper problems within a company" (Jones, 1995, 131). Problems such as a lack of complexity analysis, no reverse engineering, or no quality measurements could be the root cause of excessive maintenance costs (Jones, 1995).

Stage 3 focuses on new tools and methods. Problems occur when when management looks to software tools as the answer to their quality problems. In spite of the software industry's efforts, there is still no "silver bullet" to achieving high quality products. According to the specific needs of an organization, some of the following tools may be employed: object-oriented paradigm, multimedia applications, object-oriented languages, client/server architectures, RAD, expert-system methods, and CASE tools (Jones, 1995). The SPR group strongly emphasizes the importance of using experienced, well-trained software professionals with tools (Jones, 1997). A decrease in software quality will probably occur if only inexperienced staff employ the software tools. If an organization completes this stage in the improvement plan according to SPR suggestions, its software quality level is predicted to be 50 percent better than its original assessment level (Jones, 1995). Stage 4 focuses on infrastructure, or the ongoing effort needed to maintain

a software team at the leading edge. Establishing annual education policies for management and the technical staff is an important step for an organization in this stage. According to Jones (1995, 139), "if quality and structure could be improved, less than 30 percent of the technical staff would be devoted to maintenance" . Some of the other steps suggested by the SPR group at stage 4 are as follows: adapting hiring practices to elicit software specialists, conducting an analysis of the competition, making necessary changes in office space, and reducing high noise levels in the working environment (Jones, 1995).

Stage 5 focuses on reusability. The improvement plan is not merely referring to reusing code. It also suggests creating reusable architecture, requirements, designs, estimates, human interfaces, test plans, test cases, library tools, analysis tools, and documentation, (Jones, 1995). In order for reusability to be effective, an organization must have a library, formal inspections, a quality assurance department, use defect estimating and defect tracking tools, and have a high defect removal efficiency rate (Jones, 1997). An organization using these elements will drastically eliminate the costly mistake of reusing flawed items. The final stage, stage 6, focuses on industry leadership. After stage 5, an organization should be good enough to be classified as a world-class software organization. At this point, staff morale should be high and the defect removal efficiency should exceed 95 percent (Jones, 1997). Continuous training, annual technology reviews, as well as continual surveillance of the software industry should be performed at this stage.

SOFTWARE TESTING

A software project is considered a failure if it fails to meet the client's expectations in regards to delivery schedule, cost and resources, quality and reliability, customer support, and ease of maintenance. Failures may be induced by either social factors, such as overcrowded office space, or project technology factors, such as omitting analysis. To help reduce the risk of failure, many organizations are using one of either four approaches to process improvements in software development: SEI/CMM Model, ISO 9000 Certification, TQM for software, and SPR Assessment and Plan. Although no one plan for process improvement is perfect, many companies can testify to improved quality with the help of standards. Testing is an essential element in the development of quality software. A study conducted by the Hong Kong Polytechnic University sought to discover which of the standards, ISO 9000 or CMM standards, produced greater improvement in the test process. Their findings revealed that neither ISO 9000 or the CMM were very beneficial (Leung, 1997). The study did discover the importance of a formal testing process and an independent test team.

Software testing has been defined in many different ways. Older definitions of testing seem to limit the process to an activity performed at the end of the development life cycle. Even today, college students are taught in introductory analysis and design classes that testing is a phase after design and coding in the software development life cycle. If an organization views testing in this manner, it is probably producing software with low levels of quality and productivity. The best approach to testing is to view it as a process with its own cycle, one that parallels the development cycle and verifies each phase. To test the requirements, documentation, and design as well as the code, will improve quality and decrease the risk of failure in software. The IEEE provides two accepted definitions of testing (Kit, 1995, 21):

1. The process of analyzing a software item to detect the difference between existing and required conditions and evaluating the features of the software items
2. The process of operating a system or component under specified conditions, observing or recording the results, and making an evaluation of some aspect of the system or component.

From as early as 1973, the scope of testing has evolved from module testing to its present status. In world-class software organizations, testing is now seen as an important and vital process in development. For the elite in the software industry and in academia, testing is seen as a discipline that requires test specialists and formal standards to effectively carry out the testing process. It is also critical to have a testing department separate from the development team. However, for the average organization, it is still merely a procedure to test code after it has been implemented. The average organization at level 1 on the CMM scale needs to look no further than its testing process, or lack of, to discover a major cause of poor quality.

KIT'S SIX ESSENTIALS OF TESTING

In his book, Software Testing: Improving the Process, Edward Kit (1995) provides a fundamental list of six essentials to testing software. These essentials serve as the foundation for the book and are a good guideline for any organization trying to improve the quality of its software products. Essential one states that the quality of the test process determines the success of the test effort. "Regardless of the state of maturity of the development organization, the test group can and should focus on improving its own internal process" (Kit, 1995, 3). Essential two is to prevent defect migration by using early 0life-cycle testing techniques (Kit, 1995). In a recent lecture, Capers Jones(1997) discussed how lack of verification activities during the requirements and design phases would promote chaos during testing and maintenance. The goal is to discover the defects during the phase in which they were created. If this discovery does not occur, then the majority of errors will be found in maintenance.

Essential three necessitates that the time for software testing tools is now (Kit, 1995). The current industry provides a wide variety of tools with a large number of vendors offering mature, healthy products (Kit, 1995). Today, there are tools available for every platform, architecture, and programming language. It is with caution, however, that software testing tools should be purchased. Perry (1995) recommends that a strategy for tool acquisition be in place instead of randomly purchasing products. Essential four is for a real person to take responsibility for improving the testing process (Kit, 1995). Testing tools should never be the hub of the testing department. Tools support the methods, not the other way around. "When it is all said and done, software testing is a process that requires people who take responsibility for its improvement" (Kit, 1995, 5). Test planning and test management are the foundation for quality test efforts, not tools.

Essential five is that testing is a professional discipline requiring trained, skilled people (Kit, 1995). Effective testing requires the expertise of test specialists grouped together as a separate department from the development team. Test specialists also need to obtain the proper support from management and be clearly devoted to satisfying the customer. The biggest mistakes in many organizations today are to have part-time testers, entry level staff as testers, or have the development team serve as testers of their own work. Essential six is to cultivate a positive team attitude of creative destruction. "Establishing the proper `test to break' mental attitude has a profound effect on testing success"(Kit, 1995, 6). The objective is to discover as many defects as possible in order to prove the product does not work as it should.

VERIFICATION VERSUS VALIDATION

The modern approach to testing is best understood by dividing testing into two activities, verification activities and validation activities. Verification is a "human" examination or review of the work product. Verification is formally defined by the IEEE as, "the process of evaluating a system or component to determine whether the products of a given development phase satisfy the conditions imposed at the start of that phase" (Kit, 1995, 29). The objective of verification is to detect errors in the early phases to prevent defect migration to the testing and maintenance phases. For each phase of the life cycle, there is a verification activity that may be performed. Validation is the process of evaluating a system or component during or at the end of the development process. The IEEE defines validation as, "the process of evaluating a system or component during or a0t the end of the development process to determine whether it satisfies specified requirements" (Kit, 1995, 30). Validation activities are mainly limited to the "testing" phase of0 the systems development life cycle.

Currently, there are eighteen different kinds of validation tests that can be used to test software. The testing forms may be divided into three classes: general form, forms involving users, and specialized forms of testing. The average organization uses the six general forms of testing: subroutine testing, unit testing, system testing, new function test0ing, regression testing, and integration testing. The specialized forms of testing are viral protection testing, stress testing, performance testing, security testing, platform testing, Year 2000 testing, and independent testing. Forms of testing involving users are customer acceptance testing, field testing, usability testing, lab testing, and clean-room statistical testing (Jones, 1997). Studies have indicated that an organization which uses all eighteen forms of validation testing will have a defect removal efficiency of 99.999 percent. However, the expense of using all eighteen forms is so high that it will absorb any profit gained from the product. World-class software organizations, on average, employ eight validation testing forms (Jones, 1997).

LIFE CYCLE APPROACH TO TESTING

Currently, best quality practices treat the testing life cycle as a series of phases that p0arallel the development process. Each phase of development has either a verification or validation activity that should be performed. The following section examines the testing activities that can be performed at each of the development phases: requirements, design, implementation or code, test, and maintenance (Perry, 1995).

Testing should start with the requirements phase. It is here, in this ambiguous phase, that verification testing can be most useful. An important concept to recognize is that the user is the ultimate tester in this phase. They are the only ones who can truly verify that the requirements are complete and correct. Testers will offer an objective perspective on the requirements specifications and can determine whether the client's needs and wants have been adequately addressed by the development team in terms of functionality (Perry, 1995). Testers can also begin to generate functional test data at this phase. The major test concerns at the requirements phase are as follows: requirements comply with methodology, functional specifications are correct, applications and features are easy to use, the degree of expected maintenance are determined, security requirements are adequate, and operational and reliability of the system are defined (Perry, 1995).

Some of the recommended test tools for this phase are formal reviews, inspections, walk-throughs, risk matrixes, and checklists. With an inspection as well as a formal review, some or all of the participants are asked to prepare for the meeting in advance. Inspections and formal reviews are meetings in which the users and other project members gather to inspect documents for defects and review documents to ensure requirements were effectively communicated to the development team. Walk-throughs are less formal than inspection meetings due to lack of preparation. A risk matrix tool is a tool designed to assess the adequacy of controls in the system. According to William Perry (1995), automated systems controls account for at least 50 percent of the total development effort. Checklists are important testing tools which are oriented towards reliability and usability of the product (Kit, 1995). A generic checklist, which can be reused for other projects, is a good move toward a more formal process for any testing team.

The objectives of verification activities in the design phase are to determine the adequacy of the design, generate structural and functional test data, and determine the consistency of the design with the requirements (Perry, 1995). Input and output specifications, processing specifications and system flowcharts are some of the deliverables of the design phase. To test these deliverables using a formal design review is one of the most effective methods for detecting defects. Checklists can be used during a review and provide a path back to requirements.

The source code itself is the deliverable of the code phase. Verification of the code involves the following activities: comparing the code with internal design specifications, examining the code against a language-specific checklist, checking for compliance with the content requirements, and considering possible validation tests to search for defects (Perry, 1995). A formal code review is an effective verification tool for the code phase. A program peer review is another valuable tool. The peer review provides a forum to review the functioning of the program as well as its structure. The peer review team usually consists of programmers, programming supervisors, and testers. However, if a project is large, then automated tools may be used to analyze the code as well (Perry, 1995).

The test phase consists of validation activities which place tested programs into production. Testing during this phase must validate that the correct versions of the program are in place and that the data in the system is correct. If testing has been performed in previous phases, then the actual testing in this phase will be considerably less. The deliverables for the test phase include test phase test plan, test data, results of previous test, third-party test reactions, and formal test documentation (Perry, 1995). The forms of validation testing have been previously discussed. The general forms of testing and a brief description of each follows(Kit, 1995, 94):

- Unit testing is the process of testing the individual components of a program.
- Integration testing is the process of combining and testing multiple components together.
- New function testing is the process of attempting to detect discrepancies between a program's functional specification and its actual behavior.
- System testing is the process of attempting to demonstrate that a program or specification does not meet its original requirements.

- Regression testing is the verification that what is being installed does not effect any portion of the application already installed or other applications interfaced by the new application.

Maintenance is a necessary and critical task in systems work today. Systems must be dynamic and continually evolve to meet the needs of its users. According to Professor Kawalek at the University of Manchester, maintenance of software should allow the system to be resilient: "resilience is a static concept of design where a system is designed to be flexible and to cope with the everyday crises and shocks that it encounters"(Kawalek and Leornard, 1996, 186). The overall objective of testing in the maintenance phase is to ensure that the changed application will function properly (Perry, 1995). Trained testers are an important factor in successful maintenance. Therefore, an organization should not overlook training to ensure testers are effective. The ability to develop tests to detect problems prior to placing a change into the system is critical. If a bug is placed in the system that is trying to correct the original bug, then maintenance costs will soar. It is the role of the tester to validate that bugs are eliminated and not corrected with other bugs.

Software change feedback and software change review checklists are two important tools for testing in the maintenance phase (Perry, 1995). Management should periodically review the effectiveness of testing and training for software changes. Also, the frequency with which management receives feedback information is an indicator of the effectiveness of the maintenance process.

CONCLUSION

Satisfying the client is a high priority for many organizations. In the realm of software projects, satisfying the client means producing quality software delivered on schedule. The software industry today recognizes the need to bring the software development process closer to a formal discipline. The quest for software quality has led many organizations toward standards such as the SEI/CMM Model, the ISO 9000 Family, TQM for software, and the SPR Assessment Plan.

Software testing is an important element of software quality that is largely overlooked in many standards. Fortunately, testing has evolved into a discipline of its own, with the leaders in software testing calling for a life cycle approach to software testing. The merging of quality testing practices with a development team which employs a standardized, formal process for its projects, will provide its organization with the goal of their endeavors: quality software and a satisfied client.

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TELEMEDICINE: AN OVERVIEW

Gene C. Wunder, Washburn University at Topeka, Kansas
zzwunder@washburn.edu

ABSTRACT

This paper reviews selected aspects of telemedicine in the United States. A relatively new innovation, telemedicine has dramatically changed the means by which practitioner and patient, obtain and process medical and health care information. Telemedicine, broadly defined, is the use of telecommunications technologies to provide medical information and services. This definition includes use of the telephone, facsimile, and other electronic means of communication. The defining aspect of telemedicine is the use of electronic signals to transfer information from one location to another.

The growth of telemedicine is largely due to the expansion of the Internet and related technology. Worldwide, it is estimated that more than thirty million computers are connected to the Internet. There are more than 10,000 medical related Internet sites and the number continues to increase at a rapid pace. This growth has given physicians and patients access to an enormous quantity of medical and health care information. Improved hardware, a reliable Internet, innovative software, and a plethora of nearly continuous improvements in technology make "state of the art" at best a fleeting concept.

The rapid expansion of telemedicine has not been without problems. Legislation and regulation has not kept pace with technological advances. Privacy issues, malpractice concerns, jurisdictional questions, doctor-patient relationships, division/consolidation of medical care and the quality of the information are but a few of the concerns raised by this new way application of technology.

INTRODUCTION TO TELEMEDICINE

There are various definitions of telemedicine. One emphasizes the use of electronic information and communication technology to provide and support medical and health care services when distance separates the participants. A general definition, "medicine at a distance," covers the whole range of medical activities including treatment and education, (Woottin, 1996).

Telemedicine is a collection of various electronic technologies and applications used to communicate medical information from one point to another. The information may be in a variety of formats including voice, data, and video, alone or in some combination. Telemedicine has useful applications in which (1) distance or physical barriers make transfer of information between patient and health care practitioners difficult and (2) timely availability of information is essential to sound medical management.

EARLY TELEMEDICINE PROJECTS

A neophyte might assume that telemedicine is a recent concept. The genesis of telemedicine can be traced back to the late 1950s and early 1960s, (Boshshun, 1975). The early telemedicine projects were most often demonstration projects funded by various government agencies. Nearly all of these early projects were not financially feasible and did not continue when funding ended. One of the earlier programs linked a state psychiatric hospital to the University of Nebraska School of Medicine, (Wittson and Bensekter, 1972). The Space Technology Applied to Rural Papogo Advanced Health Care (STARPAHC) was perhaps one of the better known projects. STARPHAC was funded by NASA, equipped by Lockheed Electronics, and operated on the Pagogo Indian Reservation in southern Arizona, (Pool, Stonesifer, and Belasco, 1975).

Health care in the United States is going through a rapid revolution and telemedicine is a major element of change. Physicians and patients in rural locations are ideal candidates to benefit from telemedicine. Primary care practitioners and managed care systems are using telemedicine to centralize specialists thereby offering sufficient cost

reductions. International markets, inner-city poor, and under served urban and suburban areas are additional target markets for telemedicine.

RECENT TELEMEDICINE PROJECTS

The Mayo Clinics (Rochester, Minnesota) links its medical expertise to facilities in Amman, Jordan via satellite. In addition, Mayo has full-motion video links between Rochester and their medical clinics in Jacksonville, Florida and Scottsdale, Arizona, (Global Telemedicine, Report, 1994). Mayo also uses compressed video consultations with their regional outreach programs in western Wisconsin and northern Iowa.

The United States military has long had a strong interest in telemedicine. During the Persian Gulf War the real worth of combining advanced telecommunications and mobile health units was well demonstrated, (Cawthon, et al., 1991). CT scanners transmitted satellite images of good quality from the battle areas to medical specialists at facilities located outside the combat zone.

Although telemedicine has been around for sometime, it has only recently achieved critical mass. Currently, the rapid growth seems largely due to new technology, fundamental changes in the medical service industry, increasing competition, and a falling cost curve. Increasingly, more sophisticated medical techniques have become phenomenally expensive necessitating economies of scale. Large national hospital chains and joint venture relationships make it possible to spread expensive technology over a larger patient base.

The convergence of new technologies; fiber optics, satellites, digitalization, data compression, and sophisticated software and hardware has made telemedicine technically and economically feasible. Rapid advances in personal computer (PC) technology and the equally astounding downward cost curve has made the desktop computer a useful, powerful, and relatively inexpensive device. One proponent has stated that telemedicine will do for health care what the personal computer has done for the office, (Woottin, 1996).

APPLICATIONS OF TELEMEDICINE

One widespread application of telemedicine is the use of the Internet by patients to take responsibility for their well-being. Patients can access the Internet and read peer-reviewed journal articles, learn the latest studies by the National Institute of Cancer, and read of new treatments and procedures (Lowes, 1997). A NML software program called Grateful Med has been available since 1986. It allows medical professionals and lay persons alike to explore Medline and related databases using a PC. Patients have always sought to educate themselves, but the Internet has opened vast medical information sources previously not available.

Tom Fergson, author of "Health Online," believes this information revolution gives patients the opportunity to be proactive and assume more responsibility for their own health care. Fergson states that some physicians may feel intimidated when a patient comes to the office quoting from the latest medical journal or research findings. The doctor-patient relationship has perhaps forever been changed. Physicians must also deal with an increasing levels of education. Since 1970, according to the U.S. Census Department, the percentage of college graduates in the adult population rose from 11 percent to 23 percent in 1995.

SOME SPECIFIC OBSERVATIONS

Physicians have an opportunity to enhance the doctor-patient relationship. Tom Linden, a psychiatrist and Internet medical consultant recommends physicians get on-line and become Internet literate. Otherwise, Linden states, patients may leave your practice for a physician who can communicate on their level. This presents an opportunity to develop more efficient and effective health care practices

Cardiologist Frederic Pashkow, of the Cleveland Clinic believes that an educated patient is always better than an uneducated one. However, this progress is not without a downside. Pashkow, believes "We have gone from one extreme to another," "Patients used to be controlled by their doctors." Now it often seems as if the patient is telling the doctor what to do, (Lowes, 1997).

The efficacy of relatively unsophisticated electronic communications with patients appears to result in positive outcomes, (Balas, 1997). Eighty studies were reviewed by researchers to determine their effectiveness. The

communication systems reviewed included telephone reminders, telephone follow-up, facsimile machines (FAX), computerized communication and included telephone access to computerized information networks using a modem, (Balas, 1997).

For example, several studies suggest that providing after-hours telephone access to patients reduced hospital use and is a cost-effective means of offering primary care consultative services, (Zimmer, 1985; Rush, 1991; Serwint, 1991; Darnel, 1985). Other studies found that telephone screening, as an alternative to written or a personal interview, was as reliable and supplied as much information as data entered on a printed form, (Harlow, et al., 1989). Other studies failed to substantiate the value of this method, (Parkerson, et al., 1989).

THE KANSAS PROJECT

The Hays (Kansas) Medical Center services a relatively sparsely populated area of western Kansas and eastern Colorado has made use of a telemedicine program for televised in home patient visits, (The Economist, 1997). These televisits allow a registered nurse to see fifteen patients for routine health care checks in approximately four hours. Personal visits would require the use of an automobile and five or six patients could be seen during an eight hour day. The cost of each televisit is estimated to be $36 as compared with $135 for a personal visit by a registered nurse or $60 by a certified nursing assistant.

This system is also used for teaching, observation, and administration. Physicians at Hays consult with colleagues at primary and tertiary care hospitals as well as specialists at Kansas University Medical Center in Kansas City, Kansas. For example, a team of radiologists can examine X-rays transmitted to them from 12 sites in western Kansas and eastern Colorado. Thus, practitioners located in small or remote communities have access to a team of radiologists.

HCFA PROJECTS

Such projects would seem to offer great promise. The Health Care Financing Administration (HCFA) has a three-year trial project of Medicare reimbursements for teleconsultations using a hub and spoke system of hospitals and clinics. The project is in place in only four states; Georgia, Iowa, North Carolina, and West Virginia. The results appear promising. However, the outlook for widespread application of this program appears bleak as HCFA has no funding and no plans to expand this trial study, (Economists, 1997).

PROGRESS OR PROBLEMS?

Telemedicine would seem to offer a multitude of opportunities for patients and practitioner. However, with progress comes potential risks. Often technology races ahead of current legal and ethical standards. Legal liability and medical malpractice may increase as patient expectations rise, (Tan, 1997). A physician may be expected, as meeting current standards of practice, to consult a specialist via the telemedicine network when treating a patient. When patient and physician are fact to face there is little question of where the medical care is being administered. What if telemedicine involves a medical practitioner in another jurisdiction, state, or nation? Which laws or licenses apply? In 1995, the Federation of State Medical Boards proposed a model act that would permit a special license limited for the practice of telemedicine. To date it has not been approved.

Liability may arise out of glitches in software, system failure, or other technical problems which may not be identified until a serious medical error has occurred. System redundancy may provide backup in the event of breakdowns or power failures. Hold harmless agreements, business interruption, and errors and omissions (E&O) insurance would be appropriate methods of handling financial and legal liabilities, (Tan, 1997).

SELECTED PATIENT ISSUES

Telemedicine is changing the nature of the doctor-patient relationship. The nature of the legal definition, exactly when the physician's legal obligation begins, and which physician is responsible for coordinating patient care are but a few of the questions to be answered. Physicians must use caution when evaluating medical information from multiple sources. Some means of formalizing transfer of responsibility from one clinician to another may lessen the potential of a vital piece of information falling through the cracks.

New technology has the potential to change the patient-physician rapport. Some patients will see the broader access to clinical expertise as a positive. Others will see the lack of the personal touch as being a negative. The telemedicine physician will react to larger numbers of patients, most of whom he does not know, will never know or see after a consult. Perhaps the physical absence of the clinician could be overcome by having a second physician or nurse present to fill in missing information and provide emotional support.

Documentation issues related to this new technology are emerging. Patient records are still essential, but questions arise as to the form and content, ownership, storage, and access issues. Privacy issues need to be addressed when potentially sensitive medical information resides in a possibly insecure location. Other issues relate to how medical records are authenticated, who has access, how are errors corrected, and who is responsible for the correction of errors, are but a few of the unresolved problems.

SELECTED FINANCIAL CONSIDERATIONS

Third party payers have traditionally paid for face-to-face services that generate written documentation. Requests for payment for video consultations are often inconsistent if reimbursement is made at all. Some insurers require detailed written documentation before authorizing payment. Presently, HCFA reimburses for limited services involving radiology and pathology analysis, (Tan, 1997).

The high cost of establishing a telemedicine system is one that must be addressed. Most of the rural telemedicine systems in the United States depend upon governmental or private grants for their existence and continued survival. Few if any telemedicine systems would exist if they were required to be self sustaining. It is quite likely that telemedicine actually increases the cost of medical care by increasing the availability and use of services what would not otherwise be available.

CYBERMEDICINE, THE NEXT GENERATION?

Cybermedicine, the concept of long-distance diagnosis via cyberspace on the World Wide Web, is one of the latest evolutions of telemedicine. Patients can log onto the Internet, describe their symptoms from a menu, provide a credit card number, and receive a diagnoses and a prescription from a real cyberdoc. Numerous questions abound. Can an accurate diagnosis be made in this manner? How can the patient really know who is on the other end of the circuit?

Thomas E. Brandeisky, D.O., a New Jersey ENT, operates a web site (www.netvent.com/Doctor/consult1.html). He offers online consultation on any medical topic for $9.95. Just fill out the Virtual Doctor Consultation Form, provide MasterCard or Visa card information, and describe your concerns. The site does not provide information about Brandeisky's qualifications. The site carries the following disclaimer, "Be advised that the information provided by the Doctors is for entertainment and informative purposes only and should not be relied on for self treatment." Another Web site, Cyberdocs, (www.cyber.docs.com) provides on screen copies of medical degrees, board certifications, and licenses.

Regulators are uncertain as to when and where they have jurisdiction and wonder if they have jurisdiction over medical advice offered on the Web. For example, what authority do regulators in Illinois have when the Web site located in Texas? South Carolina regulators recently learned of an unlicensed physician offering medical advice on the Internet. Was the doctor practicing medicine or his First Amendment rights? Dale Austin, deputy executive vice-president of the Federation of State Medical Boards, sums it up with this quote, "Medicine via the Internet really suffers from the same problems as the rest of the Internet." "There is a lot of information out there, and it's buyer beware."

CONCLUSION

The application of technology to medicine is having a significant impact on how medicine is and will be practiced. A number of telemedicine projects appear to show considerable promise. Many of the projects would never exist if it were not for funding or grants from various government or private sources. There are physician and patient concerns as to how this technology will change traditional medicine. Cybermedicine offers preview of what may be ahead. However, it is apparent that technology has once again raced ahead of regulation. Caveat emptor, let the buyer beware, may be the best advice one can offer to anyone seeking medical advice on the Internet.

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MINING THE INTERNET: CULTURAL ANALYSIS OF DISCUSSION LIST TEXT

Subhash Durlabhji, Northwestern State University
Debasish Banerjee, Western Carolina University

INTRODUCTION

Globalization of business has spawned an urgent demand for reliable and valid information on cultures and their impact on behavior. Closely related to globalization, the Information Technology revolution has brought forth a powerful new medium for communications. The phenomenal growth of the Internet has unleashed a whole array of forces that will shape the twenty-first century. This paper pushes the frontiers of knowledge and research methodology in two ways: it seeks to begin the development of a new kind of cultural analysis, and it utilizes the Internet as a source of potentially highly valid data.

While "culture" is a vast and multi-faceted concept, there is little disagreement that values lie at the core of the process by which culture is manifested and by which it influences personality and behavior. To obtain information about values, this research used postings made to Internet "discussion lists" as data. We subscribed to two such discussion lists, focused on two different parts of the world, and saved the materials received. These consisted of views and opinions of the participants of these discussion lists on a wide variety of topics. We segregated the contents of these discussions by categories and subjected this to a comparative quantitative and qualitative analysis.

RESEARCH FRAMEWORK

A substantial amount of Internet communication is in "public domain," in the form of innumerable discussion lists and news groups. These are, literally, bulletin boards in cyberspace, which anyone may read from and post messages to. While a few of these are restricted to members approved by a "list-owner", and a few others are "moderated" -- messages are examined to ensure conformity to certain criteria -- most are open to all and completely free-wheeling. Again, the volume and range of these discussion lists and news groups is mind-boggling -- for discussion lists alone, a request to "LISTSERV" for a complete index generated, in hard copy form, a stack of output about four inches thick!

At first glance, all this verbiage seems devoid of any potential for useful scholarly research. However, certain characteristics of this public domain communication system suggest otherwise. The fact that these forums are organized around a particular topic -- or a particular region of the world -- means that the authors of the messages posted to any particular bulletin board share some common interest. Furthermore, the messages themselves are usually "straight from the heart." It can reasonably be argued that unsolicited, spontaneous reactions freely submitted to a forum such as a discussion list provides a rich source of valid data for drawing conclusions about the values, interests, and attitudes of the writers. We, therefore, posit that a comparison of the text from discussion lists centered on specific topics originating from different countries should provide insight into the concerns and attitudes of the people of those countries.

DATA COLLECTION

Initially, we thought we would have to subscribe to two selected lists in order to obtain the text of the discussion. We soon discovered, however, that discussion lists usually archive all their contents, and that it is possible to simply download the logs from each discussion list for any particular period. Therefore, we downloaded the entire text of the discussion for a particular month -- November 1996 -- from two lists: the "Hungarian Discussion List" <HUNGARY@GWUVM.GWU.EDU>, and the "India Discussion List" <INDIA-D@INDNET.ORG>. Each of the texts thus downloaded consisted of about 500 pages, or many megabytes of disk space!

ANALYSIS AND PRELIMINARY RESULTS

We utilized "Content Analysis" software to analyze the text data. One such package (that we downloaded from the Internet!) provides a frequency count of all the words that appear in the text being analyzed. Our expectation was that a comparison of the frequency of specific words would give us insight into the relative importance of certain topics for the members of the two lists. Another method that we used was a frequency list of word counts by category and country. Preliminary analysis showed some interesting differences.

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Provided on request.