COMPUTER ASSISTED TECHNOLOGY TRANSFER: UNDERSTANDING TECHNOLOGY DIFFUSION IN OKLAHOMA SMALL-TO-MEDIUM SIZED MANUFACTURERS

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CHAPTER I

INTRODUCTION

Educators and employers are focusing attention on developing the skills needed to be productive, informed members of a fast-paced, ever-changing, and highly technical society. Technology has contributed greatly to the shift to an information society, which is creating dramatic changes in the workforce. Although technological advances have traditionally been treated separately from other economic advances, they are interactive and firmly embedded in the American capitalist value system.

The twilight of the 20th century witnessed a mixture of technology and resources that has made possible an unprecedented economic growth. In such an industrial environment, adult-education processes in an industrial environment are the basic tools of organizational growth and development (Knowles, 1970, p. 31). These processes are used for orientation of new employees, on-the-job training for new technical skills, preparation for personnel advancement, executive development, supervisory training, improvement of interpersonal relations within the organization, and the improvement of the institution's public relations (p. 31).

Computer Assisted Technology Transfer (CATT)

The Computer Assisted Technology Transfer (CATT) project at Oklahoma State University (OSU) consisted of a research team of multidisciplinary graduate faculty and students representing the College's of Business Administration and Education. This was part of the second phase of the project, and was funded for $3 million dollars from the U.S. Department of Defense. This phase of the project focused on the communications aspects of information technologies including computer-assisted technology transfer using the Internet and World-Wide Web to encourage small-to-medium sized enterprises to do business with the U.S. Department of Defense. The researchers concentrated their efforts on understanding how Internet technology is diffused and utilized in Oklahoma small-to-medium sized enterprises (SME). The researchers also examined which types of communication formats are most effective with different groups who have varying levels of skills and different objectives for using the technologies. The faculty and students used the results to develop, test, and deploy an electronic training tutorial directed to SMEs to assist them in acquiring government contracts to manufacture parts for the U.S. Department of Defense. If SMEs could use e-mail from the U.S. Department of Defense to receive mill specifications, which are specifications for fabrication of parts or products, this process would save money and time

for various branches of the military and improve the productivity of SMEs.

Before the development of the Internet, the military sent proposal for bids for an airplane king-pins parts to large aerospace manufacturing firms via the U.S. Postal Service. This was costly in both time and money. In addition to time and money, the military had to purchase large quantities of the item they were ordering because it would not be worth the manufacturers' time to gear up their production line for one part which created storage problems. Because the military is keeping airplanes longer due to cuts in military spending, they needed to find a solution to expedite part production, cost savings, and storage issues to keep the United States aircraft ready for war.

The research team collected data to ascertain the current and expected information technology proficiency levels of the SMEs in Oklahoma. The researchers also collected data to understand how SMEs in Oklahoma could conduct business with the U.S. Department of Defense. Manufacturing capacity available to support the U.S. Department of Defense (DOD) is currently being impacted by three powerful trends: downsizing, migration toward electronic commerce, and mounting inventory costs (http://CATT.bus.okstate.edu).

First, DOD downsizing has resulted in fewer re-procurements of smaller quantities, which have led to mergers and acquisitions within the aerospace industry.

Because of these mergers, fewer aerospace companies are willing to do business with the DOD and instead have abandoned government defense work for the commercial sector.

The second trend is the worldwide migration toward electronic commerce and electronic document imaging (EC/EDI). The federal government has embarked upon an aggressive program to establish an EC/EDI capability fulfilling a presidential directive to acquire all products electronically by 1997.

Finally, due to mounting inventory costs, the Defense Logistics Agency (DLA) is quickly moving in the direction of manufacturing-on-demand. Under this concept, parts are manufactured in smaller quantities and only when required. As a result of these trends, it has become too costly and time consuming to have the original manufacturers produce parts for the products such as airplanes that are no longer in production. Therefore, it has become cost effective for the DOD to develop a new source of suppliers consisting of smaller manufacturers.

Oklahoma State University's branch campus in Okmulgee helped support the CATT project because of their specialization in technical training. Specifically, the Technology Development Center at OSU-Okmulgee was the site of the CATT Virtual Enterprise Development Center (VEDC) funded by the DOD. The VEDC hosts the CATT Quality Deployment project funded by the Oklahoma Department of Commerce in conjunction with the Rapid Response

Manufacturing Project and is considered a CATT deployment site. The CATT project serves to stimulate and recruit Oklahoma small-to-medium sized enterprises to become involved with the government's parts procurement process to form a virtual enterprise, which are manufacturers that utilize web-based technology. The selected manufacturers were identified to produce prototype parts as a means of qualifying firms to do business with the DOD.

By utilizing the process of matching together various manufacturers, each manufacturer can produce various pieces of a part that can be combined with others to make one whole part. The process also assists the manufacturers in obtaining government quality verifications. The matching process expedites the virtual enterprise to produce the parts rapidly in response to government solicitations. In these roles, OSU-Okmulgee and OSU-Stillwater have formed alliances with the North Eastern Onix™ (MM) Council to assist North Eastern Onix™ (MM) in becoming globally competitive.

Diffusion Models

The training of employees in small-to-medium sized enterprises (SMEs) in the CATT project involved technology diffusion. Technology diffusion leads to change within organizations and individuals. Jarvis (1983) concludes that "it may be possible to detect its emergence as rapidly changing levels of technology provide people with the social

conditions necessary for, and make people aware of, the opportunities to extend their learning throughout the whole of their lives" (p. 51). Since, technology diffusion models may be a useful metric by which researchers can track and predict adoption rates in Oklahoma small-to-medium sized enterprises, the CATT project involved the testing of diffusion models with SME's. In order to select the models for this testing, several factors had to be taken into consideration. These included identifying objectives and criteria for selecting the models and verifying how the model could be used to transfer the technology quickly, effectively, and efficiently.

Two diffusion models were used in the CATT project. They were selected because they could be modified to the research needs, applied to practical work environments; were not strictly based on mathematical principals; were flexible; had an evaluation component throughout the model's application; could be easily implemented and understood by the researcher, stakeholders, and manufacturing employees; and had the ability to gain measurable results within a short period of time. When selecting the models, several important items had to be considered including the rate of adoption of the new technology, the time it took to introduce the new technology, and the ability of the small-to-medium sized enterprises to willingly participate in the training. The two models judged most conducive by the CATT project staff for the criteria were the Motorola (Basili,

Daskalantonakis, & Yacobellis, 1994) and Gatekeeper (Allen, 1977; Zelkowitz, 1996) models.

Each of these technology diffusion models was selected to produce empirically-founded guidelines and quantitative results to measure which of these technology diffusion models was more affective in diffusing new technology in Oklahoma small-to-medium sized enterprises. The research served as a vehicle to build the best technology diffusion model for other information technologies.

The Motorola Model (Basili, Daskalantonakis, & Yacobellis, 1994) was developed as a process to target different user groups and to allow for modifications and applicability for transferring of software technology. The main steps include (a) characterizing the environment and technologies used, (b) setting organizational goals and choosing processes with high payoffs, (c) creating audience-targeted process-definition documents for the chosen process, (d) piloting the technologies and (e) creating a lessons-learned document. Additional steps include (f) training and consulting, (g) deploying the software package in the organization which allows for real-time feedback, (h) analyzing the data, (i) evaluating the practices, and (j) improving the process package. After completion of all of the steps, the process starts over and builds history and structured experiences.

The model relies on first putting together training material that communicates everything about the technology

that is being transferred. This includes an overview of what is expected, how to use the information, guidelines for using the process, training aids that are targeted to different groups, slides to conduct the training workshops, and an evaluation section. The last stage of the model is called involving the champions. This stage involves all of the employees in the organization in the process by getting their acknowledgment regarding the adoption of the new technology.

The Motorola Model was designed according to the Quality Improvement Paradigm and is broken down into the three phases of planning, execution, and analysis and packaging. Each of the phases has stages that characterize the environment and technologies being used by the individuals within the organization. These individuals are part of a technology development team that sets organizational goals. Within these goals, the team chooses a process with high-payoffs and creates audience-targeted, process-definition documents for the chosen processes. The documents that the team develops are similar to keeping a journal to record every step of the process so that the process is easily duplicated. The team then pilots the technology being used and creates a lessons-learned document that enhances the training and consulting. This allows the group to deploy the technology within the organization while analyzing the data and evaluating and improving the practices of technological diffusion.

This model relies on a collaborative communication effort and seeks input from all employees. Changes in the technology can be suggested and adapted by one or all members of the organization. The model also provides employees an opportunity to give feedback and emphasizes communicating everything about the technology that they are transferring. The communication involved in the process includes an overview of what is expected, explaining that information will be provided, preparing and utilizing guidelines for using the process, developing and using training aids targeted to different groups, putting slides together, which include a data and lessons-learned document after the training is completed, and involving each employee in the software technology diffusion process.

The Gatekeeper Model (Allen, 1977; Zelkowitz, 1996) emphasizes the decision-maker that determines whether or not the company will diffuse the new technology. The decision-maker is generally the chief executive officer of the company and is responsible for disseminating the new information to the rest of the company.

The communication process within the Gatekeeper Model relies on a hierarchical structure and does not seek input from anyone else within the organization. The model emphasizes the importance of utilizing external opinion leaders to validate the new technology, but change or modification in the process of delivery of the technology can only be made by the gatekeeper.

The Gatekeeper Model does not have a beginning, middle, and end phase and does not have an evaluation component. Therefore, in the CATT project Wlodowski's (1985) Adult Motivation Time Continuum Model was integrated into the Gatekeeper Model because it had all three phases and an evaluation component. Wlodowski's Model (1985) is conducive to environments where there is a single or multiple number of learners. The model is also easily understood by both the learner and instructor, and it was created to understand what motivates adult learners to participate in adult learning activities. The model requires instructors to be prepared and to give close thought to what they are doing. The model's three phases consist of the beginning, during, and end phases of various aspects of the learning environment, and it can be modified. The model requires the instructor to ask questions after each phase is completed in order to make sure that the employee is complying with the model and to ensure that the learner is progressing through the learning environment. The instructor also asks the learners if they are confident with their outcome. The model takes into consideration the learners attitude, needs, stimulus, and response. The beginning phase looks at the learner's stimulus and what is working, and the end phase deals with the learners' response or the competency they have accumulated. While concentrating on the learner's needs and attitudes, the beginning phase asks questions about how the learner feels about the training and if they

have had bad experiences in the past that would inhibit learning.

The Internet

The CATT project sought to train small-to-medium sized enterprises to use the Internet. The Internet began as an experimental method for connecting a number of Department of Defense research sites more than 20 years ago. The network was known originally as ARPAnet. The purpose of ARPAnet was to allow research facilities to communicate without fear of external agencies or organizations intercepting sensitive information. Although ARPAnet originally served a military purpose, it also provided an excellent foundation for the current version of the Internet (Krol, 1992).

The development of the Internet and the World Wide Web has also contributed to increased computer usage. The World Wide Web is closely related to the Internet. The Internet is a complex network of networks. The World Wide Web is composed of a number of large supercomputers as well as some additional smaller information servers.

The Internet has sustained phenomenal growth since the beginning of the decade. Doubling in size each year for the past several years, the Internet now connects 35 million users across the globe (Cronin, 1996). Higher education accounted for most of the growth in the early nineties, and the U.S. Department of Education estimated that more than 50% of American Schools would be attached to the Internet by

the end of 1996 (Watkins & Marenka, 1995). However, commercial usage now accounts for 65% of network traffic (Cronin, 1996).

Small-to-medium sized enterprises find themselves responding to an unplanned cultural shift because another way of viewing the Internet is as a second culture or community (Rheingold, 1993). The Internet exhibits all the key elements of a culture including language, symbols, rituals, status, and other meaning-conveying forms (December, 1993; North, 1995). Individuals may "enter" this environment, become initiated into various subgroups, and interact with other community members. At the group level, an entire company or department may introduce its members to the Internet culture. This broader conception underscores the depth of change that the Internet poses to existing organizations. One cannot expect to simply "tack on" the Internet as a cosmetic addition to an existing structure; as a new and competing culture, the Internet is bound to threaten existing conventions and cultural practices.

A gap exists between the pre-existing local community within the manufacturing environment and the virtual Internet community. As individuals are introduced to the Internet, they can experience feelings of anxiety, frustration, and lack of excitability and immersion. For some, these differing responses reflect personal stages of growth over time. Before the Internet can be introduced to small-to-medium sized enterprises like those found in

Oklahoma, it is necessary that the manufacturing culture assess the perceptions and needs of its employees (Sarason, 1988).

Through the Internet and similar collaborative learning environments, people can become enculterated into new disciplines and knowledge-building communities (Scardamalia & Bereiter, 1994). Manufacturers with limited resources can reach out to unlimited resources on the Internet. The Internet has the potential to be an "equalizer" that introduces novice outsiders into a rich community full of resources and expertise (Cronin, 1996). However, disorganized companies or those without a vision will not be able to adequately prepare employees with the metacognitive and dispositional qualities needed to take advantage of this rich virtual environment (Watkens & Marenka, 1995).

Adult Education

Learning is a constant force that must be addressed by both employees and employers because "the world we live in today is not the one we were born into, or the one we will die in" (Mead, 1953, p. 2). Things are accelerating quickly, and jobs have been created at a rate of 10,000 a day in the United States (Toffler, 1991). Some of the jobs will be created in existing areas while others will be in areas that do not exist today. For employees to succeed and subsequently for the company to succeed, employees must

continually learn to keep up with the enormous amount of knowledge and changes that occur each day.

"Learning communities" center around an investigation and development of solutions to real problems (Blumenfeld, 1991). They put the emphasis on the whole group with employees collaborating and supporting each other toward various learning goals. Both learning environments and learning communities depend heavily on employee and employer acceptance, responsibility, and continuing motivation. Both also typically rely on rich information and learning resources (Bruner, 1966).

In order for most employees to be motivated to learn something new, they first ask the question "what's in it for me?" By asking this question, adults can better understand the practicality and usefulness of what they will learn now and in what context it needs to be learned (Elias & Merriam, 1980). This "what's in it for me" philosophy is also apparent in the work setting when adults are being trained. It is important when training adults in a work setting on how to use computers, that they be allowed to practice using software on their home computers (Wlodowski, 1985, pp. 58-66). The most preferred place to learn is at home, and by practicing at home the employees become less inhibited about using the new technology at work (Penland, 1979 & Tough, 1979).

Adult educators can play an integral role in helping to understand how employees learn. This integral role can be

explained further by examining the adult-education processes in an industrial environment. Adult-education processes in an industrial environment are considered the basic tools of organizational growth and development (Knowles, 1970, p. 31). "Adult education both reflects and responds to the forces prevalent in the sociocultural context" (Merriam & Caffarella, 1991, pp. 22-23).

Adult educators play several key roles in the development of the learner by (a) helping learners diagnose their needs for learning within the scope of the given situation (diagnostic function); (b) helping learners plan a sequence of experiences that will produce desired learning (planning function); (c) creating conditions to cause learners to want to learn (motivational); (d) selecting the most effective methods and techniques for producing the desired learning (methodological function); (e) providing human and material resources to produce learning (resource); and (f) helping learners measure outcomes of their learning experience (evaluation function) (Knowles, 1970, p. 22). In assisting employees to learn within the workplace, adult educators need to negotiate between the "(1) needs and goals of the individual; (2) the needs and goals of the institution; and (3) the needs and goals of society" (p. 22). With such an approach,

> The adult learner of the future will be highly competent in deciding what to learn and planning and arranging his own learning. He will obtain appropriate help competently and quickly, but only when necessary. (Tough, 1971, p. 12)

When viewed in this way, it is clear that adult learning occurs in diverse and unique settings and "takes place in a bewildering wide range of contexts (Brookfield, 1986, p. 147).

The Problem

Change and technology have led to an emphasis on the employer as a trainer. This emphasis has stimulated a paradigm shift. To be effective, each business has to have a voice in the design of its training. In order for small-to-medium sized manufacturing employees to implement new technology quickly and inexpensively, it is important to understand how and what motivates the employees to learn the new technology. This involves a concentration on the human element and the use of adult learning principles. Thus, one of the major challenges to effective technology utilization is understanding under what conditions and circumstances new technologies need to be diffused to gain maximum benefits.

Because of the lack of knowledge of how to effectively diffuse technology among small-and-medium sized manufacturers, the U.S. Department of Defense funded a research project with the College of Education and the College of Business Administration at Oklahoma State University. The CATT project focused on the diffusion of new technology and innovations into small-to-medium sized enterprises in the form of using the Internet to do business with the U.S. Department of Defense. Using the Internet has

the potential of saving businesses time and money. These businesses need knowledge of technology diffusion to better meet the needs of the U.S. Department of Defense. Although some Oklahoma small-to-medium sized enterprises have the ability to produce parts for the Department of Defense, a large portion of small-to-medium sized enterprises do not currently have the expertise, knowledge, or access to obtain mill specification for the parts required by the DOD via e-mail. If the small-to-medium sized enterprises could receive the mill specification, they could manufacture parts for the U.S. Department of Defense. Using e-mail is quicker and less expensive than relying on past methods such as U.S. postal delivery. Mastering the use of this technology could also allow small manufacturers to acquire more business from larger manufacturers who cannot deliver a small quantity of product in a short period of time. Since the information from this project could be useful for the better understanding of the diffusion of technology and for changing training in small to medium sized enterprises, a need exists to systematically describe and analyze this project.

Purpose of the Study

The purpose of this study was to describe the technology diffusion process in Oklahoma small-to-medium sized enterprises involved in the CATT project. In order to do this, it was necessary to investigate the status of

small-to-medium sized enterprises in clarifying their (a) need for new knowledge; (b) their difficulty in getting new ideas adopted; and (c) their evaluation of existing technology adoption models to help implement new ideas. The descriptive research study was conducted in two phases.

This research utilized two technology diffusion models to provide training to employees in Oklahoma small-to-medium sized enterprises. Those who received the training completed a technology diffusion questionnaire to measure their perceived ease-of-use, perceived usefulness, and self-efficacy using the Internet. Interviews and observations and were also used to gather data related to why Oklahoma small-to-medium sized manufacturing employees accepted or rejected Internet and e-mail technologies.

Research Questions

The following research questions were used to explore views, opinions, perceptions, and profiles of Oklahoma small-to-medium sized manufacturing employees regarding their usage of the Internet and e-mail.

1. How does the Motorola Model compare to the Gatekeeper for training employees in Oklahoma small-to-medium sized enterprises?
2. What are the employees perceptions concerning ease of use, usefulness, and self-efficacy in relationship to technology diffusion?
3. What are the perceptions of Oklahoma small-to-medium sized manufacturing employees in the CATT project concerning the use of the Internet and e-mail.

Assumptions

It was assumed that the manufacturing employees who participated in the study did not receive any Internet or e-mail training either prior to or after the Internet training in the CATT project. Manufacturing employees that participated in the training were asked if they had been exposed to other computer training. This way the researcher could determine whether or not the training the researcher supplied them was the only determinant to encourage adoption of Internet and e-mail technology. The researcher did encourage them to practice e-mail and Internet on their own.

The second assumption was that the manufacturing employees were willing to put forth a concerted effort to incorporate Internet and e-mail technology into their daily work or personal environments. Putting forth an effort included accessing pages that had been introduced to them in the training, designing their own home page, or accessing any information they felt of value to them on the web.

Limitations

Three limitations applied to this study: (a) potential previous negative experiences; (b) length of the study; and (c) length of the training. Because the CATT project focused on a positive training experience rather than on gathering recorded data, no pretest was performed. As a result, it was difficult to determine whether or not employees had previous negative experiences with technology.

If employees had negative feelings about the use of new technology at work, it was not known if that influenced their willingness to accept or reject Internet and e-mail technology.

The length of the study was 2 years. Because some employers may fall into Roger's (1995) category of laggards and take longer to diffuse new technology, it might take additional research beyond the original research conducted from January of 1997 to May of 1999 to determine whether or not the employees will adopt the Internet and e-mail technology.

Additionally, the length of the training, which was 4 hours, might have prohibited certain individuals and manufacturers from participating because of time or other constraints. Therefore, the sample used might be influenced by employees or manufacturers who were willing to dedicate this amount of time to training on a new technology.

Definitions

Adult Education: is a process whereby persons whose major social roles are characteristic of adult status undertake systematic and sustained learning activities for the purpose of bringing about changes in knowledge, attitudes, values or skills (Darkenwald and Merriam, 1982, p. 9).

CATT (Computer Assisted Technology Transfer): A funded U.S. Department of Defense research project between Oklahoma

State University College if Business Administration and College of Education.

Change Agent: The person in the organization who is the opinion leader who encourages the rest of the people in the organization to adopt the new change (Rogers, 1995).

Communication: The process in which participants create and share information with one another in order to reach a mutual understanding (Rogers, 1995).

Diffusion: A kind of social change by which alteration occurs in the structure and function of a social system. The process by which an innovation is communicated through certain channels over time among members of a particular group. (Rogers, 1995, pp. 164-184)

E-mail: Electronic message delivery system utilizing the personal computer.

Internet: A system of personal computers linked to each other using the world-wide-web.

Learning: An activity where a new knowledge or skill is gained.

Small-to-medium sized enterprises: Firms with fewer than 200 employees.

Technological Innovation: This embodies information and thus reduces uncertainty about cause-effect relationships in problem-solving. When new ideas are invented, diffused, and adopted or rejected with certain

consequences, social change occurs. (Rogers, 1995, pp. 30-31)

Technology: Information that has two components: (a) Hardware consists of a tool that embodies the technology as a material or physical object, and (b) software which consists of the information base for the tool. (Rogers, 1995)

Technology Transfer: The utilization of technology or an existing technique in an instance where it has not previously been used (Gruber & Marquiss, 1969, p. 255; Stewart & Nihei, 1987, p. 2). Technology is information, and transfer is a communication process; therefore, technology transfer is the communication of information (Eveland, 1986).

Training: An organized activity designed to teach a new task or skill.

CHAPTER II

LITERATURE REVIEW

Diffusion of Innovation

The Diffusion of Innovation Theory (Rogers, 1983, pp. 257-261) provides information for selecting models for technology forecasting. Rogers' (1995) Diffusion of Innovation Theory gives insight on technology diffusion and adoption, two similar terms used in diffusion research.

According to Rogers (1995) there are four elements in the diffusion of innovations: (a) the innovation, (b) communication channels, (c) time, and (d) a social system. Each one of these elements is present in any type of diffusion campaign or study. The innovation does not need to be new as measured by a lapse of time since its first use or discovery, but it has to be new to an individual. The newness of an innovation may be expressed in terms of knowledge, persuasion, or a decision to adopt. Several characteristics exist in the diffusion process. They include (a) relative advantage, (b) compatibility, (c) complexity, (d) trialability, and (e) observability. Each of these characteristics exists in the innovation process and explains the rate of adoption of an innovation (pp. 10-23).

In addition, there are three classifications of consequences of innovations: (a) desirable versus undesirable consequences, (b) direct versus indirect consequences, and (c) anticipated versus unanticipated consequences. These consequences are the changes that occur as a result of the adoption or rejection of an innovation (Rogers, 1995, p. 30).

When looking at adopters and their adoption of a new innovation, it is helpful to look at the S-curve model. The S-curve of diffusion explains the adoption rate of various individuals and encourages diffusion scholars to ask the following questions: (1) How do early adopters differ from late adopters of an innovation? (2) How does the perceived attributes of an innovation such as its relative advantage or compatibility affect its rate of adoption? (3) Why does the S-shaped curve accelerate at about 10% to 25% adoption when interpersonal networks become activated so that a critical mass of adopters begins using an innovation (Rogers, 1995, pp. 11-12)?

For instance, those who adopt an innovation first have a low threshold for adoption. These are the ones who are considered to be venturesome. On the other hand, later adopters have a stronger resistance to change, and therefore it takes them longer to adopt the innovation. These individuals may only adopt an innovation once their peers have adopted it. Individual thresholds for adoption vary, thus creating the S-curve of diffusion (Rogers, 1995). The

S-curve model is often used to identify firms according to when they make the decision to adopt the technology. The classifications of either early or late adopters may indicate different organizational characteristics.

The innovation-decision process is the process through which an individual (or other decision-making unit) passes from first knowledge of an innovation, to forming an attitude toward the innovation, to a decision to adopt or reject the innovation, to implementation of the new idea, and finally to confirmation of this decision. This process consists of a series of actions and choices over time through which an individual (or an organization) evaluates a new idea and decides whether or not to incorporate the new innovation into ongoing practice (Rogers, 1995, p. 161).

Diffusion is a kind of social change, which is the process by which alteration occurs in the structure and function of a social system. Technology Diffusion research was most influenced by the Ryan and Gross (1943) Hybrid Corn Study. This agricultural study influenced the methodology, theoretical framework, and interpretations of diffusion research. In 1941, Dr. Bruce Ryan, a rural sociologist, persuaded the Iowa Agricultural Experiment Station to fund his investigation of the spread of hybrid seed corn to the Iowa farmers. Genetic scientists at Iowa State had spent 20 years developing a hybrid seed corn that produced about 20% higher yields, was more drought resistant, and was better suited for mechanical pickers. After its introduction in

1928, it took about 13 years to reach 100% adoption of the hybrid corn. Ryan undertook the study so researchers could better understand the diffusion of the hybrid brand of corn and so they could apply the lessons to future agricultural innovations. The research directions that came from this study continue to drive diffusion research today. Ryan and Gross effectively formed the classical diffusion paradigm.

Diffusion has been evident since the Industrial Revolution, which relied on employees learning how to operate new machinery in order to produce goods faster with less cost to the manufacturer. Unless studies are conducted to identify specific components of technology diffusion models, vague and ineffective methods of technology diffusion implementation will remain. Therefore, understanding why people accept or reject a particular technology within a specified period of time has proven to be one of the most challenging issues in information systems research (Swanson, 1988). Historically, there has been a lack of understanding of how workers attitudes are affected by specific models of technology diffusion. This lack of understanding explains the inadequate attempt to implement the technology diffusion models into the work force (Torkzadeh & Angulo, 1992). End users are often unwilling to use available technology that, if used, would generate significant performance gains due to lack of training or understanding of the technology itself (Alavi & Henderson, 1981; Nickerson, 1981; Swanson, 1988). Several studies have

been conducted in the area of technology diffusion although none have identified models that would allow researchers to predict diffusion of new technology in a small-to-medium sized manufacturing environment.

Diffusion is the process by which an innovation is communicated through certain channels over time among members of a social system (Rogers, 1995, p. 10). Diffusion of innovation is a special type of communication where the messages focus on new ideas. These new ideas allow for some degree of uncertainty, and this uncertainty is the degree to which a number of alternatives are perceived with respect to the occurrence of an event and the relative probability of these alternatives. This uncertainty also implies a lack of predictability, structure, and information.

Communication is a process in which participants create and share information with one another in order to reach a mutual understanding. This definition implies that communication is a process of convergence (or divergence) as two or more individuals exchange information in order to move toward each other (or apart) in the meaning that they give to certain events (Rogers, 1995).

Thus, communication is a two-way process of convergence or divergence rather than a one-way, linear act in which one individual seeks to transfer a message to another in order to achieve certain effects (Rogers & Kincaid, 1981, p. 64). A linear conception of human communication may accurately describe certain communication acts or events involved in

diffusion such as when a change agent seeks to persuade a client to adopt an innovation or traditional teaching methods. However, when the entire process of what came before and after a designated event is considered, it is clear this is only part of a total process of two individuals exchanging information. For example, the client may come to the change agent with a problem, and the innovation is recommended as a possible solution to a need. The change agent-client interaction may continue through several cycles as a process of information exchange (Rogers & Kincaid, 1981, p. 6).

Specifically, technology usually has two components: (a) a hardware aspect, consisting of a tool that embodies the technology as a material or physical object, and (b) a software aspect, consisting of the information base for the tool. This definition of technology as information stresses the uncertainty-reduction aspect of technology and thus the important role of information (Cleveland, 1986; Thompson, 1967).

The use of informational technology provides a design for instrumental action that reduces the uncertainty in cause-effect relationships involved in achieving a desired outcome. A technological innovation embodies information and thus reduces uncertainty about cause-effect relationships in problem-solving. When new ideas are invented, diffused, and adopted or rejected with certain

consequences, social change occurs (Rogers, 1995, pp. 30-31).

Rogers (1995) theory characterizes when industry adopts a new product by an S-shaped curve. The curve reflects exponential growth with a rate that depends on the size of the remaining market. With good data on when a low level of adoption has been achieved (e.g., 5%), the model is effective in identifying the dates by which a specific level of industry penetration (e.g., 50%) can be expected to occur.

Past studies conducted by Ajzen and Fishbein (1980) developed the Theory of Reasoned Action (TRA) Model, which was designed to measure behavior. Additional studies demonstrated how perceived ease of use might predict an effect on intentions of technology usage although this effect may subside over time (Davis, Bagozzi & Warshaw, 1987). The Technology Acceptance Model (TAM), adapted from the TRA Model, specifies the causal linkages between key beliefs including perceived usefulness and perceived ease of use, users attitudes, and intentions concerning actual technology adoption behavior (Davis, 1986). TAM is considerably less general than TRA and is designed to apply only to technology usage behavior. However, because it incorporates findings accumulated from over a decade of information systems research, it may be especially well suited for modeling technology acceptance.

The rate of adoption of an innovation is the relative speed with which an innovation is adopted by members of a social system. Rate of adoption is generally measured as the number of individuals who adopt a new idea in a specified period. So the rate of adoption is a numerical indicator of the steepness of the adoption curve for an innovation (Rogers, 1995, p. 206).

Perceived attributes of an innovation are important explanations of the rate of adoption for an innovation. From 49 to 87% of the variance in the rate of adoption is explained by five attributes: relative advantage, compatibility, complexity, trialability, and observability (Rogers, 1983). In addition to these five perceived attributes of an innovation, other variables affect an innovation's rate of adoption. These include (a) the type of innovation-decision, (b) the nature of communication channels diffusing the innovation at various stages in the innovation-decision process, (c) the nature of the social system in which the innovation is diffusing, and (d) the extent of change agents' promotion efforts if diffusing the innovation (Rogers, 1995, p. 206). The adoption process is also influenced by the number of people involved. When more people are involved in making a decision concerning an innovation, rate of adoption is slower.

In the workplace of the 90s, the "age of mass production is fading fast and the emerging economy is based on knowledge, imagination, curiosity and talent" (Peters 1994, p. 10). This new image of the workplace is in strong contrast to the one that has been prevalent for so long and based on the theories of Taylor (1912). Taylor made a dramatic attempt to use training as a means to increase productivity with the introduction of his Scientific Management System. Taylor's system led to an analysis of the workplace and identification of the most efficient work models. Jobs were broken down into their simple parts and were timed. After an analysis of the results, jobs were reconstructed to ensure maximum efficiency. Staff then were trained to implement Taylor's system, and their improved productivity was rewarded (Davies, 1976; Neumann, 1979).

The problem with Taylor's (1912) view of the workplace and the worker was that it concentrated on the instrumental aspects of human behavior with the employee being seen as just another part of the automation process. This approach ignored both the psychological and sociological aspects of the job.

Taylor advocated using time and motion studies to determine the most efficient method for performing each work task, using piece-rate systems of compensation to maximize employee work effort, and selecting and training employees based on a thorough investigation of their personalities and

skills. In contrast, in the rapidly changing workplace of the 90s and beyond and as people become more educated and more expensive, it does not make sense to treat them as automata, and those who are well educated do not enjoy having so little space for discretion in their jobs (Handy, 1994).

Within the manufacturing environment, learning has become the lifeblood of an organization. As Peters (1994) suggested that a corporation that does not figure out how to use the special curiosities of each of its people, is headed for trouble. No longer is the worker seen as an instrumental part of production. Rather, it is the company that is seen as "a tool for fostering individuals' growth" (Peters, 1994). Within the manufacturing environment, continuous learning becomes essential.

Three types of learning takes place in the workplace: formal, informal, and incidental (Marsick & Watkins, 1992, p. 294). Formal learning has been described as being sponsored by an institution and is classroom based, highly structured, and controlled by the institution that sets up objectives dealing with how learning will take place (p. 294). Informal learning is less structured allowing the learners to set up their objectives, but the institution controls how the education will be delivered (p. 294). Incidental learning is a subset of informal learning and is a by-product of another activity such as accomplishing a task, interpersonal interaction, or a formal learning

situation (p. 294). Much workplace learning is informal or incidental with 83% to 90% falling in this area and only 10-17% being formal learning (Carnevale & Others, 1988, p. 22-30; Watkins & Marenka, 1995, p. 10).

One central theme described in informal or incidental learning is learning through experience (Marsick & Watkins, 1990, p. 15). Informal or incidental learning is more apt to occur when the learners experience a situation that is not routine. Informal learning is self-motivated, self-directed, and purposeful. It takes place when the learner decides to know something and takes the steps necessary to learn it. Learners use mentors or other workers as resources to learn what they need to know. While it is difficult for an organization to provide informal learning experiences, it can create an environment where this type of learning can be enhanced (p. 21) by allowing employees to play on the computers.

Businesses benefit from investing in workforce education programs through increased worker productivity. Employers who increased the educational level of their employees by one year experienced an 8.6% increase in productivity (Jones, 1996, p. 22). Obvious validation of workplace learning is demonstrated through the fact that 400 businesses have a separate building labeled as an education or training center, and 140 companies offer over 2,250 courses that award academic credit (Watkins, 1983, p. 1).

Workplace learning accounts for 85% in the variance of the employee's lifetime earnings (Benson, 1997, p. 1). In other words, if employees participate in various learning, they will most likely earn more over their lifetime than employees who had not participated. Technology and the Information Age have transformed the workplace into a setting that requires employees to stay informed and knowledgeable. Workplace managers realize that in order for their businesses to remain successful and competitive, their workers must have the ability to generate and use knowledge to make improvements (Sorohan, 1993, p. 2). "Technology is not only making learning mandatory, it is providing many of the mechanisms for it to occur" (Merriam & Caffarella, 1991, p. 16).

American workers are not being used to their full potential (Rose, 1996, p. 5). Due to frequent change, non-routine situations, and technological demands, workers cannot take a linear step-by-step approach to a specific task (Marsick & Watkins, 1990, p. 21; Sorohan, 1993). Workers must understand and grasp a few foundational principles, internalize them, and use them as a guide to adjust to an ever-changing workplace. Consequently, businesses are rethinking their hierarchical structure and modifying their corporate environment to be reflective of a learning organization (Berryman & Bailey cited in Sorohan, 1993, p. 2). Additionally, economic pressures to improve productivity are forcing many companies to look towards

various learning organization strategies (Rose, 1996, p. 14).

Learning organizations are a place:

> Where people continually expand their capacity to create the results they truly desire, where new and expansive patterns of thinking are nurtured, where collective aspiration is set free, and where people are continually learning how to learn together. (Senge, 1990, p. 3)

By mastering certain basic disciplines, workers can facilitate and release learning at all levels within an organization (Senge, 1990). The mastery then allows team members within an organization to develop proficiency in a form of communication knows as dialogue (p. 3).

Understanding how employees use various skills in organizations allows employers to understand how employees solve problems. Problem-solving skills are no longer just required for managers; instead, employees at all levels must be able to solve problems. Employees must be flexible to adapt to any given situation since what was required last week might become outdated before next week. To respond to the demands of constant change, employees at lower levels within the organization are now being required to take on more autonomy in learning by setting goals, identifying new ways to learn, and monitoring their own progress (Ravid cited in Marsick & Watkins, 1987, p. 27).

A workplace that encourages self-direction and collaboration helps employees develop conceptual understanding (p. 4). Each workplace has specific environmental factors that affect how people interact and

how they learn (Smith, 1987, p. 40). Every workplace provides an environment that either facilitates or inhibits learning (Knowles, 1980, p. 66).

Some workplace environments fall short of their anticipated emphasis on learning goals because they focus on the behaviorist model of learning which requires observable results while personal development is considered a secondary benefit of workplace learning (Marsick, 1987, p. 1).

If businesses are to thrive and prosper in the post-industrial era, they must reconsider the intangible factors within their organizations such as respect for human value, personal development, social interactions, service orientation, independent thinking, and creativity among all employees (Marsick, 1987, p. 11). Flexibility and adaptability must overcome hierarchical structures in order to increase employee productivity in response to changed events (Knox, 1977, p. 576).

Dynamics of Learning

Formative learning takes place throughout childhood and into adulthood through socialization with the "informal or tacit learning of norms from parents, friends, and mentors that allows us to fit into society and through schooling" (Mezirow, p. 1, 1991). Adults are encouraged to become self-directed learners within their particular culture. Their culture is shaped and understood through language,

personal experience, and sets limits to future learning (Mezirow, p. 1, 1991).

In order to understand the cultural context of learning, it is helpful to look at Bowers (1994) findings on the sociology of knowledge. Bowers (1994) points out five propositions:

> Proposition I: Social reality is shared, sustained, and continuously negotiated through communication. Proposition II: Through socialization the individual's subjective self is built up in biographically unique way. It serves as a set of interpretational rules for making sense of everyday life. Proposition III: Much of the social world of everyday life is learned and experienced by the individual as the natural, even inevitable order of reality. This attitude toward the everyday world is taken for granted. Proposition IV: The individual's self-concept is constituted through interaction with significant others. The individual requires not only socially shared knowledge but also an understanding of which he or she is in relation to that knowledge. Proposition V: Human consciousness is characterized by intentionality: it is the intentionality of consciousness that assures that socialization is not deterministic (pp. 34-44.)

Bowers (1984) notes that "socialization involves internalizing the definitions, assumptions, and arbitrary typifications taken for granted and communicated by significant others" (p. 39). Bowers believes that modernization breaks down traditional forms of authority in a culture and makes it possible to create new meanings and new forms of authority through a more democratic and educative process.

Training

Rather than ignoring the argument about whether the focus should be "educating" or "training" employees, the

concentration should be on ensuring that employees "learn" (Miller, 1993, p. 201). Teaching or training does not necessarily equate to learning. Unfortunately, too often those responding to training delude themselves into believing that training does equate to learning and that as long as manufacturing employees participate in the training, the training will lead to learning and eventually to increased productivity. They are not always willing to recognize that an increase in time and money spent on training does not always translate into a more educated workforce and increased efficiency and effectiveness (p. 201). Training is in fact often seen as the easy answer (p. 201).

Learning, however, only takes place if the learner wants to learn (Tough, 1971). If there is purpose, if the environment is conducive, if learning is acknowledged, and if there is a recognition that everyone learns in different ways at different speeds and with different outcomes, then learning may occur (Brookfield, 1986, p. 18; Knowles, 1988, p. 50). In fact, learning is and has to be an interactive and reflective process with the learners being aware of what, why, and how they have learnt (Mezirow, 1990, pp. 3-5). Despite this knowledge of how adults learn, many attempts are still made to inoculate the employee with unrelated, disjointed, and extremely passive training sessions.

Many adult learning activities that occur in the workplace are referred to as training (Knowles, 1972, p. 99). Businesses spend large sums of money on training in order to produce more knowledgeable employees who in turn will be more productive and bring more profits to the organization. Approximately $50 billion is spent on formal training and $180 billion on informal training by businesses in the United States each year (Rowden, 1996, p. 3). Formal training takes place in an organized fashion where the employees register to attend a training session on a specific topic. Informal training takes place at any time and any place with no organized method and or pre-planning.

A paradigm shift is currently taking place concerning training. Which the focus in the past was on formal versus informal training, the current emphasis is on the shift from episodic training to continuous learning and knowledge enhancement. Increasingly, employers are recognizing the importance of continuously upgrading the skills and capabilities of all members of the manufacturing work force (Tobin, 1993).

The challenge to trainers is to translate what is known about learning and teaching into the real-world work environment. However, this may be difficult. Business, content, time, and financial factors often compete for priority in designing training programs. New technologies can easily redirect the focus from learning efficiently to cost effectiveness. Thus, those doing the training need to

always keep in mind that their instruction should be based on sound learning principles.

In the workplace setting, learning is generally found in the form of training. Employees indicate that they spend much more time in informal training activities than in formal, employer-sponsored training.

Small and large companies benefit from training although larger companies provide much more formal training (Carnevale, 1984). Informal training is similar at both large and small companies (Benson, 1997, p. 1). A study of Honeywell managers concluded that 50% of the skills managers use come from day-to-day work experiences, 30% from interactions with others in the organization, and 20% from training (Marsick & Watkins, 1987, p. 22).

Experiences, interactions and training are all important, but learning how to learn is pertinent for adult learners (Knowles, 1970, p. 45) especially in a training environment. Training can provide a unique view of the determinants of user acceptance and insight into a companies willingness to accept or reject a new technology (Swanson, 1988). Therefore in order for businesses to produce more knowledgeable employees, who in turn will be more productive and bring more profits to the organization, employers must search out ways to get the most for their money.

One valuable source of financial and technical support are Universities. Universities offer a particularly rich source of:

> Technical and business practices assistance. Faculty and other members of the university staff are frequently available as consultants and contractors to private industry. When involved in state-sponsored technical assistance programs, faculty are more likely to focus on issues of advanced technologies in contrast to applying off-the-shelf, state of the market technology. These programs have found that, given proper training, students are an effective, affordable resource to assist both public and private service providers (National Research Council, 1993, p. 59).

In order to understand the impact of technology on employee training at various companies, we need to look at the following statistics. In 1996, is was reported in *Training* magazine that 82% of all organizations of more than 10,000 employees used some form of technology-delivered training, and almost all of it was for technical knowledge and skills. However, this conflicts with American Society of Training and Development State of the Industry Report in 1998 that stated training delivered by technology and self-paced methods accounted for only about 6 to 21% of all training, depending on the type of organization.

When looking to improve the effectiveness of traditional training methods, most trainers today are confronted with questions regarding opening up the gates to true workplace enlightenment through electronic learning solutions (Cohen & Rustad, 1998, pp. 30-37).

> There is currently a lack of research regarding how technology works for high-touch skills. For all the casual aplomb with which people talk about the increased effectiveness of soft-skills training with hi-tech, the fact is that nobody actually knows whether it is true. Despite stupendous advances in technology, the impact on the manufacturing industry has been less than spectacular, with about 75% of all training still being conducted in the classroom.

In a 1997 questionnaire conducted by the Instructional Systems Association, a trade group representing about 150 training suppliers and human resource and training staff from nearly 90 corporations were asked to indicate their current use of technology versus future use of technology for delivering non-technical training in the next two years. They predicted a 33% increase in using the Internet and an 18% increase in using CD-ROMs for non-technical subjects (Cohen & Rustad, 1998, pp. 30-37).

Trainers need to evaluate what technology can do for their employees. In this process, they need to understand the difference between the two. Hard skills or technical skills are based on concrete, sequential, discrete information and knowledge. There are right and wrong ways for processes to be done, and usually there are correct and incorrect processes. For example, an accountant can not argue about addition or subtraction; the answer is either right or wrong. When a CPA files a tax return, there are Internal Revenue Service rules and procedures that must be followed. On the other hand, there are times when a CPA needs to raise questions, consider the intent of certain rules, and interpret them accordingly. Moreover, the accountant has to be able to interact successfully with the client and IRS agents. This requires soft skills. Soft skills are typically culture-, gender-, and model-based. They are situationally determined and effective on a relative rather than an absolute scale. These factors make

soft skills extremely difficult to measure answers (Cohen & Rustad, 1998, pp. 30-37).

Technology can facilitate measurement and ultimately reduce training costs. Additional training opportunities exist internally in companies that add a new level of flexibility, accessibility, and interactivity. Intranets are localized Internets that are less expensive and easier to update than traditional networks and are spreading rapidly throughout the corporate world. More than 85% of Fortune 500 companies use Intranets to distribute information, questionnaires, and catalogues and use them for hard-skills training. But the 1996 Training report showed that of the companies using Intranets for training, only 17% were using them for interpersonal skills, 13% for customer service, and 13% for sales and marketing (Cohen & Rustad, 1998, pp. 30-37).

When organizations do not use Intranets for soft-skills training, it is usually due to technological barriers. Authoring software for training, for instance, is still being refined. Browser, HTML, and data interactivity are not where they need to be for many soft-skills training applications. In addition, electronic networks generally can not duplicate the real-time interactivity between learners that are present in a classroom. Learners in a classroom get immediate feedback from each other and their teacher. If companies use electronic networks companies may have to wait until someone logs into their computer to get

feedback. In a nonevent-based environment such as a self-study course as opposed to a workshop, it is hard to ensure participation (Cohen & Rustad, 1998, pp. 30-37).

Future challenges for training professionals include translating learning and teaching into the real-world work environment and understanding how business, content, time, and financial factors all compete for priority in designing training programs (Cohen & Rustad, 1998, pp. 30-37). Instructional designers play a central role in defining and developing programs, particularly in the soft-skills arena.

> Programmers can decide which code or method is best, marketers can make the call about what will sell and what won't, and facilitators can push for approaches they like. But without instructional quality as a compass point, a program's value to users will be diminished, no matter how dazzling the technical delivery (Cohen & Rustad, 1998, pp. 30-37).

A few factors that trainers need to take into consideration when designing a training environment include (a) being aware of the learner and understanding their motivation for participating in the training, (b) understanding and identifying training objectives and methods for measuring success and competencies, (c) engaging the learners, (d) understanding what the learner needs to know, (e) making sure the delivery design is compatible with the learner's needs, (f) making sure the learners have a chance to practice what they have learned, (g) always making the training accessible as needed, and (h) making the learning content relevant to the learner's actual work.

Training needs to have a task or problem-centered approach to learning. This approach needs to connect the learners to their work issues and challenges. This connection starts with the instructional designer's understanding of how different learners have different and very specific needs (Cohen & Rustad, 1998, pp. 30-37). Understanding specific learner's needs can be a challenge for multimedia training because of its nonlinear structure.

When designing training, the designer should make sure the leaner is focused and clear about what they learned, and the trainer should only include things that will help the learner internalize the information.

The trainer must also be aware of the training progression, which should move the learner forward, and make sure the learners are in control. If the learners do not know where the training is going, they are not likely to get there (Cohen & Rustad, 1998, pp. 30-37). Learners also need the opportunity to practice their newly learned skills (pp. 30-37). Just as with traditional training, Internet training should provide a range of ways for learners to review, repeat, and reinforce the learning in self-study and on the job.

One of the greatest strengths of multimedia training is its ability to accommodate a wide range of learning styles simultaneously (Cohen & Rustad, 1998, pp. 30-37). "It is hard to make traditional facilitator-led training programs work equally well for everyone. There is only so much that

one instructor can do in one classroom at one time. Technological solutions can overcome that limitation" (pp. 30-37).

As learning technologies and the instructional quality of technology-delivered learning continue to improve, the future for high-tech/high-touch looks bright. Still, even with many of the obstacles out of the way, it is hard to imagine a world where computers could completely replace classrooms for creating experiences that transform people's skill performance (Cohen & Rustad, 1998, pp. 30-37).

Trainers need to begin thinking in terms of "both/and" rather than "either/or" when it comes to high-tech versus traditional soft-skills training. Classroom learning has many strengths that include learning live face-to-face discussion, exercises, and feedback. Classroom instructors can capitalize on these true strengths by using CD-ROMs, Intranets, the Internet, DVD, and other electronic self-study tools to provide learners with basic information and concepts. Trained coaches, video-conferences, and online chat rooms can provide on-the-job follow up. Intranet tools are useful for questionnaires, self-assessments, competency profiling, directories, and references (Cohen & Rustad, 1998, pp. 30-37).

One of the most difficult tasks for instructional designers is making the mind set shift to training as real-time learning. In the past, learners have been programmed to think courses, classrooms, and workshops.

Computer Assisted Technology Transfer (CATT)

The Computer Assisted Technology Transfer (CATT) research project at Oklahoma State University (OSU) consisted of a research team of multidisciplinary graduate faculty and students. The project focused on the communications aspects of information technologies including computer-assisted technology transfer using the Internet and world-wide web. The researchers concentrated their efforts on understanding how Internet technology is diffused and utilized by Oklahoma small-to-medium sized enterprises. The researchers also examined which types of communication formats are most effective with different groups who have varying levels of skills and different objectives for using the technologies. The faculty and students used the results to develop, test, and deploy an electronic training tutorial directed to small and medium-sized enterprises SMEs to assist them in acquiring government contracts to manufacture parts for the U.S. Department of Defense (DOD).

Adult Learning

Small-to-medium-sized manufacturers face technology training issues every day. These issues vary from problem-solving skills to critical analysis of understanding how to get employees to adopt new technology and to then integrate the technology into their daily work environment. Furthermore, problems with learning exist in a global economy that mandates that employees need to have access to

global information quickly to remain competitive in the marketplace.

These learning problems are directly influenced by the leaner who determines the level of acquisition, interpretation, or assimilation of knowledge. The shift means that rather than focusing on education, the field of adult education focuses on the individual adult learner and how and what motivates them to learn.

The very term, adult education, suggests a focus on the educator; however, adult learning implies that the emphasis be directed to the learner (Fellenz & Conti, 1989).

Andragogy

Andragogy is an alternative set of assumptions about teaching and learning of adults that is completely student centered. Andragogy produces collaborative relationships among students and between the students and the instructor. Active participation in the andragogical model is in part a result of the maturity and self-directedness of adult learners.

Malcolm Knowles (1970) has emphasized the learner-centered concept, which has gained acceptance in the field of adult education. He takes an andragogical approach to learning. The definition of andragogy stresses the growth of self-direction in learning and the use of experiences of the learner in the educational process (Davenport, 1987, p. 6; Knowles, 1968). The androgogical approach is

characterized by a set of assumptions that the adult teacher has about the adult learner:

> There is a development of the self-concept from dependency to self-direction. Adults are encouraged to use their accumulated experiences as rich resource for learning. Readiness to learn is a function of the need to perform social roles. Adults have a problem-centered orientation to learning. For adults the more potent motivators are internal. (Knowles, 1970, p.22)

Andragogy is based upon learner-centered, self-directed methodologies. As learners better understand their own learning strategies, the more empowered they are to enhance their personal learning. "Trends in adult education and cognitive psychology that advance the understanding of the individuality of learning experiences and that promote learner self-knowledge and control of personal perceptions and judgments provide for potential empowerment of the individual" (Fellenz & Conti, 1989, p. 23).

Smith (1982) suggests that a central task of learning how to learn is developing awareness of oneself as a learner. When learners become more aware of themselves as learners they gain a self-understanding. Learners act as their own managers of change, and their focus of change is their own self-concept and learning processes (p. 57).

Learners have to conceptualize their own learning process, be able to pay attention to how they go about learning, and thrust themselves into managing the process (Smith, 1982, p. 30). Success relies on the learner possessing the following skills:

> The ability to develop and be in touch with curiosities (to engage in divergent thinking). The ability to

> formulate questions that are answerable through inquiry (to engage in convergent or inductive-deductive reasoning). The ability to identify the data required to answer the various kinds of questions. The ability to locate the most relevant and reliable sources of data. The ability to select and use the most efficient means for collecting the required data from the appropriate sources. The ability to organize, analyze, and evaluate the data so as to get valid answers. The ability to generalize, apply and communicate the answers to the questions raised. (Knowles, 1972, p. 163)

The Constructivist Theory (Bruner, 1966) deals with the concept of real-life learning. This theory suggests that learning is an active process in which learners construct new ideas or concepts based upon their current and past knowledge. The learner selects and transforms information, constructs hypotheses, and makes decisions, relying on a cognitive structure. This cognitive structure (i.e., schema or mental models) provides meaning and organization to experiences and allows the individual to go beyond the information given. This theory also encourages learners to discover principles by themselves and requires that the instructor and student engage in an active dialog (i.e., Socratic learning). In this process, the instructor is required to translate information to be learned into a format appropriate to the learner's current understanding.

Constructivist Theory also relates learning environments and learning communities to models for thinking about instruction. Dewey (1916) first identified "learning environments" where learning occurred through direct experience and was identified as an authentic task. A "learning environment" then becomes an active process on the

part of the learner where knowledge and understanding are constructed by the learner and are considered socially enhanced through conversations. A "learning environment" is mediated by the construction of external artifacts where the construction of artifacts leads to the construction of understanding. Real-life learning environments are created to offer learners an abundance of resources to explore.

Additionally, Tough (1971) looked at the individual learner and how adults go about learning in real life and what motivates them to learn. He found that on average 70% of adults had successful efforts to learn and change and were self-guided in their learning without relying much on professionals or institutions. Most adults participate in learning activities without even knowing it and have different motivating factors on why they choose to participate in certain learning activities based on their specific needs.

Adults voluntarily participate in learning activities for various reasons. Their personal motivations for participating in continuing education can be categorized, as either goal-oriented, activity-oriented, or learning oriented (Houle, 1961).

Adults have various motivational factors that influence their participation in adult learning activities. These include learning that enables them to respond to life crises, to participate in the innate joy of learning, and for a specific task purpose (Brookfield, 1983, p. 7). Adult

learners may also have external circumstances that precipitate, facilitate, and force learning (Knowles, 1977). Adults also choose to participate in learning to seek new knowledge and autonomy of direction in the act of learning and to promote change (Morris, 1961, p. 162; Simpson, 1980). Beyond promoting change, adults who participate in adult learning activities become their own makers of meaning and can freely challenge one another and feel comfortable in being challenged in a group culture (Knowles, 1980; Miller, 1994, p. 10).

The learning environment is very important to the process of learning for adults. One important element in the environment is the role of the teacher. The teacher must understand that "attention to increasing an adult's self-worth underlies all educational effort" (Brookfield, 1985, p. 48). Therefore, "what is important to consider is the nature of the teaching/learning transaction itself and the extent to which mutual respect, negotiation, collaborativeness, and praxis are present" (Brookfield, 1983, p. 9).

Adult learners are goal oriented and are interested in learning through problem-solving activities. Since adult learners are willing to assume responsibility for acquiring content on their own, the primary responsibility of the instructor is to facilitate the learning process by selecting appropriate learning activities and encouraging application of the content. By focusing in on their own

learning process, adults can pay attention to how they go about learning and thrust themselves into managing the process.

Employees in modern-America's work-environments personify the adult learner in that adult learners are self-directed, continuous, lifelong learners (Knowles, 1970, p. 23). The majority of today's employees are motivated to learn because they have a need to acquire new knowledge and skills to obtain and maintain a good job. If employees are to gain the knowledge required to achieve success for themselves and their employer, they will have to be self-directed, or they will be left behind and unemployable. Employees will be required to learn new knowledge and skills not just because they want to but because it is necessary.

Although "the behavior of the teacher probably influences the character of the learning environment more than any other single factor" (Knowles, 1970, p.42), it is ultimately the learner who determines the level of acquisition, interpretation, or assimilation of knowledge.

> Without taking away from the important role played by the teacher, what the student does is actually more important in determining what is learned than what the teacher does (Shuell, 1986, p. 429).

Adult education research recently has moved toward a focus on the learner, and Jarvis (1983) recognized the beginning of this change and affirmed that "the aims of the educational process are about the learners rather than about the profession of the wider society" (p. 41). The idea of the learner-centered approach to learning has been the focus

of change as the field of Adult Education has evolved over the past 25 years with a shift from education toward learning (Fellenz & Conti, 1989, p. 1). The learner, the learner's willingness to become involved with the subject matter, and the set of "tools" that the learner possesses to enhance learning are the driving forces that motivates the concept of self-directed learning.

Therefore, to facilitate a truly successful adult learning experience for employees, the trainer must skillfully direct the focus away from the role of the trainer and toward the needs of the employee. This shift deals with understanding how to meet a learner's specific needs instead of teaching information that is not relevant to the learner (Knowles, 1977). This focus on the learner was inspired by John Dewey's pragmatic approach to the learning environment and has been advanced further by the research of Kidd (1973). By understanding and meeting the learners' needs, the information being conveyed is much more meaningful and relevant to the learners, and the learners will be more apt to incorporate it into daily life. Kidd (1973) viewed this new emphasis on learning as the implication that adult education was finally moving from a field of practice toward a field of study.

An important part of learning is "knowing your way around" (Perkins, 1996, p. 5). While this skill is not often acknowledged in formal school settings, it is an important process in a manufacturing environment. Just as

people knew their way around their neighborhoods as children, knowing your way around when you participate in various learning activities combines a number of kinds of knowing including (a) having a sense of orientation, (b) recognizing problems and opportunities, (c) perceiving how things work together, and (d) possessing a feel for the texture and structure of the domain (p. 5). Knowing your way around encompasses (a) tacit knowledge, (b) focal awareness, (c) peripheral awareness, and (d) a sense of what is interesting and valuable (p. 6).

Knowing your way around resonates with the notion of real-life learning. Real-life learning (Fellenz & Conti, 1989; Sternberg, 1993) and knowing your way around can be critical. To apply what is learned to a real-life learning environment requires flexible orientation to what things and places they contain, what resources they afford, and how to get jobs done (Perkins, 1996, p. vi). People who learn their way around the Internet are learning more than facts, rules, and procedures. Being able to "get around" an information-rich environment is closely related to mastering the complexity of modern disciplines (cf. Kelly, 1994).

Adults learn for immediate results and have vast resources of experiences that should be utilized in the learning process (Knowles, 1970). When involved in a training situation, adult learners need to explore new ideas, skills, or bodies of knowledge within the context of

their past, current, and future experiences (Miller, 1985, p. 201).

One important part of the adult learning environment is the role of the teacher. It is important to consider that simply because adults are under the direction of a teacher that learning is being facilitated (Brookfield, 1985, p. 9). "What is important to consider is the nature of the teaching-learning transaction (p. 9). This can be accomplished by the teacher or trainer engaging the learner in a continuous and alternating process of investigation and exploration, reflection on this action, and then further action (Brookfield, 1983, p. 154-160). This alternating process of investigation and exploration allows adult learners to exercise and enhance their ability to problem solve and use problem-solving skills (Elias & Merriam, 1980).

When engaging the learner, there should be an emphasis on real-life learning, which is grounded in reality and practical knowledge. Real-life learning is distinctly different from school-oriented tasks (Wagner & Sternberg, 1986). Real-life learning needs can grow from the influences in the learner's social environment (Fellenz & Conti, 1989).

> Adults engage in purposeful learning projects on their own, outside of educational institutions and in many cases for purposes unrelated to educational credit. (Linkenbach, 1995, p. 11).

Transformation Theory

Mezirow's (1981, 1985) Perspective Transformation Theory has evolved since his initial research in the mid-seventies on women returning to work study. A similar basis for research in Australia (Martin, 1986, 1988) indicated that some factors in formal learning organizations inhibited any change in a person's view of self or in fact, her prescribed place in society. Transformation theory can be defined as an individual establishing new meaning where there exists uncertainty, and "naming" of a new reality by an individual who divorces themselves from what has been taken for granted. This uncertainty creates a transitional stage that allows people to name "what is" in new ways. Transformation theory allows the individual to take a self-directed approach to negotiate new meanings, purposes, and values critically, reflectively, and rationally instead of accepting social realities defined by others.

In the past, the Industrial Revolution discouraged transformative thought, critical reflection, and presuppositions by working adults. These adults were part of an assembly line and were discouraged from thinking on their own. Currently, the technology revolution requires working adults to think on their own and become their own makers of meaning. Meaning is an interpretation, and to make meaning is to construe or interpret experience and to give it coherence (Mezirow, 1991). Meaning is construed through cues, symbolic models, and language (p. 4).

Mezirow (1981, 1985) offers a complex theory all about the transformative nature of learning. According to Mezirow's theory, all meaning is based on interpretation; to make meaning is to construe or interpret experience. The critical dimension of adult learning is reflection or the process of validating ideas and assumptions based on prior learning.

Working adults acknowledge that within change exists a diversity of beliefs, values, and social practices. Adults can no longer apply old ways of knowing, but must "acquire new perspectives in order to gain a more complete understanding of changing events and a higher degree of control over their lives" (Mezirow, 1991, p.3). Learning is "the process of using a prior interpretation to construe a new or a revised interpretation of the meaning of one's experience in order to guide future action" (Mezirow, 1991, p. 12). Mezirow defines action as being broadly defined and referenced to include making a decision, revising a point of view, posing a problem, reframing a structure of meaning, or changing a behavior.

Mezirow's (1981, 1985) theory specifies two domains of learning: instrumental and communicative. Instrumental learning is the act of learning to control or manipulate the environment or other people such as through predictions or "task-oriented" problem-solving which is based on hypothetical-deductive logic. Communicative learning is the act of learning what people mean by coming to understand

values, ideals, feelings, and cultural concepts like freedom, love, and justice based on "abductive" logic where each step suggests the next (Mezirow, 1995, p. 49; Mezirow, 1991, pp. 72-75). Communicative learning often happens through the use of metaphors and analogies.

In addition to the instrumental and communicative domains, Mezirow (1981, 1985) distinguishes four particular types of learning that can be found in both domains:

1. Learning within meaning schemes - adding to, further differentiating or integrating ideas within pre-existing schemes.
2. Learning a set of beliefs, feelings, judgments, attitudes, and knowledge that make up a new meaning scheme.
3. Learning that transforms a meaning scheme through critical reflection on the content or process of problem-solving, rational discourse, and action.
4. Learning which transforms a meaning perspective.

Mezirow (1981, 1985) clearly believes that the responsibility of education is to foster critical reflection in students. In fact, two aspects of critical reflection can be identified. One examines external power relations and belief systems and the other looks at personal experience in the light of that examination. In other words, once people understand the social, economic and cultural structures in which they live, they can reassess personal experience and what has been learned from it in a more detached, objective manner. It could be argued that if students are not encouraged to critically reflect on the nature of power structures in society and within the

educational system itself, they might view themselves as failures if they are not part of the dominant culture.

Mezirow (1981) suggests that most adult educators conceptualize program development in terms of behavior to be acquired or tasks to be accomplished. He believes that when this "input" model is applied to Habermas (1984) theory of the emancipatory stage of adult learning, it is inadequate. The process central to perspective transformation is to engage the learner in identifying "real problems involving reified power relationships rooted in institutionalized ideologies"(Mezirow, 1991, p. 3) which has been internalized in the learner's "psychological history" (p. 3).

Identification of Models

The identification of various technology diffusion models can help manufacturers better understand how to diffuse new technology into their work environment. Several technology diffusion models have been developed over the years that would serve this purpose. Each model is specific to the context for which it was developed, has strengths and weaknesses that are relevant to the particular environment for which it is being used, but can be adapted to meet the needs of additional audiences. In order for a model to be effective, it must be implemented, and then data must be collected to measures the models success.

Some diffusion models include: Bozeman's ARCS Model, the Gatekeeper Model, and Motorola Model (Basili,

Daskalantonakis & Yacobellis, 1994). This research concentrated on the Gatekeeper and Motorola Model (Basili, Daskalantonakis & Yacobellis, 1994) although it is helpful to understand the history of technology diffusion models and their relationship to each other to understand their impact.

One technology diffusion model that emphasizes the need for employee training and understanding of the technology is the Motorola Model (Basili, Daskalantonakis & Yacobellis, 1994). This software diffusion model emphasizes that when trainers design technology training, they should include a variety of simulations, games, and drills to address people's different learning styles and preferences. Additionally, the model encourages the trainers to provide a printed action plan for employees to incorporate into their daily work, has employees try a new Internet skill weekly, has employees review the Internet training materials to assess their own growth, and allows employees to take control of their own training destiny.

In 1978, Bozeman worked with the information gleaned from a literature review to develop a model of a scientific information system for public agencies. The model mapped the flow of scientific and technical information in a typical public agency. The system contained five major components: person attribute, external social network, internal social network, organizational structure, and policy process and policy substance.

A related study dealt with the dissemination of technical information within a number of research and development organizations, Thomas Allen (1977) conducted an in-depth study regarding the manner in which information is passed among individuals and the strength of the relationship of these individuals. Developing his thoughts on the technological gatekeeper phenomenon, he discovered a correlation between project performance and technical communication outside of the project group. The data showed a statistically significant relationship between high project performers and high frequency of external communication. These findings highlighted the importance of intra-organizational communication to the success and quality of technical projects.

The individual level, frequency, and diversity of communication positively influenced the success of technology innovation (Ebadi & Utterback, 1984). The communication is thought to stimulate creativity, interest, and knowledge. All of these are known to promote project success.

Understanding communication between individuals is crucial to grasping the way in which information flows into an organization (Keller & Holland,1983). The flow of information into an organization can be viewed as the gatekeeper phenomenon (Allen, 1977). This concept identifies a group of people (gatekeepers) who tend to become more acquainted with information sources outside

their immediate community (p. 47). The information sources can be professional journals, other written information, or individuals from other organizations. The gatekeeper digests the external information, translates the data into an easily comprehensible format, and then presses the material to the appropriate members of the organization or department. The networking of information processing also takes place between the gatekeeper and others within and outside the organization. External information enters the organization through one gatekeeper and is passed on to other individuals within the gatekeeper network. These other gatekeepers then disseminate the external information throughout the organization (p. 48).

Several other models also apply to the diffusion of information in small-to-medium sized enterprises. One model is the Attention, Relevance, Confidence, and Satisfaction (ARCS) Motivation Model for Instructional Design (Keller, 1987). This model relies on arousing and sustaining the learners curiosity, relating the instruction to the learner's needs, matching the learner's challenges to the learner's capabilities, and providing the learner with extrinsic and intrinsic awards.

The attention aspect of the model relates to arousing and sustaining the learner's curiosity. To do this, the instructor must rely on perceptual arousal and offer inquiry and variability. For example, the instructor could introduce the idea of doing business on the Internet and

then cite statistics about the number of small manufacturers using the Internet to increase their business profits.

The relevant aspect of the model relies on relating the instruction to the learner's needs. This can be accomplished through relating the instruction to the learner's concrete language, experiences, and values and by laying out objectives as well as motive matching. Motive matching relates the teaching strategies to the learner's profiles. Confidence and satisfaction need to match the learner's challenges to the learner's capabilities and provide the learner with extrinsic and intrinsic rewards. By matching the learner's challenges to their capabilities, the instructor can identify and match the learners objectives with their capabilities, set varying skill levels, outline expectations for success, receive feedback, and promote an internal sense of control. The rewards can be applicable to the new knowledge or skills gained and can provide consistency toward appropriate challenges. The rewards can also provide positive consequences, which provide feedback to sustain desired behavior.

This model has numerous strengths and weaknesses. Some strengths include being prescriptive and descriptive. The model gives a how-to approach rather than just providing theory which has little or no defined application, which allows the instructor to take an active role and prescribe what should be done. This ARCS model reinforces the learner-centered design for instructors, and the application

of the model improves the motivation for repetitive and other intrinsically uninteresting material.

However, the model has some weaknesses. The models affective outcomes are difficult to quantitatively evaluate, and the continuous evolution of the model makes evaluation very difficult. This model would have been useful to implement in the CATT project, but was discovered after the two initial models were tested.

Internet Usage

Despite enormous growth of the Internet and its proliferation of tools, resources, and online communities, the connection between local learning environments and virtual learning environments remains tenuous (Watkins & Marenka, 1995). Manufacturing employee's acceptance and understanding of the Internet as a new technological resource remains to be a mystery. Although the Internet offers solutions to problems, answers to questions, and communication amongst professionals on a project, it is difficult to assess how and why individuals move toward Internet usage. Several questions have come into play when looking at motivators for manufacturing employees to use the Internet. These deal with the employees feeling comfortable with the new machine, affording Internet access and support, and having a new skill. All of these issues are valid and need further investigation by each employer. Because the Internet is interactive, it does not guess what users are

getting at when they ask it a question, and it does not try to figure out an unrecognizable word or syntax when it does not understand what the user meant. The Internet can be frustrating to those who do not know how to begin dialogue or how to restate their queries. Frustration can also stem from poorly organized information that is difficult to retrieve and down servers (Hopey, 1990, pp. 91-95).

In spite of the Internet's growth, most people remain on the sidelines, hearing media reports but staying a cautious distance away from time-consuming forays into the medium (Cronin, 1996). In the business world, some employees spend time exploring virtual worlds, some have engaged in public forums on specific issues, some have utilized the Internet for its research capabilities, and some have adopted the convenience of electronic mail (Cronin, 1996). Nevertheless, substantial numbers of small-to-medium sized enterprises remain largely unaware of the full array of resources available to them on the Internet.

On the positive side, the Internet is asynchronic, meaning anyone anywhere can use it at the same time regardless as to their time zone. Consequently, a user with a different work schedule, from their own, can also use it at the same time. The Internet fits well into distance learning, is a great collaboration tool, and has a plethora of information (Lam, 1986, pp. 174-178). This new communication tool relies heavily on the responsibility of and the money that the learner has (Rosen, 1997). Users can

determine the timing of their own access and can learn while they are at their personal best. Both night owls and early birds can use the Internet with equal success by logging on when they are ready.

Another positive feature of the Internet is that everyone can appear truly equal on the Internet. Once the protocols are understood, users all "look" pretty much alike. While there are no accents, skin colors, or age, strength, or beauty issues to deal with when one is at the terminal, certain barriers do exist rooted in culture, lifestyles, learning styles, paradigms, and comfort zones that are more difficult to overcome than technical barriers (Wilson, 1998). Some websites give users the option to have their page "translated" into the user's own language preference. Some computers have become user-friendly to handicapped individuals who may not have easy access to classroom learning, and the Internet has opened new worlds of hope to the disabled.

The Internet lends itself to almost any kind of learning. With new technologies, users can hear as well as see the spoken word or even music. There are, however, a lot of things that the user can not come to understand fully on the Internet. For example, one can learn the basics of good composition to know how to appreciate good art, but looking at digital photos of fine art is not the same as seeing the original painting. Being present for a live opera is not the same as hearing an opera recording. Coming

across an interesting article by surfing the web and then reading it is not the same as visiting the library and accidentally finding a book on a subject one did not even realize existed. Looking at vacation promotions about Scotland is not the same as traveling there.

Technology has always existed. It is a creation by humans to facilitate the accomplishment of something, but it is not, nor should it be, merely an end means to itself. Technology is an outgrowth of problem-solving efforts. It can often also influence further problem-solving and learning.

When learners explore the Internet and discover possibilities that may apply to their particular contexts, they can from needed practice and experience tailor it for their needs. The bookmark option on the Internet browsers is a learning process in itself because it permits the searcher to save pertinent Internet addresses and then to organize and personalize their bookmark resources for future needs and easy retrieval.

Individualization of the Internet is a great feature and is useful when the Internet is used for on-line courses. "The Internet offers tremendous potential to eliminate the academic isolation associated with learning at a distance" (Kubala, 1998, pp. 44-46). When employed creatively, the Internet can influence and enhance learning and reciprocally can influence what learners demand of it. Surfing the

Internet is like channel skipping on the television and can result in many memorable learning moments.

The Internet has the ability to link electronic files regardless of their location on the World Wide Web. Information shown in one location on a homepage may actually be located at several sites across the Internet. Homepages can be accessed using one of many World Wide Web browsers, which include Netscape, and Microsoft Explorer. These browsers allow the user to access information files though a graphical display interface that provides text or visual explanations of the accessible data.

The Internet cannot simply be "tacked on" as a cosmetic addition to an existing structure. As a new and competing culture, the Internet is bound to threaten existing conventions and cultural practices. Therefore, people who learn their way around the Internet are learning more than facts, rules, and procedures. Through Internet usage and similar collaborative learning environments, people can become enculterated into new disciplines and knowledge-building communities (Scardamalia & Bereiter, 1994). Students facing limited resources in their local environments (e.g., an under-funded, inner-city school) potentially can reach out to unlimited resources on the Internet. The possibilities are staggering, the Internet has the potential to be an "equalizer" that introduces novice outsiders into a rich community full of resources and expertise.

Within healthy local environments, providing clear guidance for practitioners is a challenge as they try to incorporate the Internet. Understanding the factors affecting use, however, should help employers get a better grasp of methods to bridge the gap between the two cultures.

Examining discussions of people posting to certain Usernet newsgroups, performing searches for World Wide Web sites containing particular topics, and contacting by e-mail the people found in these newsgroups. Or on Web sites can usually provide quick access to information. E-mail can make a person's life much better by reducing interruptions from phone calls, by allowing one to read and respond to e-mail when it is convenient for us, and by allowing them to be more proactive and less reactive. E-mail is independent of time zones so if someone sends an e-mail from a different country it can be read and responded to next time the e-mail is opened (Watkins & Marenka, 1995).

In addition to the manufacturing area, the Internet is being used for educational purposes. For example, literacy practitioners and teachers use the Internet for the following in priority order: e-mail communication, online instruction, research and information, professional development, and marketing information (Hopey, 1990, pp. 91-95). The Internet differs from the traditional learning media in that it demands the users learn and adapt to the (a) physical use of the computer; (b) complexities and idiosyncrasies of Internet organization; and (c) the

Internet's complete reliance upon technical transmission with the inherent Pandora-like problems therein of costs, breakdowns, server problems, and broken links (Hopey, 1990, pp. 91-95).

While the history of the Internet is important, the most interesting impact of the Internet is not its technology features but rather that it is putting people in communication with one another (Gates, Myhrvold, Nathan, & Rinearson, 1996). By putting people in communication with one another from all over the world at any given time, the Internet connects people from various backgrounds. That is why understanding the importance of the history of the Internet is directly related to understanding how various theoretical frameworks of cognitive psychologists and anthropologists are connected to understand the learning potential of the Internet. Within each of these theoretical frameworks, there are numerous barriers that must be surpassed in order to bring the Internet and the working organizational culture together.

Consequently, initial uses of a new technology tend to mirror existing educational forms and practices. However, eventually there will be a greater departure from traditional communication techniques within manufacturing organizations, which will allow the Internet to create new paradigms and approaches to learning (Blurton, 1994; Lemke, 1993). Adult Education can play a role in assisting the transition from traditional educational techniques to those

that will effectively help small-to-medium sized manufacturing organizations adopt the use of the Internet. One such aid in this transition can occur through the process of diffusion.

CHAPTER III

METHODOLOGY

Research Design

Descriptive Research

This study was descriptive research that involved the use of a questionnaire and observation. Descriptive research designs involve collecting data in order to test hypotheses or answer questions concerning the current status of the subject of the study. Descriptive studies determine and report the way things are. Typical descriptive studies involve assessing attitudes, opinions, demographic information, conditions, and procedures (Gay, 1992, p. 13). Descriptive research is more than asking questions and reporting answers. Since the researcher is asking questions to obtain answers that will add to the current body of existing knowledge in a specific area, questionnaires often have to be developed for specific studies (p. 213). Questionnaire development requires both time and skill.

In addition to questionnaire development, some descriptive studies involve observation. Observational research involves training observers so that data can be collected objectively and reliably (Gay, 1992, p. 13). Such

studies can be used to explore areas that are initially difficult to conceptualize and lay the basis for additional investigation. Descriptive studies provide "rich" contextual information within which additional quantitative findings can be interpreted (Guba & Lincoln, 1990, p. 160). Observational research is grounded in the naturalistic inquiry method, which allows:

> The naturalist to be committed in making his data and explanatory schemes as public and replaceable as possible. The naturalist details in careful fashion the nature of his sampling framework, triangulates his observations, and continually assess the empirical grounding of his casual propositions. (Denzin, 1971, p. 167)

Observations can be used to illustrate or exemplify what has been uncovered through more conventional evaluation approaches and can help audiences "make real" such findings by providing depth and description of participants' vicarious experiences (Linkenbach, 1995, p. 111).

A "naturalistic setting" refers to the fact that the variables that are being investigated are studies where and as they naturally occur and as they naturally occur. They are not controlled or manipulated by a researcher. Accurate understanding of particular behaviors requires familiarity with the context in which it occurs. This research was interdisciplinary in approach. Researchers with management information systems background conducted the majority of the previous studies that have been looked into technology diffusion. Management information systems researchers do not deal with the human aspect of technology diffusion and

therefore do not address why employees interact with technology and how it influences their behaviors and attitudes.

The field of adult education and adult learning principles provides solutions for technology diffusion researchers who have questions about how and why people adopt new technology. To understand real world settings, the findings should be derived from research conducted in real-world settings (Gay, 1992).

Phase 1: Internet Training Priorities

This study was descriptive, conducted in two phases, and funded by the U.S. Department of Defense as part of a larger study. In Phase 1, quantitative data from a questionnaire and qualitative data from interviews and observations were combined to describe Oklahoma small-to-medium sized manufacturing employees' views on implementing the Internet into their work environment. During Phase 1, the researcher asked the manufacturers questions enabling the researcher to determine if the manufacturers would benefit from the training being introduced and to ensure that the manufacturers were not too advanced for the training the university was providing. This process also established a clear set of objectives so that neither party would be disappointed in the end results. This process also enabled the researcher to identify how many of the companies

were currently using the Internet at their site and how many of the employees had previous knowledge of the Internet's usefulness.

This study had several aspects beyond the Internet training including model identification, selection, and implementation; questionnaire identification, modification, and dissemination; training design and implementation; quantitative and qualitative data collection utilizing a t-test to understand the questionnaire results, and observations and interviews. Each phase of the study required the researcher's input and direction to ensure the study was in compliance with what the College of Business Administration would be submitting to the U.S. Department of Defense.

Several priorities were established before the Internet training began. These were identifying two technology diffusion models, finding a technology diffusion questionnaire to measure the progress of the employees' use of technology, developing training to diffuse the models and technology, and collecting qualitative data to support the findings. The first task after the models were identified was to determine which technology diffusion model would be used at each manufacturing site. An additional task was getting the employees interested in the training by explaining how it would benefit them.

The first element prior to the beginning of the training was the introduction of the OSU-Stillwater graduate

students, and OSU-Okmulgee staff member who would be conducting the research. The next element was to explain that the U.S. Department of Defense funded the research in hopes that the manufacturers would use the Internet to conduct business with the U.S. Department of Defense. The third element was for the trainers to explain that one free year of Internet service was provided by the Northeast Oklahoma Alliance of Manufacturers Council and the U.S. Chamber of Commerce for the manufacturer's participation in the Internet training.

During the training, the OSU Internet training staff encouraged the employees to discuss their views about using the Internet at work to achieve their business goals. Respondents were told that all information shared would be confidential and that the data reported would only be categorized by company affiliation. Phase 1 of the study addressed manufacturing employees developing priorities to diffuse a new innovation, and this innovation was Internet usage. It brought together faculty and students from various academic areas at Oklahoma State University representing the College of Business Administration, the College of Education, and the OSU-Okmulgee business incubation center to rely on their expertise in creating a computer-assisted technology transfer training module for Oklahoma small-to-medium sized enterprises. However, before training could be conducted with manufacturers, a need existed for identifying and prioritizing the training issues

related to incorporating the Internet into current business operations and to utilizing e-mail and other services available on the Internet.

Delphi Technique

A research method that involves participation of outside experts under the direction of an individual researcher is known as the Delphi process (Dalkey & Helmer, 1963; Isaac & Michael, 1981; Linstone & Turoff, 1975). While this study did not utilize the Delphi design, it drew upon the concepts of the Delphi technique for involving others in the development and validation of the training modules and evaluation questionnaire. When used in curriculum development, the Delphi process utilizes opinions taken from a large group of experts and recognizes the values, needs, and perceptions of the individual. The Delphi process is also used to forecast and gather information from groups, and it is used extensively in business and industry for the systematic development of expert consensus (Delbecq, Van de Ven, & Gustafson, 1975).

Today's rapid and broad-ranged advancements in knowledge require several experts in one area and fewer masters of all areas. These specialized experts must combine their talents toward a common goal in order to be effective and competitive. The combination of talent is the strength of the Delphi process. It involves establishing several sources of knowledge and expertise and using these

collective judgments in a process that reflects interaction of the group (Jones & Twiss, 1978).

The Delphi process is based upon judgments of a certain group of experts who participate in various rounds of questioning designed to (a) collect individual opinion on likely future events, (b) gain a group consensus on those opinion, and (c) identify future events and their effects (Sommers, Baker & Isbell, 1984). The Delphi process works better with important rather than with trivial issues that might better be solved by an individual instead of a group. The Delphi process deals with inter-disciplinary solutions that affect many areas. The Delphi process was implemented in this study to combine opinions and expertise from the graduate faculty and students in the telecommunications and adult education areas.

The experts that were selected to formulate the study came from a cross section of academic areas representing graduate students and faculty in the areas of computer information, adult education, business, and management information systems. They were from the College of Business Administration and the College of Education. The blending of these various academic backgrounds created a cadre of knowledgeable people that utilized Delphi principles rather than administering a standard Delphi process. In a typical Delphi study, there are several rounds of data gathering. However, in this study the data guided the process.

Consequently, only one round was needed to find a general consensus to organize the training process.

The round of the feedback process elicited individual judgments, opinions, and perceptions from each member of the groups represented. At the information gathering sessions for the Delphi stage, the participants were presented with the purpose of the study and were asked to share their knowledge from their expert area that could enhance the study. The representative from education asked about various adult learning principles and technology diffusion models and was asked to work with the telecommunications management representative who was also asked to find information regarding technology diffusion models. The active relationship of these individuals, who represented different genders and cultures, added extra insight into the study. These two were also used as the technology trainers. The computer information system representative created a Power Point presentation-training module with input from the adult education and telecommunication management representative. The OSU-Okmulgee business incubation representative served as the manufacturer's first point of contact, and he identified the manufacturers that would be receiving the training. Concerns held by the faculty, graduate students, or business incubation representative regarding any phase of the study were also addressed. This process allowed these individuals to give input from their

perspective without feeling inadequate for not knowing what the other individual was talking about.

Faculty overseeing the research and representing the College of Business Administration and the College of Education analyzed the concerns about the study raised by the faculty, graduate students, or business incubation representative. They recommended the following important units for training the manufacturers: (a) Introduction, (b) Overview of the Internet, (c) Requirements for Accessing the Internet, (d) What Can We Do on the Internet, (e) Expanding Your Market, (f) Finding New Technology, (g) Enhancing Your Business Relationships, (h) Discovering Human Resources, (I) Discovering Financial Opportunities, (j) Services Available on the Internet, (k) Advantages and Disadvantages of Using the Internet, (l) How Much Does it Cost, (m) The World Wide Web, (n) Search Engines, (o) E-mail, (p) Other services Available on the Internet, and (q) Useful Sites on the Internet. Each of these areas in the training module was explained more fully by an Internet site that was visited by the trainer with the employees during their training session. The training modules were all put on a Power Point presentation and loaded on a laptop computer so that they could be taken to each manufacturer for on-site training.

Phase 2: Technology Transfer Questionnaire

Phase 2 of the study moved from the broad, general views and opinions of the academic experts about the

Oklahoma small-to-medium sized enterprises to the academicians understanding the priorities of the manufacturers in regards to Internet technology. Without first identifying the various views from the academic experts before bringing their views to the manufacturers, the training would have lacked a theoretical foundation. In turn, these general theoretical views would have proven to be meaningless unless they were put into action. Therefore, the academicians conducted a thorough literature review in the area of technology diffusion to familiarize themselves with the current research and then prioritized the research as it related to the small-to-medium sized enterprises.

Based on the findings and recommendations from Phase 1, the Oklahoma State University Computer Assisted Technology Transfer Training project and the OSU-Okmulgee Business Incubation Center received continued funding for Phase 2 of the project from the U.S. Department of Defense. Phase 2 allowed the researcher to train Oklahoma small-to-medium sized enterprises on how to use the Internet to enhance their business opportunities in dealing with the U.S. Department of Defense.

During Phase 2, follow-up research was conducted to see if the manufacturers implemented the Internet into their work environment. This phase included both quantitative and qualitative data collection and analysis through the administering and collection of a questionnaire. The quantitative data from questionnaires produced findings that

could easily be expressed in numerical form to determine the employees perceived ease of use, usefulness, and self-efficacy regarding the new technology. The qualitative data findings gave a clearer understanding of the manufacturing employee's feelings about the new technology and identified what motivated them to learn.

This study gathered both qualitative and quantitative data about technology diffusion and reported it in a narrative form that would allow the voices of those using the technology to be heard. The employees voiced their opinions about what they liked and disliked about the new technology and about what they liked and disliked about the technology training.

Sample

"The population is the group of interest to the research, the group to which he would like the results of the study to be generalizable. The defined population has at least one characteristic that differentiates it from other groups" (Gay, 1992, p. 125). The population for this study was 30 northeast Oklahoma small-to-medium sized manufacturing enterprises with less than 200 employees. These manufacturers were selected because of their previous working relationship with the OSU-Okmulgee business incubation program representative through their involvement with the Northeast Oklahoma Alliance of Manufacturers and because of their willingness to volunteer to receive the

training. Each manufacturer was chosen to receive either the Motorola Model (Basili, Daskalantonakis, & Yacobellis, 1994) or Gatekeeper Model (Allen, 1977; Zelkowitz, 1996) because of the process by which information is disseminated within the organization. The technology training that was used to convey the models was the same.

A sample is the selection of "a number of individuals for a study in such a way that the individuals represent the larger group from which they were selected" (Gay, 1992, p. 123). Several methods exist in selecting samples for research studies. Selecting the sample is a very important part of the study. The "goodness" of the sample determines the generalizability of the results (Gay, 1992, p. 125). A purposive selection process is the most appropriate method to obtain a meaningful selection for qualitative data gathering (Guba & Lincoln, 1990). In purposive sampling, participants are selected because they possess a specific characteristic and are likely to possess certain knowledge.

Training

In order to determine the acceptance of the training by the users and their willingness to use the new technology, each employee, who participated in the training, completed an anonymous questionnaire after the training session and put it into a sealed envelope for the trainers to take with them. The number and gender of employees at each company who participated in the training varied at each site. The

employers selected those involved in the training. The research team conducted the Internet training. The research team consisted of a graduate student from OSU from the area of either Adult Education or Management Information Systems and the OSU-Okmulgee business incubation representative. The training lasted two hours at each site and the format of the training depended upon what technology diffusion model was being utilized. The Gatekeeper/Adult Motivation Time Continuum Model training was given to manufacturers with two employees and dealt with training and asked for no feedback or accountability measurement. The Motorola Model (Basili, Daskalantonakis & Yacobellis, 1994) training was given to manufacturers with more than two employees and had a check-up section after each new component of the training was introduced. The check-up section allowed the trainer to ask the employees to recall the information that they had just learned. This served to reinforce the new technology to which they were being exposed. The training used a laptop with a Power Point presentation that was presented to employees in an office, break room, or training center. The training provided a brief introduction and overview of the Internet through website demonstrations with an explanation of how the Internet could be helpful to the manufacturer's business practices. The training also briefly explained services available on the Internet, the advantages and disadvantages of using the Internet, the cost of access to

the Internet, and a brief introduction to e-mail and its uses.

Development of Questionnaire

The categories and items used for questionnaire development were adapted from those developed by Davis (1989) and Compeau (1995) which measured word-processing software diffusion among college freshman. By combining these two questionnaires, the Technology Diffusion Questionnaire was created. The two questionnaires upon which this one was based had not been used in the area of adult education, and the authors had not reported on their questionnaire validity in their research. The Technology Diffusion Questionnaire had several items that included measuring whether or not an employee would be more likely to diffuse technology into their work environment. These items were pilot tested with Computer Assisted Technology Transfer OSU graduate students. The questionnaire was further refined after the students gave their input, which included making the questionnaire simpler to understand and quicker and easier to complete.

Whether testing hypotheses or seeking answers to questions, the questionnaire that is used for collecting data in a study must be valid and reliable. Validity is the degree to which a test measures what it is supposed to measure (Gay, 1992, p. 155). A test is not valid per se; it is valid for a particular purpose and for a particular

group. In other words, the issue is for what and for who is the questionnaire valid (Gay, 1992, p. 155). Since tests are designed for a variety if purposes and since validity can be evaluated only in terms of purpose, it is not surprising that there are several different types of validity such as content, construct, and criterion-related validity (Gay, 1992, p. 155).

The two types of validity that are most relevant for the questionnaire developed for this study are construct and content validity. "Construct validity is the degree to which a test measures an intended hypothetical construct" (Gay, 1992, p. 157) such as Perceived ease of use, Perceived usefulness, and Self-efficacy. A primary concern for any questionnaire concerns the theory that it is measuring. Construct validity "is probably the most important form of validity from the scientific research point of view" (Kerlinger, 1973, p. 457). The best way to ensure content validity of an questionnaire is through an independent study such as the review of experts in the given area (Gay, 1992, p. 158). The content validity of this questionnaire was established through a process of rigorous critiques, rewrites, and revisions involving the input from (a) faculty and students from the area of Management Information Systems who have developed similar questionnaires, (b) graduate students involved with OSU's Computer Assisted Technology Transfer project, (c) faculty in both OSU's College of Business Administration and College of Education, (d) staff

from OSU's Okmulgee Technical branch in their Business Incubator Program, and (e) Oklahoma small-to-medium-sized manufacturers. The Delphi process of multiple rounds of input gathering was utilized to get validity. A Delphi process included sending out a draft, having it returned with comments, then sending it out again as the final questionnaire. The end result was a questionnaire which gathered pertinent information and which addressed in the proper language the primary issues of perceived ease of use, which measured how the employee's felt about how easy the technology was to deal with; perceived usefulness; and self-efficacy associated with Internet usage. Through this process, the questionnaire was developed with the assistance of those who use or who might be inclined to use Internet technology in their daily work environment.

The Technology Diffusion Questionnaire was used to measure whether or not the employees at the small-to-medium sized enterprises would diffuse the Internet technology into their work environment. The questionnaire was divided into three parts. The first section solicited information related to the person's individual experience and the ability to better achieve personal business goals by using the Internet. The other sections dealt with the areas of attitudes toward using the Internet on the job and learning to operate and interact with the Internet, and Internet Usage and Usefulness with 6 questions. The self-efficacy section asked if the employee could better achieve their

business goals by using the Internet for the employee to rank on a Likert Scale. In the self-efficacy section of the questionnaire, each of the 10 statements dealt with the employee's confidence and feelings in using Internet technology. This section also asked the employees if they would be more likely to ask someone else for help to understand how to use the Internet or if they would be more apt to consult a manual or help tutorial. The section also asked the employees if they had more time to figure the technology out, would they be more apt to solve a work-related goal. The perceived usefulness section asked whether or not the Internet would help the employees do a better job, increase their productivity, be more effective on the job, and whether or not the employee found the Internet useful. The perceived ease of use section dealt with whether or not the employee can operate the Internet, if the employee can get the Internet to do what they want it to, if the Internet is easy to use, and if the employees are able to interact with the Internet.

Observations

Perceived ease of use, perceived usefulness, and self-efficacy were observed at each Northeast Oklahoma small-to-medium manufacturing site using observations and follow-up phone interviews. Although qualitative approaches such as observations and interviews are most often associated with exploratory studies (Merriam, 1988), these approaches can

also be used to clarify and enrich areas that have been studied quantitatively. Qualitative approaches can give substance to previously identified areas of focus to "flesh out the bones...to bring the results to life" (Patton, 1990, p. 131). In order to conduct a thorough qualitative study one must first understand the "knowledge of the people, of their culture, and their psychology" (Spicer, 1952, p. 67). Therefore, the purpose of the interviews and participant observations was to obtain rich descriptive data and detailed information and to answer questions to supplement the responses of the employees on the Technology Diffusion questionnaire and provide information on assessing how well the models predict and explain voluntary usage of Internet technology.

Two months after the initial training, observations were conducted for 8 hours at 3 manufacturing sites for a total of 24 hours. These sites were easily accessible and were chosen to give a range in the various sizes of participating companies and to provide a better understanding as to what motivated the employees to use Internet technology. In order to maintain the anonymity of the companies, acronyms designating which company received either the Motorola Model (MM) or Gatekeeper Model are (GK). Manufacturers names are withheld, but they have been identified with a pseudonym name. The names include Jynx™, Kakuna™, Tangela™, Bulbasaur™, Onix™ (MM), Floreon™ (MM),

Pinsir™, Ekans™, and Arbok™. The three sites that were observed were Kakuna™ (MM) with 200 employees, Ekans™ (MM) with 100 employees, and the Bulbasaur™ (GK) with 5 employees. The smaller manufacturer was located in an urban area, and the other two were located in a suburban and rural area of northeast Oklahoma. The observations were conducted by the OSU-Stillwater graduate student sitting in a chair in an unobtrusive area at each site observing employee interactions and usage of technology. At one site the OSU graduate student had to walk around the site to view the employees who participated in the training.

Interviews

Two follow-up phone interviews were conducted with each of those who participated in this phase of the study. The first interview was conducted two weeks following the initial training session. The second interview was two weeks later. Each interview was approximately 30 minutes in length. Interviews were conducted with 10 sites identified by the OSU-Okmulgee business incubation representative who had been working with the manufacturers.

The interviews were conversational in manner, and the format followed the broad framework of the Technology Diffusion questionnaire as a guide. These broad, open-ended questions initiated discussion of Internet usage at work, and they initiated more specific questions to further probe

their use of the Internet by asking the following questions: (a) How often do you use the Internet and for what? (b) Do you like using the Internet? If not, why? If yes, why? (c) Has it made your life easier or less time consuming? (d) When do you plan to adopt the new technology? (e) When did you buy your fax machine and computer? (f) How often do you use e-mail? (g) Have you contacted or been contacted by companies using e-mail? And (h) Have you designed your own home page?

CHAPTER IV

FINDINGS

Thirty manufacturers were involved in the study because of their previous working relationship with the OSU-Okmulgee business incubation program representative through their involvement with the Northeast Oklahoma Manufacturing Alliance, because of their willingness to allow the Computer Assisted Technology Transfer Project team to conduct the training at the manufacturers site, and because of their willingness to consider doing business with the U.S. Department of Defense in the future. The OSU-Okmulgee representative scheduled the training sessions at both rural and urban manufacturers. The majority of the manufacturers were located in rural or suburban areas; only two manufacturers were located in the Tulsa area. The manufacturers varied in size from husband-and-wife operations to those that had approximately 200 employees. Two manufacturers were corporate owned while the remainder were privately owned. The manufacturers produced a variety of items including boat trailers, an artificial sweetener, parts for larger manufacturers, bows and arrows for Olympians, screws and bolts, and special items requested from them.

Likewise, the employees who participated in the training were diverse. They included engineers, secretaries, company owners, technology trainers, and front-office clerical help. Each company had no less than 2 employees participating in the training, and 1 company had over 20. Some of the employees shared that they had bachelor degrees while the majority was less educated. Some employees spoke of their eagerness to get on the Internet while others spoke of their apprehension about using new technology and accessing the Internet. The company owners or the plant manager in corporate owned companies selected who would receive the Internet training and access to the Internet on their work computer.

Analysis of the Questionnaire

The Technology Diffusion Questionnaire was distributed to each employee participating in the training sessions. It was completed by 25 participants at sites operating under the Motorola Model and by 9 at sites operating under the Gatekeeper Model. A t-test was conducted on each of the 22 items in the questionnaire to compare the two groups "to see whether the differences between group means are large enough that the corresponding population means are different" (Huck, Cormier, & Bounds, 1974, p. 49). The t-test can be used to compare the means of two groups; "if the two sample means are far enough apart, the t-test will yield a significant difference, thus permitting the researcher to

conclude that the two populations probably do not have the same mean" (p. 50).

The responses of the participants in the Motorola Model group and the Gatekeeper Model group were not significantly different (see Table 1). No differences were found on 21 of the 22 items. The groups differed only on Question 2 in the Self-Efficacy section of the questionnaire. This item dealt with the participants being able to better achieve their business goals by using the Internet when they had never used a computer before for a task. On the 7-point Likert scale with the options of 1 = Extremely Unlikely, 4 = Neutral, and 7 = Extremely Unlikely, those in the Motorola Model group scored 3.2 while those in the Gatekeeper Model scored 1.8 indicating that they were less likely to achieve their goals if they had not used the computer before. Because this was the only difference on the overall questionnaire, it was judged that the two groups did not differ on the three areas measured by the questionnaire.

Table 1

Comparison of Motorola Model and Gatekeeper Model Participants on Technology Diffusion Questionnaire

	t	df	p
Self-Efficacy			
1	1.46	32	.15
2	2.35	32	.03
3	1.77	32	.09
4	.60	32	.55
5	.46	32	.65
6	.06	32	.96
7	.01	32	.99
8	.05	32	.96
9	.82	32	.42
10	.31	32	.76
Perceived Use			
1	.12	28	.90
2	.00	31	1.00
3	.31	31	.76
4	.06	32	.95
5	.15	31	.88
6	.39	31	.70
Ease of Use			
1	1.60	32	.12
2	1.53	32	.13
3	1.10	32	.28
4	.76	32	.45
5	1.36	32	.18
6	1.87	32	.07

Huck, S., Cormier, W., & Bounds, W. (1974). Reading statistics and research. New York: Harper & Row.

Employees' Perceptions of the Internet Training

Observations and interviews of Oklahoma small-to-medium sized manufacturing employees who participated in the technology training identified the following themes: (a) access, (b) resisting technology, (c) technology acceptance, (d) technophobia, (e) clear payoff, (f) technology adoption, (g) scaffolding, (h) hand-holding, (i) tracking information, (j) acceptance by employees of the trainers, (k) interoffice

communication, (l) implementing technology change, (m) prioritizing Internet opportunities, and (n) recreational versus personal use of the computer.

The qualitative data revealed why people choose or do not choose to implement new technology. Observations and interviews were conducted at the manufacturers to gain a better understanding as to what motivated the employees to use the new technology and how they felt about the technology.

Acceptance by Employees of the Trainers

Researchers who work with small-to-medium sized manufacturing populations need to be accepted by the population being studied. The employees were much more courteous and open to answering the researchers questions when the researcher was dressed in casual attire. This acceptance amongst the manufacturers gave the researcher insight that would have not been provided otherwise and allowed the researcher to develop relationships with the employees. This acceptance was evident when Tracy at Floreon™ (MM) accepted started heating up popcorn during the training session, and shared it with the trainers. This act helped form a bond between the three employees receiving the training and the two trainers. A similar bonding between the employees and the trainers occurred at Ekans™ (MM). Here the company was hosting a chili cook-off contest the day the trainer went to observe. Vince and Brian

offered the trainer chili and then pie for dessert. At both of these companies, employees dressed casually in jeans and T-shirts, and the employees were friendly and easy to talk with.

Because of cultural factors related to the images of various universities in the state, the trainers were not warmly received at all training sites. For example, employees from Kakuna™ (MM) were suspect of the researchers. When Oscar, the Kakuna™ (MM) technology trainer introduced the researcher to an employee, he said he would not take the time to talk to someone from Oklahoma State University (OSU). But when Oscar introduced the researcher as being from Oklahoma State University-Okmulgee the technical branch of OSU, located just down the street, they were willing to talk about their experience with the technology. A similar situation occurred when the engineers from Kakuna™ (MM) mentioned that they were University of Oklahoma (OU) graduates and that they would not talk to an OSU employee. The Oklahoma division between its two major universities obviously runs deep within the culture.

At another site, a conducive climate for training was established by talking about football. At Ekans™ (MM) the employees asked the researcher about the football team and about the teams coaches and players. The employees said that they were big OSU football fans and they thought the researcher might have some insights on information about the

team. In Oklahoma, football is a cultural past-time, and although it had nothing to do with the technology research or training, the employees were able to feel connected to the researcher by identifying their common knowledge, which was the football team.

Access

Access to technology takes time and training. Before employees can be trained, and use a new technology they must first have the equipment. In this project which involved the use of e-mail and the Internet, the equipment included a computer, a computer modem, and an Internet service provider. Some of the manufacturers did not have any equipment, and therefore their rate of adoption was much slower then those with computers. Some employees after receiving the training bought a new computer for their home usage to access the Internet. However, Tamryn from Ekans™ (MM) found the training to be helpful in understanding the basics of the Internet, she does not use the Internet at work because she is too busy and because her computers at home and at work are not compatible with each other.

Lack of access also affected some employees' attitudes about the new technology. Some employees at Jynx™ (GK) in Henryetta, OK felt it was not worth their time to learn about the Internet because they did not have a computer yet. These negative attitudes can affect how and what people choose to learn.

Access for some employees was an important issue. Some of the manufacturers at Onix™ (GK) had difficulty getting on-line during the day. Because of this difficulty, at Onix™ (GK), the trainer installed the capability to access the Internet on the owner's home computer. This allowed the owner's wife, Judy, to send the company payroll via e-mail to the office. This saved Judy a trip to the office since she had been out of the office sick. Judy stated, "I can't get on during the day, the connection seems to be overloaded." Therefore, Judy logged on the Internet at home and in the evening.

Resisting Technology

Some people actively resist technology on grounds of principle, believing technology influences their lives in negative ways. To address this concern, employees need skills and tools to manage the complexity of the technology and to retain a sense of control over the technology. Some employees such as Mike at Pinsir™ (GK) resist technology because there is too much information to absorb on the Internet. Mike sees the Internet as an open-ended tool, but "the World-Wide Web is a garage sale. There's so much junk out there! I have to be selective in how I spend my time and what resources I use."

Mike at Pinsir™ (GK) was apprehensive about using the computer for Internet and e-mail even though he had been

using the computer for spreadsheets since 1984. Mike did like the tutorial on the OSU home page, which demonstrated how to use the Internet. Bill, owner of Pinsir™ (GK), stated, "Mike and I tried to get on the Internet to do some research, and it was burdensome and cumbersome. We don't have enough time to use it." Bill felt that:

> If the Internet was easier to use and on my level, I would use it. Where we got hung up was trying to do our own research. We would rather use a consultant to do the searches. It is probably just a matter of using it. Lack of use is not contributed to intimidation. I have not had much time to adopt it as of yet, even though I've been using computers since 1982. We've had two people contact our company after seeing our company listing on the Northeast Oklahoma Alliance for Manufacturing Home Page listing. They tried to put a deal together to supply parts to other companies. All this stuff will fit together at one time. We are currently working on distributing a brochure that's being made and bits and pieces from the brochure will be included on our home page to help us find potential customers.

Technology Acceptance

Some employees have remained static or resistant toward technology use while others dynamically appropriate technology into their work environment. John Clabo from Bulbasaur™ (MM) implemented the technology immediately after being trained. John at Bulbasaur™ (MM) started tracking daily the packages that he shipped via United Parcel Service to ensure that his shipments of parts were arriving at their destination on time. Personnel at Kakuna™ (MM) also used the Internet to track their UPS

shipments. Because John at Bulbasaur™ (MM) could tell his clients the exact date the product he manufactured would arrive, they were happier and let him know they appreciated the accuracy of the information. Thus, John at Bulbasaur™ (MM) felt that the Internet kept him more informed about company product shipments. Indeed, John was so excited about the results of the Internet usage that he tracked me down in the parking lot of Onix™ (GK), which is adjacent to the Bulbasaur™ (MM) parking lot, and told me that the training was beneficial and that they loved using the Internet and e-mail. John also asked me to come inside the factor to see how they were using the Internet. He also shared with me that if they had not received the one-on-one training their company would not have adopted the technology as quickly as they did. John also reported that other companies were already contacting his company via e-mail about bidding for other jobs because of the information that was listed on the Northeast Oklahoma Manufacturing Alliance's home page. John reiterated that he would not have sought this Internet training out of his own.

The increased use of new technology can simulate the employee's personal and professional growth, which can stimulate the use of new resources and tools via the Internet to more effectively run the business. This growth is reflected by the expanded use of technology. John at

Bulbasaur™ (MM) experienced a major shift in how he thought about and used the Internet;

> What I wasn't tuned into at first was my potential role on the Net--that I could be a resource for others; that I could have a site and offer my wares to the world. I now use the Internet almost every day to communicate.

The participants had different levels of use and interest toward the Internet following the training. John at Bulbasaur™ (MM) used the electronic medium to communicate globally with sales people. However, others such as Ed at Onix™ (GK) and Mike at Pinsir (GK) saw using the Internet as a cumbersome, time-consuming activity. While Mike Mike from Pinsir™ (GK) is an active e-mail user, he does not take full advantage of the Internet resources that were introduced in the training because he feels that

> The Internet is very time consuming and takes a lot of effort to search and/or monitor the Internet for my companies needs. I realize that the vast amount of information available could be invaluable, but I do not currently have the time or the inclination to fight the technology as well as the effort needed to find what I need.

Manufacturing employees had various levels of Internet acceptance. This was demonstrated consistently between their interview comments and questionnaire responses. The responses demonstrated the usage diversity the Internet can provoke, which creates local cultures within organizations. Local culture is defined as the culture within the manufacturing organization. Several employees including John at Kakuna™ (MM); Joann and Mary from Ekans™ (MM); and Ed

from Onix™ (GK) made a conscious, reflective choice to avoid using Internet technology within the local culture.

Overall, the local manufacturers that participated in the training are moving toward Internet usage, but they are far from assimilating the new technology. At Ekans™ (MM), Bulbasaur™ (MM), Onix™ (MM), Kakuna™ (MM), and Pinsir™ (GK), e-mail usage was becoming routine. For example, John of Bulbasaur™ (MM) used e-mail to communicate with numerous sales people throughout the world that he has since hired to work for him on an independent contractor basis. John indicated that without e-mail this was not possible because of the time zone differences and cost involved.

However, Internet usage, which included looking up information and setting up a home page to market the manufacturers goods, varied dramatically at each of the manufacturers with employee differences playing a key role in the variation. Two years have passed since the initial training. The Northeast Oklahoma Alliance of Manufacturers Home page reveals that the majority of the manufacturers who participated in the training all have a link to this home page. Most of the manufacturers have their own home page and an e-mail address where they could be contacted using the e-mail address listed on the Northeast Oklahoma Alliance of Manufacturers Home page, an attempt was made to contact the companies in order to do a follow-up survey concerning their use of the new technology. However, none of the

employees responded to this e-mail. In addition a follow-up questionnaire similar to the one they initially filled out at the training was sent to all the manufacturers, but none were returned. This could be because they are all to busy to reply, because they do not access that particular e-mail address, or because the companies have had a large turnover and the employees who participated in the training are not with the company.

Technophobia

Technophobia is a term used to describe someone who feels inadequate when using technology and avoids using technology because it causes uncomfortable feelings. Technophobia is common because it seems there is always some new technology demanding to be learned. Technophobia is usually triggered by two things: (a) a belief in the value or necessity of learning and using new technology and (b) feelings of incompetence of inability to learn the new technology (Wilson, 1998, p. 24-29).

Jynx™ (GK) is a small operation with five employees. At the time of the training, the company did not have a computer, and hesitated on purchasing one because their lack of knowledge about technology. When the follow-up interview was conducted 6 months after the initial training, the company still had not purchased a computer. Sharon seemed embarrassed that the company had not purchased a computer and made excuses for why they had not. Sharon mentioned

they would like to grow and was looking into purchasing a computer.

Many people have deeply ingrained feelings of incompetence regarding technology. Feelings of inadequacy can lead to a condition of "learned helplessness" where the person quits trying to learn and becomes entrenched in the avoidance of technology (Wilson, 1998). When reinforced by past experiences of failure, persisting avoidance behavior only widens the knowledge gap. This can lead to a vicious cycle of avoidance, growing incompetence, and feelings of inadequacy (pp. 24-29).

Through the follow-up phone interviews, Jynx™ (GK) employee Lynne shared that she had not bought a computer yet because she was not confident in using the technology, and Mike from Pinsir™ (GK) indicated that he did not feel comfortable using the Internet because there was too much information and he felt overwhelmed with all of the choices. Richard, an older individual at Kakuna™ (MM) with less technological experience, mentioned "I would rather go to the library and find a book then use the Net because it has too much information." Richard's remark indicated that he felt guilty that so much information was available and so easy to find, and that accessing information should be a chore. John at Kakuna™ (MM) mentioned, "I need more time to practice with and work with it." John also mentioned the

training taught him to do basic things and that over time he would find it more useful.

Clear Payoff

There needs to be some compelling need for employees to engage in learning a new technology. Otherwise, employees will wonder, as Mike at Pinsir™ (GK) did, "how is this gonna help me down the road?" Mike used the example of his wife pressuring him to use Quicken for their personal finances. "I have always known exactly what I have in the bank within $5. What do I need Quicken for?" Likewise, Mike at Pinsir™ (GK) mentioned,

> You can chase your tail looking at swell things on the government's home page, but it does not tell you anything. I personally think that it [Internet] is not real helpful. But it will soon be structured and formalized and useful five years from now.

John at Bulbasaur™ (MM) estimated that his company was saving $30 for each bid submitted via the Internet. In the past, the bid was sent via overnight courier, and now they are being sent via e-mail.

Employee's who had been trained, including Greg at Floreon™ (MM), recognized that in order for the company he worked for to be competitive, they would need to implement the new technology quickly. Greg at Floreon™ (MM) mentioned that he thought that the Internet will soon replace our phone systems. John at Bulbasaur™ (MM) made the analogy that when fax machines were first introduced and cost

several thousand dollars, he went out and bought one and put it into his home, which was his office at that time. John did the same when he bought his first computer and began using the Internet. John thought if he was the first one to use a fax machine, he would have a competitive edge against other companies that had been in business longer than he had. John recognized that competition motivates people to adopt technology when he said, "We can work better and smarter if we start using Internet and e-mail."

Technology Adoption

Most employees have preconceived notions about how new technology can help them, and the majority of the employees had already made up their minds on whether or not they would implement the new technology before the trainers had trained them. The majority of the small-to-medium sized Onix™ (MM), who did not have computers, were only interested in purchasing computers if they knew they had to because they would get more business and if they felt that the technology would give them an edge.

As employers look for creative ways to gain a competitive edge, they often turn to a new technology for that edge. Often small employers do not have the financial resources or the time to incorporate new technology into their work environment. Mike at Pinsir™ (GK) noted that he does not have time to look up information on the Internet because of the time it takes to sift through all of the

stuff he does not need. However, he believes that as the Internet grows in use it will become more organized.

Floreon™ (MM) has developed a home page where customers can view their products. This saves time and money so people do not have to wait for overnight packages to arrive with pictures and dimensions of what they need. Bulbasaur™ (MM) has been in business for one year, and Onix™ (GK) has been in business for 100 years. Bulbasaur tm (MM) has received some international inquiries about the possibility of producing parts for larger manufacturers via an e-mail inquiry. The commitment to adopt the technology expediently was not the case at Onix™ (GK) where the owner Ed felt that his company had been in business for 100 years and therefore did not need access to the Internet to increase its business. They already had more business then they could handle, according to Ed. Ed seemed to be committed to the old adage "if it is not broke don't fix it."

During the training, the trainers tried to demonstrate how the manufacturers could not only increase their business profits but could also be more productive and efficient by using e-mail to communicate within and outside the company. One of the Onix™ (GK) older employees, Tim, tied to demonstrate this to Ed, the owner. When Ed was calling around looking for a particular part and was having no luck, Tim looked on the Internet and found a part supplier in

Texas and e-mailed the size specifications. Ed was still slow to accept the technology and would rather do business the old fashioned way. By not adopting the new technology, Ed can be categorized as a laggard according to Rogers (1995).

Scaffolding

People need a scaffold or support structure in place as they engage in complex performances outside their normal repertoire of skills. In the case of the Internet, a complete scaffolding system seems to include a supportive, non-judgmental, social support system. Support systems in the manufacturing sector include employees helping other employees without feeling threatened due to their lack of knowledge. Oscar, Kakuna™ (MM) pointed out that one weakness in training sessions is that trainers often assume that all of the employees know how to do basic things. "I shouldn't have to ask for help; I'm a competent employee! Then we are embarrassed when we don't know what we are doing, and we are afraid to ask. You don't want to look stupid, so you're not going to venture out." Manufacturing employees need to feel comfortable in asking questions about new technologies being used before they will feel comfortable in implementing them.

Hand-holding

Hand-holding is when an employee needs another employee to take them by the hand and lead them into understanding how a new technology works. Some employees are hesitant on adopting a new technology and need more hand-holding than others. The complexity and newness of the technology can easily overwhelm new users. Greg at Pinsir™ (GK) complained, "We don't know what we don't know." John at Bulbasaur™ (MM), on the other hand, suggested that technology be mastered in small groups of two to three learners. John felt that "people need personal attention and hand-holding that is not possible in a large group. Five minutes into a large group training session, some employees would get lost but won't say anything, because they feel there is nothing that can be done in such a large group." John said he appreciated that he had received training in a small group of two. If he would have been asked to participate in a large group training, he would have chose not to participate.

Interoffice Communication

One way in which the new technology that was introduced could help the participating companies with little or no effort would be with their interoffice communication. E-mail is very effective can be very effective in allowing people to communicate without taking the time to make a phone call

or go to another employee's office. Several of the companies used antiquated message delivery systems, which were similar to each other, that were very ineffective and time consuming. Although the training did not point out the fact that e-mail could be used as a new and efficient mode of interoffice communication, the trainers were optimistic that the companies would use it for this purpose.

Ekans™ (MM) used an outdated message delivery system. Instead of using e-mail or voice-mail, the receptionist called back through an intercom system when employees received a phone call. This method was disruptive to the employees. If the person who was called did not respond, the receptionist would search for the person by asking other people where they were. Non-emergency calls would have been better delivered by using voice or e-mail. The receptionist also took messages by hand and personally delivered them rather than forwarding them electronically.

Implementing Technology Change

Technological change must be considered important by the plant managers before it can be respected and incorporated into the manufacturing environment. Ekans™ (MM) is a good example of this. Here the plant manager had been with the company for 3 years and had taken them, according to Monty, from the 1950s to the 1990s. Monty explained that:

> The new plant manager has encouraged automation. We are finally moving away from the same production techniques we have used since the 1950's and are now fully automated. The best part about the new plant manager was that the corporate office in Seattle let the employees choose who we wanted to hire.

Oscar, Kakuna™ (MM) instructional technology designer, had been a part-time contractor but hired full-time because managers at Kakuna™ (MM) felt their plant needed help in the area of instructional technology. Oscar mentioned that "the corporate office has just spent $400 million to consolidate their inventory accounting system and is going to put it on a web page using Lotus Notes Domino.tm" This new effort would allow all of the their plants, of which Kakuna™ (MM) is a subsidiary, to have simultaneous access and would ensure consistent communication. Oscar knew that not all of the 200 employees at Kakuna™ (MM) would be able to participate in the Internet training, but if they were all just able to "test their mouse, so when everything becomes automated they will feel less inhibited, I've done my job."

Recreational versus Professional Use of the Computer

At the companies that the researchers observed, the majority of employees accessed the Internet for recreational information. For example, Mike at Pinsir™ (GK) looked up collector car information, and several maintenance employees and engineers at Kakuna™ (MM) looked up the value of their

Kakuna™ (MM) stock, fishing facts, and ball game scores. Oscar at Kakuna™ (MM) encouraged the employees to "play" with the technology. Ed, owner of Onix™ (GK), decided not to adopt the new Internet technology but did use the Internet to plan a trip for him and his wife to Germany. Ed was able to find hotels and locations to visit. Even though Ed did not think that the Internet had any value to his business, he did find it valuable for his personal life.

For instance, Joann from Ekans™ (MM) bought a home computer because she had time to use the Internet at home, but did not have time to use it at work. Another employee at Ekans™ (MM) said that he used his home computer to look up information about part suppliers that could provide raw materials for the company to use at a competitive price. Yet, another employee at Ekans™ (MM) said that he was able to keep up with what products the corporate office was selling in Seattle through the company's home page.

CHAPTER V

CONCLUSIONS AND RECOMMENDATIONS

Summary

Adult-education processes in an industrial environment are the basic tools of organizational growth and development (Knowles, 1970, p. 31). These processes are used for orientation of new employees, on-the-job training for new technical skills, preparation of personnel for advancement, executive development, supervisory training, improvement of interpersonal relations within the organization, and the improvement of the institution's public relations (Knowles, 1970, p. 31). This is important to know since

> Constant change within organizations due to factors such as technology, competition, and organization structures has prompted the need for organizations to consider their role in the education of the adult workforce. (Gehring, 1997, p. 142)

Businesses spend large sums of money in order to produce more knowledgeable employees who in turn will be more productive and bring more profits to the organization. More money is spent on workplace learning than on all of public higher education (Carnevale, 1989, p. 27). This huge commitment of resources reinforces the importance of employers understanding how their employees use current

technology and how they can diffuse new technology into the workplace quicker and for less money.

As employers look for creative ways to gain a competitive edge, they often turn to new technology. More often than not, Northeastern Oklahoma small-to-medium sized enterprises do not have the financial resources or time to incorporate new technology into their work environment. One new technology that does not take a great deal of time or money to implement is the use of the Internet. Although it is a relatively new technology, the Internet is a valuable resource for small employers who can take advantage of the employees using Knowles' (1970) adult education theory. Using the ideas of Knowles (1970) allows employers to understand their employees need to be self-directed, to rely on their past experiences, and to be problem-centered rather than subject-centered with little or no intervention by the employer (p. 48).

To understand people's use and resistance of the Internet, this research concentrated on specific training in the work environment which prepared employees in small-to-medium sized enterprises to prepare for the coming role of e-mail and the World-Wide Web in the workplace. The survival of a small-to-medium sized manufacturer is linked to the adoption of technology as a regular part of doing business (Schroeder, 1989, pp. 1-10). Since it is in the nation's interest for small-to-medium sized small-to-medium sized enterprises to thrive, a diffusion of information

issue centers on how to accelerate the adoption of information technologies among small-to-medium sized enterprises.

This Internet training project provided information related to the determinants of user acceptance and gave insight into the employees' perceived ease of use, perceived usefulness, and self-efficacy about the technology. Bandura's (1986) and Lepper (1985) studies identified why user's sense of self-efficacy is greater when it is easier to interact with the technology and demonstrated that efficacy influences affect, effort, persistence, and motivation due to inborn drives of competence and self-determination. Employees need opportunities to practice their newly learned skill to become efficient users of the new technology (Bandura 1986; Lepper, 1985). This research specifically provided insight as to why both traditional and Internet training should provide a range of ways for learners to review, repeat, and reinforce the learning in self-study and on the job.

The purpose of this study was to describe the technology diffusion process in Oklahoma small-to-medium sized enterprises involved in the CATT project. This study was descriptive research that involved the use of a questionnaire and observation. Quantitative data was collected from the questionnaire and qualitative data from interviews and observations were combined to describe Oklahoma small-to-medium sized manufacturing employees'

views on implementing the Internet into their work environment. The population for this study was 30 northeast Oklahoma small-to-medium sized manufacturing enterprises with less than 200 employees. These manufacturers were selected because of their previous working relationship with the OSU-Okmulgee business incubation program representative through their involvement with the Northeast Oklahoma Alliance of Manufacturers and because of their willingness to volunteer to receive the training. Several themes were identified through data collection including: (a) access, (b) resisting technology, (c) technology acceptance, (d) technophobia, (e) clear payoff, (f) technology adoption, (g) scaffolding, (h) hand-holding, (I) tracking information, (j) acceptance by employees of the trainers, (k) interoffice communication, (l) implementing technology change, (m) prioritizing Internet opportunities, and (n) recreational versus personal use of the computer.

Conclusions

Training outcomes are not influenced by the model used to introduce a technological innovation into an Oklahoma small-to-medium sized manufacturer.

Employees want to know why they should learn what the trainers are teaching.

Past studies have been weak in demonstrating strengths and weaknesses of Technology diffusion models.

Researchers must develop and test models to insure their productivity.

Good technology training design is rooted in the idea that people learn best what they really want and need to learn (Wilson, 1998). Employees must be engaged in and in control of their learning experience through the training process. Employees of small-to-medium sized enterprises want to know what is in it for them. This is best accomplished by introducing a set of objectives and establishing goals at the beginning of the training. By establishing goals and objectives, the employer can quantitatively measure the adoption of technology in the small-to-medium sized manufacturer. For example, the clear objective of "you will learn how to open and save a file" lets people know whether they need to proceed. However, the unclear objective of "you will understand how interpersonal style can affect others" does not. Learners will not participate in training, which results in learning, unless they see a direct benefit of participating in the training. Learners need to understand how the training will benefit them personally or professionally before they will participate.

Many researchers take time to develop models but do not take the time to see if the models will work. Because of the lack of implementation of Technology diffusion models, being able to predict whether or not the manufacturing employees will use the new technology is an important issue for researchers to further investigate. Regardless as to what model was used for the technology diffusion training,

what mattered most was understanding the needs of each individual employee at the manufacturing site. To understand each employee, the trainer had to implement various adult learning principles to encourage the perceived ease of use, perceived usefulness, and self-efficacy of each employee. The utilization of these principles allowed the trainer to better understand each adults andralogical needs, and the employee was able to make meaning of the training (Knowles, 1970).

> In order to determine if diffusion of the technology has occurred, trainers need to look at the adult learners as opposed to the organizational structure.

In order to understand what learning has taking place, it is more important to look at the individual than at the organizational structure. When looking at individuals, the trainer can understand whether or not the new technology is being diffused into the work environment. However, looking at the organization does not give the trainer the whole picture because the technology may not be diffused in the manner which it was intended. The human resource development research area focuses on the organization rather than on the employees' learning experiences. Research concentrating on individuals versus organizations can begin to address what and how people want to learn and how they need to get to the completion of their learning experience. Knowles (1970) adult learning theory defines andragogy which can help explain how employees who are self-directed learners and problem-solvers can develop their own level of

confidence in using new technology and can trouble shoot when it comes to doing Internet searches.

Employees are less intimidated by new technology when they can take control of their own learning environment and practice using the new technology at home immediately. For example, one employee at Ekans™ (MM) implemented the technology rapidly by purchasing a new home computer after participating in the training session, by working on material at home, and then by taking work-related information back to work with her to use.

> Since Adult learners will learn what is meaningful to them, trainers must personalize this learning experience to be compatible with the organization's goals.
>
> Personalizing the adult learning experience quickens technology adoption rate and allows employees to do their job better by understanding and using the new technology.

Trainers need to look at adult learning concepts rather than theoretical models as the starting place for designing technology training. Training which is based on adult learning concepts that rely on the individual's technology confidence levels should result in encouraging employees diffuse technology quicker and easier than in the past.

> Training designed to provide stability to the economy and survival of the small-to-medium sized enterprises depends upon manufacturers understanding how individuals use their personal learning style.
>
> Small-to-medium sized enterprises that train their employees to diffuse Internet and e-mail usage are more likely to stay in business and increase production than those which do not provide training.

The key to implementing a new technology is the individual learning pattern of each employee. Therefore, the process of technology diffusion could be more successful if the small-to-medium sized enterprises were to look at the individuals within the organization rather than relying on models to disseminate technology. Such an examination should look at the individuals involved in the training and assess their learning style. This would allow employees to apply what they learned immediately and to understand its relevance and importance. The employees could then transfer the new knowledge to the organization and start a process of shared information between employer and employee. Such a process can result in economic gain for the company. For example, some companies saw immediate results by implementing the Internet technology in the form of listing their company contact information on the Northeast Oklahoma Alliance of Manufacturers home page.

One large company understood the immediate need of getting its employees to diffuse the new technology because of a monetary investment they made. Kakuna™ (MM), one of the largest companies involved in the training was anxious to get the majority of their employees acclimated with the Internet because of a $4 million investment the main office had made to implement a new accounting system.

> Employees desire training that clarifies "what's in it for me" and which will allow them to utilize the new technology immediately.

Models academicians develop often have limited use and user friendly because they cannot be implemented into a work environment.

Employees want to understand how learning a new task will solve a problem they currently have.

The selection of the sites for the implementation of the training in the project was based on two models. Several problems existed with both of these models. For instance, the Gatekeeper Model had no evaluation component. Therefore, the Adult Motivation Time Continuum Model had to be integrated into the model.

The overall project was conceptualized as a test to determine which of the two technology diffusion models was most effective in training employees in small-to-medium sized enterprises. However, the actual experiences of the trainers and the training results indicate that the need for the training should determine the model selection rather than having the model selection drive the training. The results also exemplify the need for the trainers to understand the needs of the audience being trained rather than deciding what the employees need to know. The employees need to be involved in the training design and implementation to get the most from the training.

This research project demonstrates that there is clearly not enough collaboration amongst academicians and practitioners. Academicians should strive to understand that small-to-medium sized enterprises do not understand the importance of models such as those used in this study, but they do understand the importance of the Internet. Rather

than academicians researching how they think models should unfold, they need to go into the field and talk to practitioners who are actually doing the work to formulate models. Instead of writing models in abstract terms, academicians should ground them in the terminology of real practice and use practitioners as resources for textbooks.

Most employees have a task-centered or problem-centered approach to learning, which was correctly described by Knowles (1970) in the theory of andragogy. This approach was evidenced as an employee contacted raw material suppliers using e-mail to see if they had material they could get to make a part. By giving meaning to the learning task (Knowles, 1970), the employee was able to implement the new technology with little or no effort. Having small-to-medium sized manufacturing employees connect with the Internet training by understanding that the training could actually help solve work-related problems and challenges can motivate the employees to understand what they really need to know. Once the learning content is relevant to the participants' actual work, technology enables small-to-medium sized manufacturer employees to get to the next level of relevance by making learning on the Internet an internal part of the workday. By not confining training to scheduled events, it is always accessible as needed and just-in-time. This just enough and just-in-time learning is learning that is introduced to the employee when it will be most useful to them to implement (Wilson, 1998).

> Successful training occurs when the researcher is welcomed, accepted, and respected by the group involved in the study.

The researcher must be empathetic toward the employee's time, which is valuable, so that the employees will not feel as though the researcher is coming in to "tell us how to do things." If the employees participating in the training are one of the company owners, the company may be losing money by participating in the training since they cannot take phone orders or talk to customers if they are being trained. Therefore, the trainer should consistently try to make the training convenient so that the employees will have instant access to the technology.

> Employees need to feel a part of or buy into the technology that is being introduced before they will use it.

> Both personal and work-related learning takes place when dealing with new technology involving individuals and relationships.

> The Internet has both personal and work-related elements that can be tied to training.

> Employees will feel as though they can contribute to the company's success if they are encouraged to utilize the Internet to find unique opportunities for the company.

Some individuals who participated in the training adopted the technology for their personal use. Employees who owned their company were more interested in the business aspects of the Internet, and employees of larger companies found the Internet to be more entertaining when looking up such things as fishing fact sites, baseball information, or stock quotes. Employees looked up information on the

Internet based on what was important to them, and most did not realize that they were learning in the process.

Employees have different social roles which have a large influence on what information the employee decides to access via the Internet. Consequently, the uses of the Internet varied and involved such things as planning a trip to Germany and hiring an international sales representative to get product orders from overseas. All of these uses deal with various individual and work-related aspects.

Technology trainers should integrate individualized Internet learning environments for employees by providing authentic tasks that legitimatize reasons to use the new technology (Wilson, 1998). Technology trainers should also integrate Internet resources into the work environment and cultivate informal, employee-directed uses. This will encourage the adoption of the use of the Internet and independent and collaborative inquiry, student-directed learning, and professional responsibility within organizations (Wilson, 1998). Employees should also be encouraged to adopt the Internet through a variety of incentives, policies, and practices, but keep to a minimum explicit mandates and requirements. Technology trainers should seek to create an atmosphere of expected and natural Internet participation without the feeling of coercion. Let employees have a say as to what information is put on the company's home page.

Training modules are not as important to the employee as is the overall training environment and support provided after the training.

The technology diffusion rate will be higher when the researcher is knowledgeable of the employee's affective feelings about the technology.

The technology diffusion rate will be higher when the researcher conveys to the employees that some risk is involved when diffusing new technology.

Companies can benefit financially when effective technology training is used.

The technology diffusion rate will be higher when trainers understand the needs of the company receiving the training.

The Internet training was successful for Oklahoma small-to-medium sized enterprises.

Overall the Internet training was very successful for all of the small-to-medium sized manufacturing employees who participated. All but one manufacturer began to use the Internet technology that was introduced to them through the Oklahoma State University training. However, this implementation involved a certain amount of risk. One employee at Kakuna™ (MM) did not want to take a risk and preferred to look up information, which was available on the Internet in the library because "there was too much information on the web."

Employees perceptions regarding perceived ease of use, perceived usefulness, and self-efficacy are directly related to their feelings of confidence and competence toward the new technology.

Employees perceptions regarding perceived ease of use, perceived usefulness and self-efficacy are inter-related.

Employees perceptions regarding perceived ease of use, perceived usefulness, and self-efficacy are useful in predicting technology diffusion.

Several affective feelings are involved when employees are trained on how to use new technology. Some feelings include intimidation, lack of confidence, helplessness, competence, and confidence. These feelings were measured with a questionnaire and categorized in the sub-categories of perceived ease of use, perceived usefulness, and self-efficacy. Each of these categories then had 6 to 10 items to determine which employees were more likely to diffuse the new technology. Overall, the employees that had lower confidence levels on the Likert scales in the one portion of the questionnaire had similar confidence levels in other portions.

Employees must emanate feelings of competence and confidence toward new technology after receiving training. If the employees do not feel competent and confident about the technology, they will be overcome with anxiety, and they will not diffuse the new technology into their work environment. Companies with employees who scored high on the questionnaire's Likert scale exhibited confidence in using the new technology when they were observed. The situation at Bulbasaur™ (MM) the employee chased down the trainer in the parking lot to tell how much money he was saving using the Internet exemplified not only that money can be saved, but that the employee felt confident and competent with the new technology.

Smaller-to-medium sized manufacturers have a lot to gain, by implementing new technology. Several of the participating companies were already benefiting from their participation in the training and saving their company's money by sending documents electronically instead of shipping them overnight. Research conducted by Amonsen, Moore and Taylor, (1994), found that the benefit-cost variables were better predictors then psychological characteristics for predicting technology diffusion. That emphasizes that if small-to-medium sized enterprises understand how it benefits their bottom line they are more likely to implement the new technology even if they are not comfortable with the new technology.

One method to disseminate new technology quickly and inexpensively would be to organize large group training sessions at one indigenous site. This would allow employees to form small learning groups of two or three people to help and to learn from each other. Such training would reach a large number of employees and could allow the researcher to measure the results quickly and easily (Wilson, 1998). This would also allow for learning to happen through experience (Dewey, 1938, p. 27). "An experience is always what it is because of a transaction taking place between an individual and what, at the time, constitutes his environment" (p. 41). Despite stupendous advances in technology training, the impact on the manufacturing industry has been less than

spectacular with about 75% of all training still being conducted in the classroom (Wilson, 1998).

Further Research

Further research should be conducted to address prospects for synthesizing elements of various technology diffusion models introduced in this Internet training. Beyond the Motorola Model and the Gatekeeper Models the diffusion model and theories that support it (Rogers, 1995) may be a useful tool to track and predict adoption rates. However, the diffusion model (Rogers, 1995) does not help explain how companies make decisions. Therefore, questions about how individuals learn and make technology adoption decisions may be answered by using adult education theories in future research.

Additional research is needed on technology diffusion for various sizes of small-to-medium sized enterprises. Small-to-medium sized enterprises with two employees have vastly different motivating factors to diffuse technology than to manufacturers with 200 employees. Small-to-medium sized enterprises with two employees have a greater risk but potentially more to gain by participating in an Internet training session when compared to a manufacturer with 200 employees. Smaller companies that do not make that much money cannot take time out of production and manufacturing parts to do Internet searches because then they are not making money. Whereas larger companies that have more money

to invest in their employees can encourage their employees to diffuse new technology and will not lose money in the process. When a manufacturer with two employees takes one employee from the business of creating parts and taking customer orders, they have the potential of losing income. However, if they design a web site and get a plethora of orders, it may be worth their time. When a manufacturer with several hundred employees has some employees participate in an Internet training session, it is not as costly for them for each person.

Companies in this study ranged in size from a husband and wife team to a company with over 200 employees. The smaller companies did not evaluate the long-term economic benefits and therefore only considered adopting the new technology. However, the largest company had projected the economic benefit and had to implement the technology just-in-time because the corporate office had invested a large amount in a new accounting program.

Further research must also examine Intranet potential. Intranet is a local Internet within one company to which only that company has access. Company Intranets have the capability for individualizing training and providing more learner control, are adaptable to participants' different learning styles and levels, and can provide immediate and private feedback. They can be used for just enough and just-in-time learning that is introduced to the employee when it will be most useful to them to implement (Wilson,

1998). One company in this study, Kakuna™ (MM), will be implementing an Intranet that would give employees simultaneous access to documents throughout all of its manufacturing and corporate sites world-wide.

Further Challenges

The technology challenge for small-to-medium sized small-to-medium sized enterprises is to translate what is known about learning and teaching using technology into the real-world small-to-medium sized manufacturing work environment. Business, content, time, and financial factors often compete for priority in designing small-to-medium sized manufacturing technology training programs. It is more crucial than ever for small-to-medium sized enterprises to play a central role in defining and developing their own technology training.

The Oklahoma small-to-medium sized enterprise technology diffusion research findings have implications for others in other business areas. It may be helpful to other researchers for understanding the needs of Oklahoma small-to-medium sized enterprises, and it may be applied to larger manufacturers to understand how everyone uses technology and look at the individual learner before looking at the organization.

Overall, this study exemplifies and reinforces the adult learning theory and demonstrates how it works to show that employers need to involve employees in the training

process. While the Motorola Model and the Gatekeeper Models provided insights into the utilization of technology diffusion, adult learning principles were the key factors in explaining how the employee's learned to actually use the technology. Thus, this project demonstrates that for effective technology diffusion to occur, the focus needs to be on the individual learner rather than on the organization. Employees are likely to implement a new technology when they are self-directed, utilize their past experiences, and serve as problems solvers throughout training that is based on their needs. Although the organization's goals are important, effective diffusion of a new technology results not from the diffusion model that is used but rather from employers focusing on the employees buying into the technology diffusion process.

BIBLIOGRAPHY

Ajzen & Fishbein. (1980). Understanding attitudes and predicting social behavior. Englewood Cliffs, NJ: Prentice Hall.

Alavi M., & Henderson, J.C. (1981). An evolutionary strategy for implementing a decision support system. Management Science, 27, 1309-1323.

Allen, Thomas J. (1977). The role of personal communication networks in the dissemination of industrial technology. Massachusetts.

Bandura, Albert. (1986). Social foundations of thought and action: a social cognitive theory. Englewood Cliffs, NH: Prentice-Hall.

Basili, Victor R., Daskalantonakis, Michael K., & Yacobellis, Robert H. (March 1994). Technology transfer at Motorola. IEEE Software, 11, 70-76.

Benson, Donna. (Jan. 1997). Technology training: meeting teachers' changing needs. Principal, 76(3), 17-19.

Blumenfeld, S.M. (1994). Technology introduction in a cost conscious age: Image-guided therapy. International symposium on computer and communication systems for image guided diagnosis and therapy--1995 June: Berlin.

Blumenfeld, S.M. (1993). Current issues and opportunities in health care high technology development and transfer. SPIE the International Society for Optical Engineering, 2102, 23-29.

Blurton, Craig. (Spring 1984). Integrating the new "basic"--computer literacy--into the science curriculum. Journal of Computers in Mathematics and Science Teaching,3(3), 7-14.

Bozeman, Barry. (1978). All organizations are public: bridging public and private organizational theories (Jossey-Bass Management Series). San Francisco: Jossey-Bass.

Bozeman, William C. (1978). An investigation of psychological typology as an intervening variable in the implementation of a computer managed instruction system. Technical Report No. 454. Wisconsin.

Brookfield, Stephen. (Spring, 1983). Community adult education: a conceptual analysis. Adult Education Quarterly, 33(3), 154-160.

Brookfield, D. Stephen. (1986). Understanding and facilitating adult learning (Jossey-Bass Higher Education Series). San Francisco: Jossey-Bass.

Brookfield, Stephen. (March 1985). Self-directed learning: A critical review of research (pp. 5-16). New Directions for Continuing Education. San Francisco: Jossey-Bass.

Brookfield, Stephen. (May 1985). Self-directed learning: From theory to practice. San Francisco: Jossey-Bass.

Brookfield, Stephen. (Fall, 1985). A critical definition of adult education. Adult Education Quarterly, 36(1), 44-49.

Bruner, Jerome. (1966). Learning about learning. Conference Report.

Carnegie Foundation. (1991). Educating adult.

Carnevale, Patrick Anthony. (1984). Society based on work, center on education & training for employment. Information Series No. 270. Ohio.

Carnevale, Patrick Anthony. (1989). Training America: Strategies for the Nation.

Carnevale, P. Anthony, Gainer, J. Leila & Meltzer, S. Ann. (1988). Workplace basics: The skills employers want. Training and Development Journal, 42(10), pp. 22-26, 28-30.

Carnevale, P. Anthony. (Feb. 1989). The learning enterprise. Training and Development Journal, 43(2), 26-33.

Cohen, Stephen L., & Rustad, James M. (1998). High-tech/high-touch: High time? Training and Development, 52(12), pp. 30-32, 34, 36-37.

Compeau, Deborah. (June 1995). Computer self-efficacy: Development of a measure and initial test. MIS Quarterly, 189-205.

Dalkey, N., & Helmer, O.(1963). An experimental application of the Delphi method to the use of experts. Management Science, 9(3), 458-467.

Davenport, Joseph, III. (1987). Is there any way out of the andragogy morass? Lifelong Learning, 11(3), 17-20.

Davis, F.D. (1986). A technology acceptance model for empirically testing new end-user information systems: Theory and results. Ph.D. dissertation, MIT Sloan School of Management, Cambridge, M.A.

Davis F.D., R.P. Bagozzi, & P.R. Warshaw. (1987). User acceptance of computer technology: A comparison of two theoretical models. Management Science, 35, 982-1003.

December, J. (Oct. 1993). Directions for computer-mediated scholarship. IEEE: PA

Delbecq, A. L., Van de Ven, A. H., & Gustafson, D.H. (1975). Group techniques for program planning: A guide to nominal group and Delphi processes. Glenview, IL: Scott, Foresman.

Denzin, K. Norman. (June 1972). The values of social science. Transaction Pub.

Dewey, John. (1915). The school and society. Chicago: The University of Chicago Press.

Dewey, John. (1938). Experience and education. New York: Collier Books.

Fellenz, Robert A., & Conti, Gary J. (1989). Learning and reality: reflections on trends in adult learning. Information Series No. 336. Columbus,Ohio: Eric Charingham.

Gates Bill, Myhrvold Nathan, & Rinearson, M. Peter. (November 1996). The road ahead. Penguin.

Gay, L.R. (1992). Educational research: Competencies for analysis and application (4th ed.). Columbus, OH: Merrill Publishing Company.

Gayford, Norman, & Habermas, James. (1990). Classroom applications of current technology. New York.

Gehring, Clayton Mark (1997). Factors affecting learning strategies in the professional workplace. Unpublished doctoral dissertation, Montana State University, Bozeman.

Guba, G. Egon & Lincoln, S. Yvonna. (1989). Fourth generation evaluation. Sage Publications.

Handy, Charles & Others. (May 1994). A special issue on learning in the workplace. Adults Learning (England), 5(9), 218-41.

Hopey. (1990). Industrial technology institute, 91-95.

Houle, C.O. (1961). The inquiring mind: A study of the adult who continues to learn. Madison, WI: University of Wisconsin Press.

Huck, S., Cormier, W., & Bounds, W. (1974). Reading statistics and research. New York: Harper & Row.

Isaac, Stephen, & Michael, William. (1981). Handbook in research and evaluation. (2nd ed.) San Diego: EdITS.

Jarvis Peter. (November 1983). Adult and continuing education: Theory and practice. Nichols Publishing Company.

Jones, Byrd, & Maloy, Robert W. (1996). Schools for an information age. Reconstructing foundations for learning and teaching.

Jones, H., & Twiss, B.C. (1978). Forecasting technology for planning decisions. London, England: The MacMillian Press, Ltd.

Keller, John. (1983). Development and use of the ARCS model of motivational design. This paper is based on a series of lectures given at the Technische Hogeschool Tewnte (Enschede, Netherlands, Feb. 2-March 19).

Kelly, M. G., & Wiebe, James H. (Jan. 1994). Teaching mathematics with technology: mining mathematics on the internet. Arithmetic Teacher, 41(5), 276-281.

Kerlinger, N. Fred. (1973). Multiple Regression in Behavioral Research.

Kidd, J. Roby. (1973). How Adults Learn. Revised Edition.

Knowles, Malcolm. (1969) Higher adult education in the United States: The current picture, trends, and issues. Washington, DC: American Council on Education.

Knowles, Malcolm. (1970). The modern practice of adult education: Andragogy versus pedagogy. New York: Association Press.

Knowles, Malcolm. (1972). Toward a model of lifelong education.

Knowles, Malcolm. (Spr. 1972). Innovations in teaching styles and approaches based upon adult learning. Journal of Education for Social Work, 8(2), 32-39.

Knowles, Malcolm. (Nov. 1972). The manager as educator. Journal of Continuing Education and Training, 2(2), 97-105.

Knowles, Malcolm. 1975. Self-directed learning, New York: Associated Press.

Knowles, Malcolm. (1977). A history of the adult education movement in the United States. Huntington, N.Y.: R.E. Krieger Pub. Co.

Knowles, Malcolm. (1980). The modern practice of adult education: from pedagogy to andragogy. Chicago: Follett Pub.

Knowles, Malcolm (1984). Andragogy in action: Applying modern principles of adult learning San Francisco: Jossey-Bass.

Knowles, Malcolm. (1988). Modern practice of adult education: From pedagogy to andragogy. Cambridge Book Co.

Knowles, Malcolm. (March 1988). Self-directed learning: A guide for learners and teachers. Cambridge Book Co.

Knox, Alan B. (1977). Adult development and learning. A handbook on individual growth and competence in the adult years for education and the helping professions. San Francisco: Jossey-Bass.

Krol, Ed. (1992). The whole Internet: User's guide & catalog. Sebastopol, CA: O'Reilly & Associates.

Kubala, Tom. (Spr. 1998). Teaching on the Internet. Visions: The Journal of Applied Research for the Florida Association of Community Colleges, 2(1), 44-46.

Lam, Margaret. (1986). Restrictions on technology transfer among academic researchers: Will recent changes in the export control system make a difference? Journal of College and University Law, 13(3), Winter.

Lemke, J. L. (1993). Education, cyberspace, and change. Electronic Journal on Virtual Culture, 1(1).

Linkenbach, Jeffrey Warren (1995). Behind the Big Sky bar: The Montana alcohol servers' study. Unpublished doctoral dissertation, Montana State University, Bozeman.

Linstone, A. Harold, & Turoff Murray (Eds.).(1975) The Delphi method: Techniques and applications. Reading, MA: Addison-Wesley.

Marsick, J. Victoria. Learning in the workplace (Croom Helm Series on Theory and Practice of Adult Education in North America).

Marsick, J. Victoria. (1987). Action learning: A strategy for empowering managers. New York.

Marsick, J. Victoria, & Watkins, E. Karen. Informal and incidental learning in the workplace (International Perspectives on Adult and Continuing Education).

Mead, Margaret. (1953). Cultural patterns and technical change.

Merriam, B. Sharan. (1986). The research-to-practice dilemma. Lifelong Learning, 10(1), pp. 4-6, 24.

Merriam, Sharan B., & Caffarella, Rosemary S. (1991). Learning in adulthood. A comprehensive guide. San Francisco: Jossey-Bass.

Mezirow Jack. (1981). A critical theory of adult learning and education. Adult Education Quarterly, 32(1), 3-24.

Miller, Michael T. (1993). Barriers to adult education training programs: Challenges for the adult educator. Nebraska.

Miller, E. Melvin, & Cook-Greuter, R. Susanne. (March 1994). Transcendence and mature thought in adulthood: The further reaches of adult development. Rowman & Littlefield.

Morris, Robert. (1961). Task force report on assessment and evaluation.

National Research Council. (1993). Learning to change: opportunities to improve the performance of smaller manufacturers. Washington, DC: National Academy Press.

Neumann, Kari F., & Others. (June 1979). Factor analysis of a system of students' learning styles. Perceptual and Motor Skills, 48(3), 723-738.

Nickerson, R.S. (1981). Why interactive computer systems are sometimes not used by people who might benefit from them. Intranet. J. Man-Machine Studies, 15, 469-483.

Patton, Michael Quinn. (March 1990). Qualitative evaluation and research methods. Thousand Oaks, CA: Sage.

Penfield, Kathleen R. (1975). Prospects for a learning society. Adult Leadership, 24(1), 40-44.

Perkins, David, & McGinnis, Evan. (1996). Understanding Snmp Mibs. Prentice Hall.

Rheingold, Howard. (1993). The virtual community: homesteading on the electronic frontier.

Rogers, M. Everett. (May 1995). Diffusion of innovations. Free Press. p. 10, pp. 11-12, pp. 30-31, pp. 164-184.

Rose, Amy D. (1996). Group learning in adult education: Its historical roots. New Directions for Adult and Continuing Education. San Francisco: Jossey-Bass.

Rosen, W. Robert. (April 1997). Workplace learning: Debating five critical questions of theory and practice (new directions for adult and continuing education, No. 72). San Francisco: Jossey-Bass.

Rowden, Robert. (1996). Current realities and future challenges. New Directions for Adult and Continuing Education. San Francisco: Jossey-Bass.

Sarason, Bernard Seymour. (1984). The psychological sense of community: Prospects for a community psychology. San Francisco: Jossey-Bass.

Senge, Peter M., & Lannon, Colleen. (July 1990). Managerial microworlds. Technology Review, 93, 62-68.

Smith, R.M. (1982). Learning how to learn. Chicago: Follett.

Sommers, K., Baker, G., & Isbell, C. (May, 1984). How to use the Delphi technique to forecast training needs. Performance and Instruction Journal, 26-28.

Sorohan, Erica Gordon. (1993). We do; therefore, we learn. Training and Development, 47(10), pp. 47-48, 50, 52-55.

Spicer, Edward H. (1952). Human problems in technological change. New York: Russell Sage Foundation.

Sternberg, Robert J., & Others. (1993). Experiential education and practical intelligence. Journal of Cooperative Education, 28(2), 6-67.

Stewart, Charles T., & Nihei, Yasumitsu. (1987). Technology transfer and human factors. Massashusetts/Toronto: Lexington Books.

Swanson, E.B. (1988). Information system implementation: bridging the gap between design and utilization. Homewood, IL: Irwin.

Taylor, James R., Moore, Eric G., & Amonsen, Edwin J. (1994). Profiling technology diffusion categories: Empirical tests of two models. Journal of Business Research, 31(1), 155-162.

Toffler, Alvin. (1991). Future shock. New York: Bantam Books.

Toffler, Alvin. (1991). Powershift: Knowledge, wealth, and violence at the edge of the 21st Century. New York: Bantam Books.

Toffler, Alvin. (1991). Third wave. New York: Bantam Books.

Tough, Allen M. (1971). The adult's learning projects: A fresh approach to theory and practice in adult education. Toronto: Ontario Institute for Studies in Education.

Wagner, R.K., & Sternberg, R.J. (Eds.) (1986). Practical intelligence: Nature and origins of competence in the everyday world. Cambridge, England: Cambridge University Press.

Wallerstein, N., & Bernstein, E. (1988). Empowerment education: Freire's ideas applied to health education. Health Education Quarterly, 15(4), 379-394.

Wilson, Brent, Dobrovolny, Jackie, & Lowry, May. (1998). A critique of how technology adoption models get used. Performance Improvement. Denver, CO: University of Colorado.

Wlodowski, Raymond J. (1985). Enhancing adult motivation to learn: A guide to improving instruction and increasing learner achievement. San Francisco: Jossey-Bass.

Zelkowitz, Marvin V. (1996). Software engineering technology infusion within NASA. IEEE Transactions on Engineering Management, 43(3), 250-261.

Zelkowitz, Marvin V (1993). A competitiveness strategy for America. Second report to the President & Congress. District of Columbia: U.S.

Zelkowitz, Marvin V. Reports of the subcouncils. Second report to the President & Congress. District of Columbia: U.S.

Zelkowitz, Marvin V. (1993). Enhancing American competitiveness: A progress report to the President and Congress. District of Columbia: U.S.

Zelkowitz, Marvin V (1993). National collaboratories: Applying information technology for scientific research. District of Columbia: U.S.

Zelkowitz, Marvin V. (July 1994). Promoting long-term prosperity: Third report to the President & Congress: Competitiveness Policy Council. DIANE Publishing Co.

Zelkowitz, Marvin V. A competitiveness strategy for America: joint hearing before the Committee on Banking, Housing, and Urban Affairs, Joint Economic Committee, United States Senate, One Hundred Third Congress, first session, on the Competitiveness Policy Council second annual report to the President and the stronger incentives for private investment, a new export expansion strategy, and a sweeping education reform, March 16, 1993.

APPENDIX A

Internet Training Questionnaire

Internet Usage Self-Efficacy

Please circle the appropriate numbers below:

I could better achieve my business goals by using the Internet

1...if there was no one around to tell me what to do

Extremely unlikely _____ Neutral _____ Extremely likely

1 2 3 4 5 6 7

2...if I had never used a computer before

Extremely unlikely _____ Neutral _____ Extremely likely

1 2 3 4 5 6 7

3...if I had only an Internet manual for reference

Extremely unlikely _____ Neutral _____ Extremely likely

1 2 3 4 5 6 7

4...if I had seen someone else using it before trying it myself

Extremely unlikely _____ Neutral _____ Extremely likely

1 2 3 4 5 6 7

5...if I could call someone for help if I got stuck

Extremely unlikely _____ Neutral _____ Extremely likely

1 2 3 4 5 6 7

6...if someone else had helped me get started

Extremely unlikely _____ Neutral _____ Extremely likely

1 2 3 4 5 6 7

7...if I had a lot of time to complete the work-related goal after the Internet training was provided

Extremely unlikely _____ Neutral _____ Extremely likely

1 2 3 4 5 6 7

8...if I had just the built-in help facility for assistance

Extremely unlikely _____ Neutral _____ Extremely likely

1 2 3 4 5 6 7

9...if someone showed me how to do it first.

Extremely unlikely _____ Neutral _____ Extremely likely

1 2 3 4 5 6 7

10...if I had used the Internet before to do the same job.

Extremely unlikely _____ Neutral _____ Extremely likely

1 2 3 4 5 6 7

PERCEIVED USEFULNESS

1. Using the Internet in my job would enable me to accomplish tasks more quickly.

Extremely unlikely _____ Neutral _____ Extremely likely

1 2 3 4 5 6 7

2. Using the Internet would improve my job performance.

Extremely unlikely _____ Neutral _____ Extremely likely

1 2 3 4 5 6 7

3. Using the Internet in my job would increase my productivity.

Extremely unlikely _____ Neutral _____ Extremely likely

1 2 3 4 5 6 7

4. Using the Internet would enhance my effectiveness on the job.

Extremely unlikely _____ Neutral _____ Extremely likely

1 2 3 4 5 6 7

5. Using the Internet would make it easier to do my job.

Extremely unlikely _____ Neutral _____ Extremely likely

1 2 3 4 5 6 7

6. I would find Internet useful in my job.

Extremely unlikely _____ Neutral _____ Extremely likely

1 2 3 4 5 6 7

PERCEIVED EASE OF USE

1. Learning to operate the Internet would be easy for me.

Extremely unlikely _____ Neutral _____ Extremely likely

1 2 3 4 5 6 7

2. I would find it easy to get the Internet to do what I want it to do.

Extremely unlikely _____ Neutral _____ Extremely likely

1 2 3 4 5 6 7

3. My interaction with the Internet would be clear and understandable.

Extremely unlikely _____ Neutral _____ Extremely likely

1 2 3 4 5 6 7

4. I would find the Internet to be flexible to interact with.

Extremely unlikely _____ Neutral _____ Extremely likely

1 2 3 4 5 6 7

5. It would be easy for me to become skillful at using the Internet.

Extremely unlikely _____ Neutral _____ Extremely likely

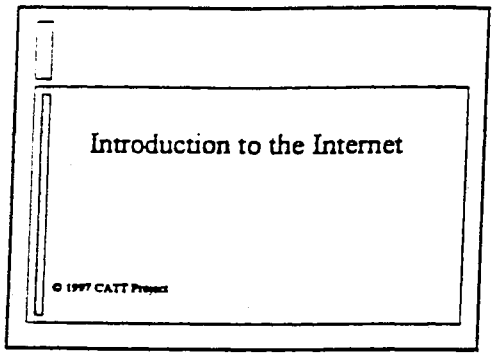
1 2 3 4 5 6 7

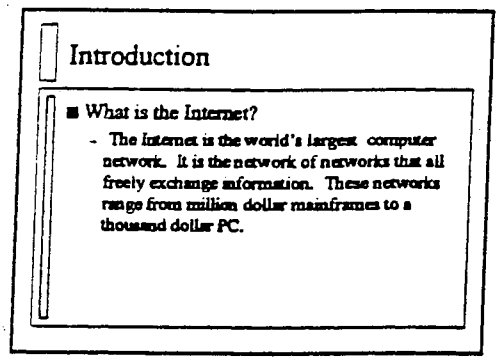
6. I would find the Internet easy to use.

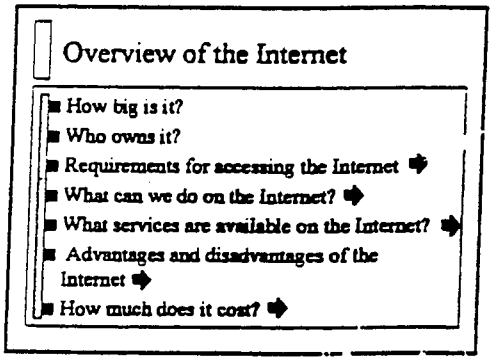
Extremely unlikely _____ Neutral _____ Extremely likely

1 2 3 4 5 6 7

APPENDIX B


Introduction to the Internet
© 1997 CATT Project


Introduction
What is the Internet?
- The Internet is the world's largest computer network. It is the network of networks that all freely exchange information. These networks range from million dollar mainframes to a thousand dollar PC.


Overview of the Internet
How big is it?
Who owns it?
Requirements for accessing the Internet
What can we do on the Internet?
What services are available on the Internet?
Advantages and disadvantages of the Internet
How much does it cost?

Requirements for Accessing the 'Net'

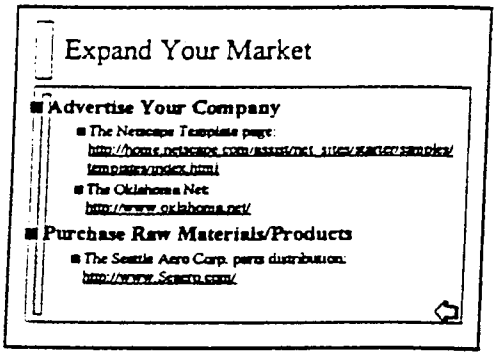
- Computer
- Modem
- Phone line
- Service from Internet Service Provider

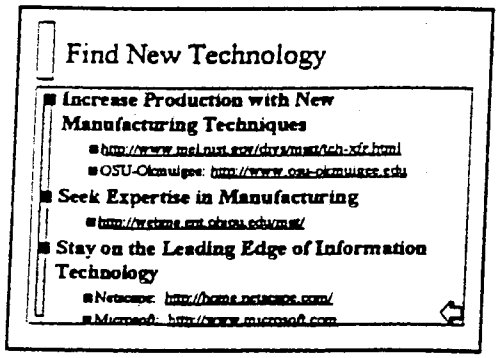
What can we do on the Internet

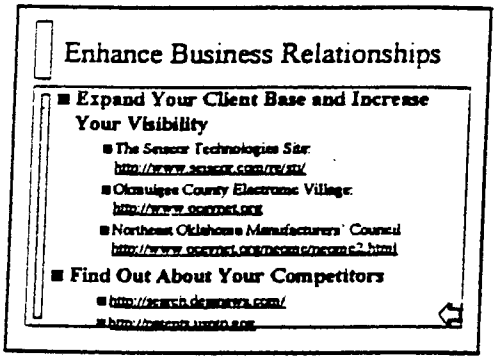
- Explore Potential Markets and Increase Your Visibility
- Find Information About Current Technology
- Enhance Business Relationships
- Discover Human Resources
- Discover Financial Opportunities

Expand Your Market

- **Discover Business Opportunities**
  - Electronic Commerce Resource Center : http://www.ecrc.ctc.com/
  - GE . http://www.ge.com/
- **Reach More Customers**
  - The IBM : http://www.ridm.ibm.com/ambus/dbnit/dbnit.htm


Expand Your Market
Advertise Your Company
The Netscape Template page:
http://home.netscape.com/assist/net_sites/starter/samples/templates/index.html
The Oklahoma Net:
http://www.oklahoma.net/
Purchase Raw Materials/Products
The Seattle Aero Corp. parts distribution:
http://www.Seaero.com/


Find New Technology
Increase Production with New Manufacturing Techniques
http://www.mel.nist.gov/div826/msid/tch-xfr.html
OSU-Okmulgee: http://www.osu-okmulgee.edu
Seek Expertise in Manufacturing
http://weizmann.ent.ohiou.edu/mst/
Stay on the Leading Edge of Information Technology
Netscape: http://home.netscape.com/
Microsoft: http://www.microsoft.com


Enhance Business Relationships
Expand Your Client Base and Increase Your Visibility
The Sensor Technologies Site:
http://www.sensor.com/nr/stt/
Okmulgee County Electronic Village:
http://www.ocemet.org
Northeast Oklahoma Manufacturers' Council
http://www.ocemet.org/mecouncil/mecouncil2.html
Find Out About Your Competitors

Discover Human Resources

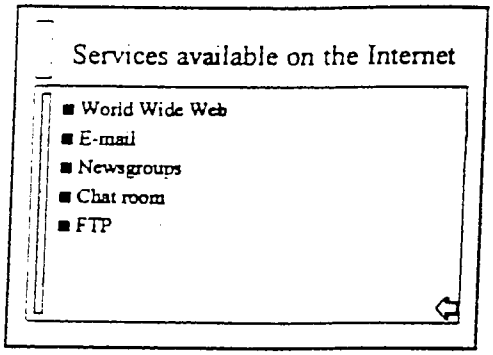
- **Search Resumes of Potential Employees**
  - The Career Mosaic site:
    http://www.careermosaic.com/
- **Post Jobs Openings on Your Homepage**
  - The Sensor Technologies page
    http://tulsa.oklahoma.net/~okpotz/job_list.htm
  - The ERIM Homepage:
    http://www.i.erim.org/humanres.html

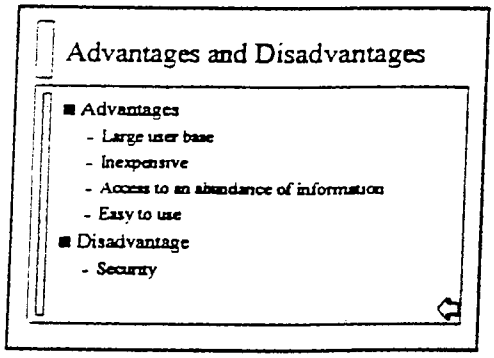
Discover Financial Opportunities

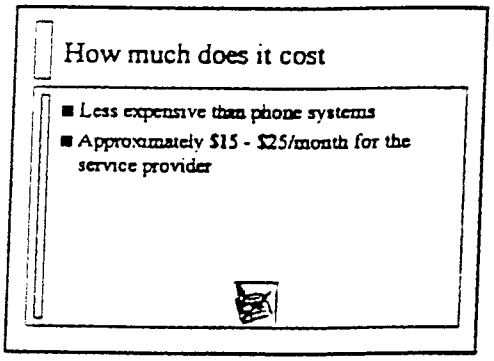
- **Find Out About Financial Opportunities:**
  - PMC Loan Site:
    http://198.170.163.10:80/mktnet/pmc/infcr.html
  - Small Business Administration Site:
    http://www.sba.gov/
  - Zion's Small Business Finance Site:
    http://www.zsbf.com/home.html
  - Kiely & Associates Site:
    http://www.ICI.net/cust_pages/kielyassc/kielyassc.html

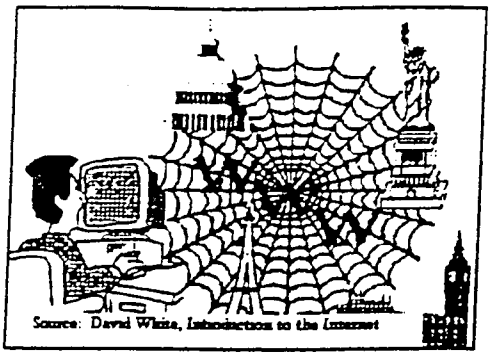
Discover Financial Opportunities

- **Access Reliable Information About Your Clients**
  - Dun & Bradstreet
    http://www.dnb.com/
  - Market Guide Company Research
    http://www.marketguide.com/MGI/INDUSTRY/srdef.htm


Services available on the Internet
World Wide Web
E-mail
Newsgroups
Chat room
FTP


Advantages and Disadvantages
Advantages
- Large user base
- Inexpensive
- Access to an abundance of information
- Easy to use
Disadvantage
- Security


How much does it cost
Less expensive than phone systems
Approximately $15 - $25/month for the service provider



World Wide Web

- Addresses - Uniform Resource Locators(URL)
  http://www.metacrawler.com
- Web Browsers
  - Netscape
  - Microsoft Explorer
- Key Buttons and Menu Bars

Search Engines

- Yahoo- http://www.yahoo.com
- WebCrawler- http://www.webcrawler.com
- Lycos- http://www.lycos.com
- Alta Vista- http://www.altavista.com
- InfoSeek- http://www.infoseek.com
- MetaCrawler- http://www.metacrawler.com

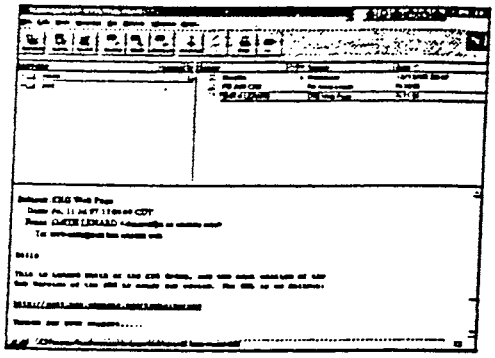
E-mail

- The most widely-used Internet service
- E-mail Address

lxiaomi@okstate.edu

username — host name

- Example



E-mail

- Setting up mail preference
- Receiving
- Sending
- Forwarding
- Before sending - think

Other services available on the Net

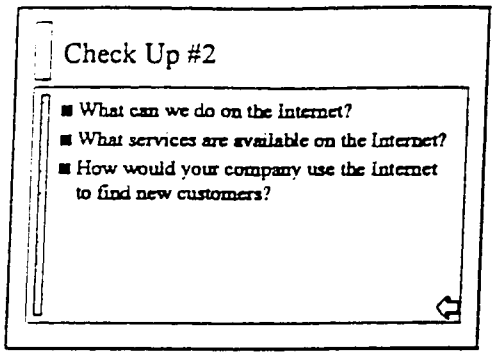
- Mailing Lists
- Network News
- Talk
- File Transfer Protocol - FTP

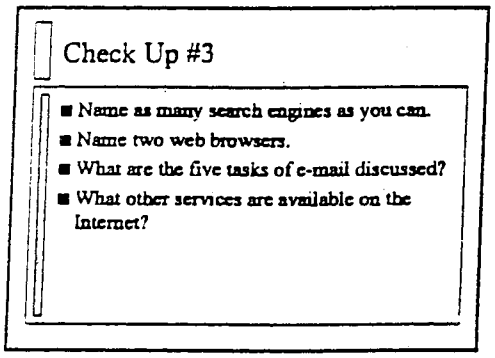
Some useful sites on the Internet

- Internet tutorial
  - Northeastern Oklahoma Manufacture Council: http://www.ocevnet.org/neomc/asynch.html
- Doing business with Government
  - CATT project: http://catt.bus.okstate.edu

Check Up #1

- What is the Internet?
- How big is the Internet?
- Who owns the Internet?


Check Up #2
■ What can we do on the Internet?
■ What services are available on the Internet?
■ How would your company use the Internet to find new customers?


Check Up #3
■ Name as many search engines as you can.
■ Name two web browsers.
■ What are the five tasks of e-mail discussed?
■ What other services are available on the Internet?

APPENDIX C

OKLAHOMA STATE UNIVERSITY
INSTITUTIONAL REVIEW BOARD
HUMAN SUBJECTS REVIEW

Date: 07-08-97

IRB#: ED-98-000
BU-98-000

Proposal Title: COMPUTER ASSISTED TECHNOLOGY TRANSFER-TECHNOLOGY DIFFUSION IN THE WORKPLACE

Principal Investigator(s): Ramesh Sharda, Ray Sanders, Brenda Solomon

Reviewed and Processed as: Exempt

Approval Status Recommended by Reviewer(s): Approved

ALL APPROVALS MAY BE SUBJECT TO REVIEW BY FULL INSTITUTIONAL REVIEW BOARD AT NEXT MEETING, AS WELL AS ARE SUBJECT TO MONITORING AT ANY TIME DURING THE APPROVAL PERIOD.
APPROVAL STATUS PERIOD VALID FOR DATA COLLECTION FOR A ONE CALENDAR YEAR PERIOD AFTER WHICH A CONTINUATION OR RENEWAL REQUEST IS REQUIRED TO BE SUBMITTED FOR BOARD APPROVAL.
ANY MODIFICATIONS TO APPROVED PROJECT MUST ALSO BE SUBMITTED FOR APPROVAL.

Comments, Modifications/Conditions for Approval or Disapproval are as follows:

Because this study will use only aggregate data and names/responses will not be disclosed to company officials or others, there will be no risk to the participants. Therefore, the reviewer recommends that it be allowed to proceed with the "Exempt" status.

Signature: _____ Date: July 9, 1997

Chair of Institutional Review Board

cc: Brenda Solomon

OKLAHOMA STATE UNIVERSITY
INSTITUTIONAL REVIEW BOARD
HUMAN SUBJECTS REVIEW

Date: 07-08-97

IRB #: ED-98-000A
BU-98-000A

Proposal Title: COMPUTER ASSISTED TECHNOLOGY TRANSFER-TECHNOLOGY DIFFUSION IN THE WORKPLACE

Principal Investigator(s): Ramesh Sharda, Ray Sanders, Brenda Solomon

Reviewed and Processed as: Continuation

Approval Status Recommended by Reviewer(s): Approved

ALL APPROVALS MAY BE SUBJECT TO REVIEW BY FULL INSTITUTIONAL REVIEW BOARD AT NEXT MEETING, AS WELL AS ARE SUBJECT TO MONITORING AT ANY TIME DURING THE APPROVAL PERIOD.
APPROVAL STATUS PERIOD VALID FOR DATA COLLECTION FOR A ONE CALENDAR YEAR PERIOD AFTER WHICH A CONTINUATION OR RENEWAL REQUEST IS REQUIRED TO BE SUBMITTED FOR BOARD APPROVAL.
ANY MODIFICATIONS TO APPROVED PROJECT MUST ALSO BE SUBMITTED FOR APPROVAL.

Comments, Modifications/Conditions for Approval or Disapproval are as follows:

Signature: John H. Wyckoff

Chair of Institutional Review Board

Date: June 9, 1998

cc: Brenda Solomon

VITA

Brenda Sue Solomon

Candidate for the Degree of

Doctor of Education

Thesis: COMPUTER ASSISTED TECHNOLOGY TRANSFER: UNDERSTANDING TECHNOLOGY DIFFUSION IN OKLAHOMA SMALL-TO-MEDIUM SIZED MANUFACTURERS

Major Field: Occupational and Adult Education

Biographical:

Education: Received Bachelor of Arts degree in Radio, Television & Film from California State University, Northridge, California in 1985 and a Master of Arts degree in Communication Arts from Loyola Marymount University, Los Angeles, California in 1991. Completed the requirements for the Doctor of Education degree at Oklahoma State University in July, 2000.

Experience: Owner of Drive Me Wild, Los Angeles, California, 1988-1990; employed by Media Services as Broadcast Business Affairs Consultant, Los Angeles, California, 1988-1993; employed as a Research Associate, CATT, College of Business, Oklahoma State University, 1997-1998; employed as Program Manager, Education Extension, Oklahoma State University, 1994 to present.