# Information Technology Change in the Architecture, Engineering, and Construction Industry: An Investigation of Individuals' Resistance

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Dissertation submitted to the Faculty of

Virginia Polytechnic Institute and State University

in partial fulfillment of the requirements for the degree of

Doctor of Philosophy

In

Civil Engineering

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April 23, 2004

Blacksburg, Virginia

Keywords: Resistance, Resistance to Change, Change Management, Information Technology, Technological Change, Construction Industry

# Abstract

## Information Technology Change in the Architecture, Engineering, and Construction Industry: An Investigation of Individuals' Resistance

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This research project investigates individuals' resistance to change brought about by new information technology implementation in the Architecture, Engineering, and Construction (AEC) industry. By understanding how individual participants resist and adapt to change, their resistance can be better accommodated by the organization in the adoption of new information technology within the AEC industry. This enables researchers and practitioners to understand how new technologies should be introduced within organizations.

A social architecture factor model associated with impeding/promoting use of information technologies was created based on a literature review of change management theory on resistance to change and attitude-behavior connections. In Phase I of the research, the personality traits and behavioral characteristics individuals included in the original model were reduced to a smaller number of variables indicative of resistance to information technology change. A revised social architecture factor model was created after this reduction. The variable reduction and revised model were based on data collected from a 50-person sample of the AEC population. At the conclusion of Phase I, a Resistance to Change Index (RTCI) was created, enabling estimations of the intensity of resistance an individual is likely to exhibit using the personality traits and behavioral characteristics kept in the revised social architecture factor model.

Phase II of the research investigated relationships between the RTCI and demographics of the individual using a 156-person sample of the AEC population. This phase of the research determined whether different demographic groups within the AEC population exhibited differences in their RTCI. The data analysis found several demographic groups that were

different in their likelihood of resistance, including profession, gender, computer understanding and experience, and awareness of past or future changes occurring in their company.

Age and education level were expected to have relationships with RTCI, based on industry stereotypes. The data analysis found that these stereotypes have no scientific basis. Two other stereotypes, gender and computer understanding and experience, were supported by the data analysis, however.

## Acknowledgements

I would first like to thank my parents. You have provided me with support and encouragement when I've needed it the most. And yes, this is the last degree I will get!

To my friends, thanks for putting up with me through thick and thin, especially since I've been such a hermit during these last few months. Special thanks go to Carole Dabney-Smith, for being there first, telling me I was being silly when I was, and helping me through the tough spots. Thanks also go to Tom Adams for providing me with sanity breaks while I was writing.

I would also like to thank my committee members, Drs. Songer, Beliveau, Bonham, de la Garza, and Schulman for their time and contributions to this research. In particular, Dr. Songer deserves special recognition for all the time and energy he has spent working with me throughout this project, believing in me and my work.

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*"It is not necessary to change. Survival is not mandatory."*

W. Edwards Denning

*"The world hates change, yet it is the only thing that has brought progress."*

Charles F. Kettering

## Chapter 1. Introduction

This research project investigated individuals' resistance to change brought about by new information technology implementation in the Architecture, Engineering, and Construction (AEC) industry. By understanding how individual participants resist and adapt to change, their resistance can be better accommodated by the organization during the adoption of new information technology within the AEC industry. This enables researchers and practitioners to understand how new technologies should be introduced within organizations.

This chapter presents background information pertaining to the initial development of the project and the general methodology used, along with specific research questions and objectives for this work. This chapter also includes several limitations of the overall project and an overview of the dissertation.

### *1.1 Background*

Ever increasing information technology capabilities exist in the AEC industry. Email, project specific websites, Computer Aided Drafting (CAD), and animations exemplify technologies adopted in recent years within the industry. While the change methods used in the adoptions suggest a focus on technology, the technology itself is often seen as a primary barrier to successful implementation.

In general, the AEC industry is extremely slow to embrace available information technology (Emond 1999; Rosenbaum and Schriener 2000; U.S. Department of Labor 1988). Executives often delay investing in new technologies, hoping that the rate of technological growth will

stabilize, reducing long-term investment costs. According to Moore's Law*, stabilization is unlikely to occur in the next several years (Hayes and Jaikumar 1988). The Intel Corporation forecasts that Moore's Law will hold true until at least 2010 (Intel Corporation 2003). This places financial implications on new technology adoptions, limiting their introduction into the AEC industry.

Even when financial issues are disregarded, a successful implementation process must meet the technical requirements of the problem, satisfy the organizational needs and desires, and address any worker-related challenges (Parsons et al. 1991). Management is usually preoccupied with the technical aspects of implementing a new technology and ensuring that it meets the organizational needs. Unfortunately, the worker-related issues are regularly neglected (Parsons et al. 1991; Steier 1989).

On the whole, the hesitation in information technology adoption originates from too much emphasis on technology and too little focus on people. Figure 1-1 illustrates technology centered change models.

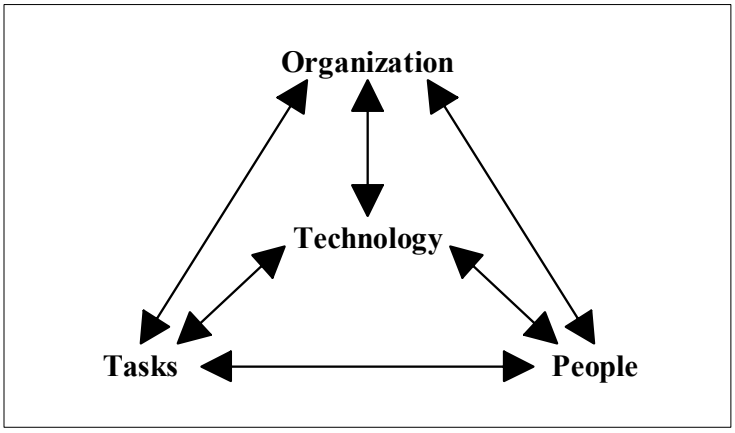


**Figure 1-1 Technology is Central to Change** (adapted from Sutton and Sutton 1990)

* The press coined the term, Moore's Law, which is based on an observation made by Gordon Moore in 1965 that the number of transistors per square inch on integrated circuits would double every year. This has been modified slightly to a doubling every 18 months, which is the accepted definition at this time (Intel Corporation 2003). In common usage, it implies that information technology development continues to dramatically improve at an exponential rate.

Throughout history, changes in technologies and the inventions of new machines have altered the skill requirements, tasks, and relationships among workers. Improvements in industrial technologies profoundly changed organizations (Kingsford 1964). Examples of significant changes are not limited to a single industry. The telephone, while initially thought to be only for the elite, has changed global communication. The Internet, first thought of as a curiosity of academics and government researchers, is fundamentally changing the global economy. The impact of technological changes is often vastly underestimated.

When information technology changes such as email, project specific websites, or CAD are implemented in an organization, they affect the way work is done. Frequently, the communication modes are altered. The power structure of the organization may change and become flatter than it was before the implementation. The people involved form opinions and ultimately choose to accept or reject the change.

The importance of cultural issues such as these during technological implementation is well documented, yet predominantly unresearched within the building and construction industry (Cleveland 1999; Ford et al. 2000; Mitropoulos and Tatum 2000; O'Brien 2000; Songer et al. 2001; Thorpe and Mead 2001; Todd 1996). Technological changes will not be successful until researchers develop a fundamental understanding of <u>how</u> people change and <u>why</u> they react the way they do. Therefore, studying individuals and their change processes is essential to successful implementation of information technology change.

To support the importance of cultural issues in technology implementations, Figure 1-2 illustrates a people focused model for technological change (Leavitt 1958; as adapted by Sutton and Sutton 1990). This model places technology in a change enabling position, rather than being a driver of change, as in the technology focused change model of Figure 1-1. A people centered paradigm for developing information technology implementation models provides the primary foundation of this research.

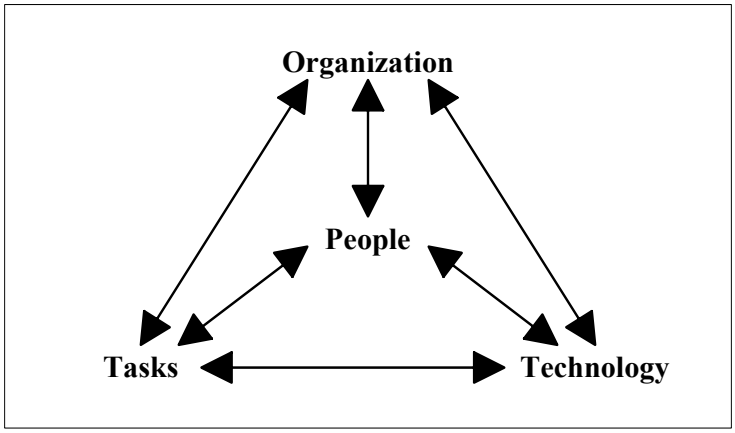


**Figure 1-2 People are Central to Change**
(Reprinted with permission of Sage Publications Ltd from Sutton and Sutton 1990)

## *1.2 General Methodology*

This research investigated individuals' resistance to change brought about by new information technology implementation in the AEC industry. This section provides a brief overview of the project and identifies locations within the dissertation where more detail can be found. Figure 1-3 illustrates the general methodological steps for this research, as well as indicating how each step fits into the Ph.D. process.

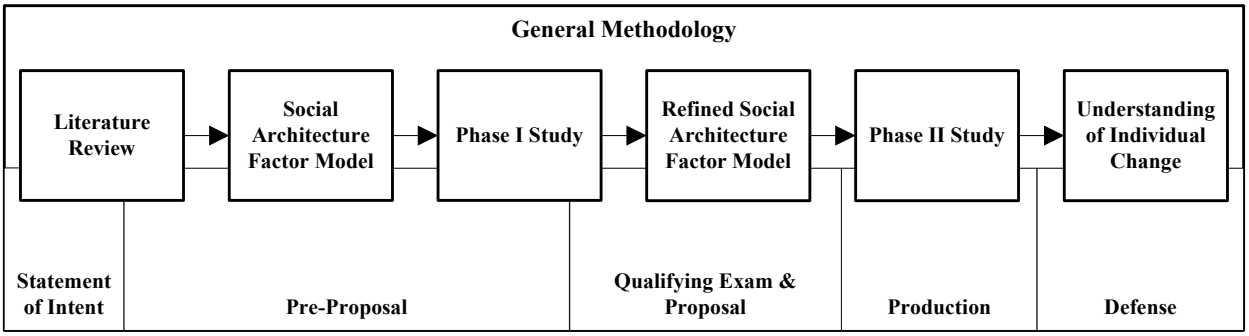


**Figure 1-3 General Methodology of Research**

Change management theory provided the background literature for the project. The primary topics reviewed were: (1) resistance to change and (2) the connection between attitudes and behaviors of an individual. These topics are discussed in detail in Chapter 2 - *Change Management Theory*.

Using the background literature on change management theory as a starting point, potentially influential attitudes, beliefs, and fears towards technological change were identified, as were potentially significant demographic characteristics of the individuals. Additionally, characteristics of the change itself and the individual's reactions to it were noted. Using the factors determined, a social architecture factor model associated with impeding/promoting use of technologies was constructed. This model served as a framework for the larger investigation into individual resistance and the creation of an initial social architecture assessment instrument for measuring individual factors. The development of the social architecture factor model is discussed in detail in Chapter 3 - *Social Architecture Factor Model*.

Using a social architecture survey instrument, based on the model, an initial study (Phase I) was conducted with a sample of AEC participants. The social architecture factor model included 39 factors consisting of 76 variables – far too many variables to investigate adequately in this research project. The purpose of the initial study was to reduce the number of factors in the model and focus the research for the remainder of the study (Phase II). The Phase I study also provided an opportunity to learn the realities of data collection and analysis by validating possible methods. Additionally, a Resistance to Change Index (RTCI) was created from the remaining variables in preparation for Phase II of the research. The Phase I study, discussed further in Chapter 4 - *Phase I Methodology*, included data collection, data analysis, and findings.

Phase II of the study is discussed in Chapter 5 - *Phase II Methodology* and Chapter 6 - *Limitations and Discussion of Phase II*. Phase II explored the relationships between the social variables and the demographics of individuals to understand different AEC participants' resistance to information technology change. From this, it was determined whether individuals that exhibit different intensities of resistance to information technology change can be identified based on their demographics. By examining these relationships, the most significant demographic factors relating to information technology implementation were identified. Providing companies in the industry with the ability to identify their potential resistors is the first step in helping ensure that new technology implementations succeed.

To summarize, the general methodological steps for this research included:

1. Conducting a literature review investigating resistance to change and the connection between attitudes and behaviors.
2. Construction of a model of social architecture factors associated with impeding/promoting use of information technologies. This model served as the basis for the creation of an initial social architecture assessment survey instrument for measuring individual factors.
3. Collection of data from a sample of AEC participants using the Phase I survey.
4. Analysis of results of Phase I data by examining patterns and relationships of the variables to determine which measures could be reduced or eliminated resulting in a smaller number of factors. A refined social architecture assessment survey for measuring individual factors was the product of this step. A Resistance to Change Index (RTCI) was also created in preparation for Phase II. Additionally, specific hypotheses for the research were established at the conclusion of the Phase I data analysis.
5. Collection of data using the refined assessment survey instrument. Employees at all organizational levels were queried to understand and identify individual resistance factors for IT implementation. The data set for this aspect of the project was identified through multistage random sampling to ensure that the results could be generalized to the entire AEC industry.
6. Analysis of the relationships between social variables and demographics of the individual to identify any existing relationships using statistical analysis techniques.
7. Creation of benchmark statistics for the investigation. AEC participants were compared and contrasted and individuals' likelihood of resistance and its relationship to their demographics was identified.

## *1.3 Research Questions*

The methodology discussed in the previous section investigates four primary research questions, each of which drives a portion of this work. These research questions are:

- Which of the social architecture factor measures are most indicative of resistance to information technology change within the AEC industry?
- What are the relationships between the social variables and the demographics of the individuals?

- Do different demographic groups exhibit different intensities of resistance to information technology change?
- Are industry stereotypes about resistance to information technology adoption true?

## *1.4 General Objectives*

In order to achieve the goal of answering the research questions, each question was developed into a measurable objective. The primary objectives of the research were:

- To isolate attitudes, fears, and beliefs that are indicative of resistance to information technology change within the AEC industry.
- To estimate the intensity of resistance an individual is likely to exhibit using the personality traits and behavioral characteristics identified.
- To identify any variances that exist between different demographic groups based on the estimates of intensity of resistance likely to be exhibited.
- To provide sound research that can help to debunk stereotypes that currently exist within the AEC industry with respect to information technology implementation.

Each of these objectives was achieved during the research effort. A summary of the findings of these objectives can be found in section 7.3 - *Summary of Research*.

## *1.5 Limitations of the Research*

In order to maintain a manageable scope for this project, limitations on the research were necessary. This section of the dissertation discusses these limitations, including:

- The definition of technology used for the research;
- The restriction of the research to individuals' perceptions; and
- The restriction of the research to providing an understanding of resistance variables and their relationship with an individual's demographics.

### 1.5.1 Technology Defined

Many authors define technology as any knowledge, machine, tool, product, process, material, or method used to accomplish work (Cohen et al. 1995; Khalil 2000). This is an extremely broad definition and, taken literally, can include everything from a pencil and a piece of paper to a nuclear submarine or a multi-million dollar computer network. For the purposes of this work,

technology is defined as computer hardware and software tools used to create goods, provide services, or carry out specific tasks and/or processes as they relate to the AEC industry. It shall include but not be limited to the following:

- Computer Aided Drafting (CAD) in 2 or 3 dimensions
- Animation (4D CAD)
- Virtual reality
- Email
- Word processing
- Spreadsheets
- Databases
- E-Commerce including electronic data interchange (EDI)
- Project specific websites
- Robotics
- Global Position System (GPS)

The definition of technology for this research project shall not include new management styles, new material technologies, or technologies that have been accepted as a normal part of business throughout all industries, such as telephones, photo copiers and fax machines, unless they have been substantially changed from the norm (like a videophone). It also shall not include heavy construction equipment such as cranes and earthmoving machinery, even if their operations have been substantially changed from the current norm.

### 1.5.2 Individuals, Organizations, and Groups

A second limitation is the restriction of the research to technological change as it relates to individuals within the AEC community. Organizations and groups, such as inter-organizational project teams, certainly influence individuals' attitudes, beliefs, and fears, which in turn can influence reactions to change. However, organizational and group aspects of technological change are outside of the scope of this research project with the exception of the collection of some demographic information about the organization that employs an individual. This limitation helps to maintain a manageable scope of work for the research. Individuals were chosen for this research, instead of groups or organizations, because individuals are the building blocks making up groups and organizations and it is important to understand them first. Figure 1-4 illustrates this portion of the scope reduction.

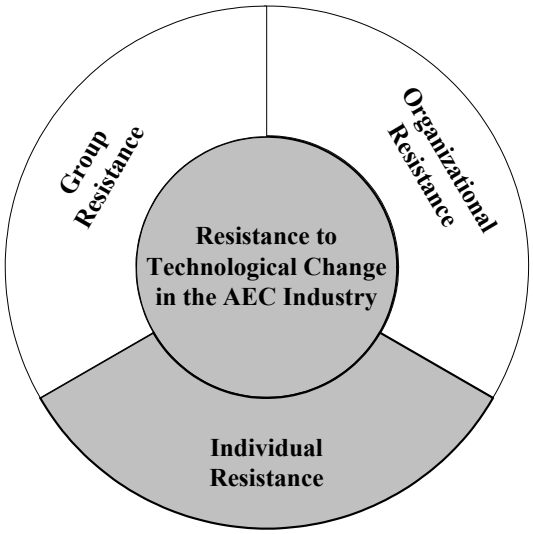


**Figure 1-4 Scope of Research – Individual Resistance**

### 1.5.3 Understanding Resistance, Predicting Resistance, Creating Change Models

The scope of the research is reduced further by limiting it to providing an understanding of resistance variables and their relationship with an individual's demographics. As previously mentioned in section 1.4 - *General Objectives*, the work estimates the intensity of resistance an individual is likely to exhibit in an information technology change based on their personality traits and behavioral characteristics. An attempt at prediction of resistance using linear regression based on the demographics measured is made, primarily as a stepping stone for future research. It is acknowledged that prediction is an important step in the study of this topic, but any further regression analysis will be left for future research. This limitation is necessary in order to maintain a manageable scope of work for the research. Once prediction models have been firmly established, change models can be created to help the AEC industry move forward in information technology implementation with more success. Figure 1-5 illustrates this portion of the scope reduction.

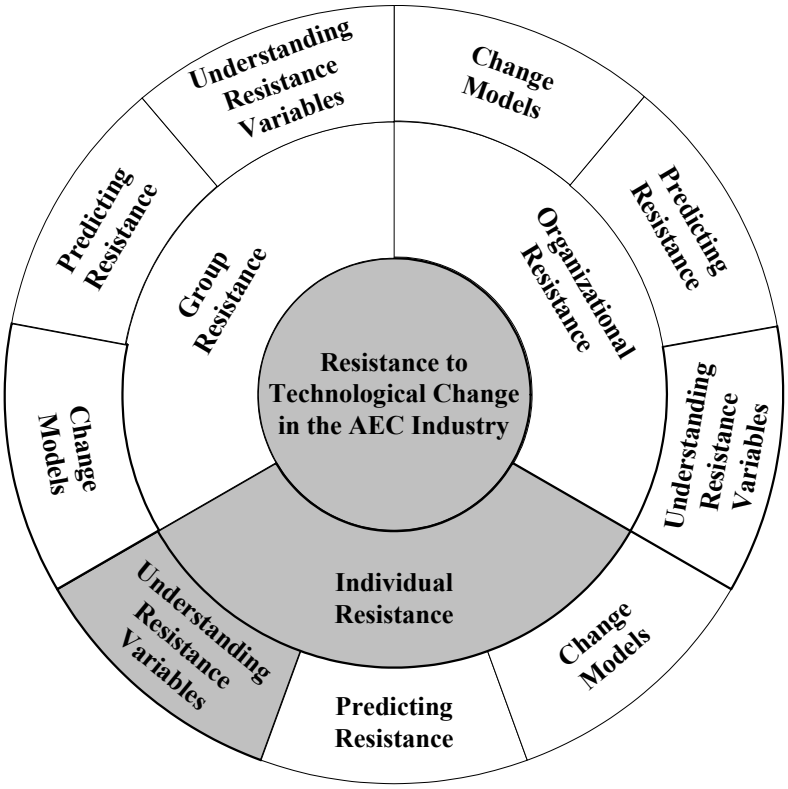


**Figure 1-5 Scope of Research – Understanding Resistance Variables**

A brief discussion of areas outside of the scope of this research is included in section 7.2 - *Recommendations for Future Research*.

## *1.6 Overview of the Dissertation*

This section briefly describes the organization and contents of the remaining chapters of this dissertation.

Chapter 2 discusses the underlying theory of resistance to change as represented in the literature and identifies aspects of resistance that were and were not investigated in this research. It also describes the connection between attitudes and behaviors of individuals within change management.

Chapter 3 describes the creation and development of a social architecture factor model for new information technology implementation in the AEC industry. The model illustrates the change process from an individual perspective. The broad categorical measures indicative of

individuals' resistance to information technology change represented in the model are: type and scope of change; method and speed of introduction; demographics of individual; attitudes, beliefs, and fears of individual; and demographics of organization.

Chapter 4 presents the research methodology for Phase I of the work. Objectives for Phase I are identified and the data collection process is discussed in detail. This chapter also discusses the data analysis method used for reducing the number of variables in the social architecture factor model and the resultant findings. Additionally, the creation of the Resistance to Change Index (RTCI), representative of an individual's level of likelihood of resistance to information technology change, is presented. This chapter concludes with a discussion of the limitations and results of Phase I of the research.

Chapter 5 describes the research methodology for Phase II of the work. Hypotheses for Phase II are identified and the data collection for this portion of the research is discussed in detail. The data analysis method for evaluating the hypotheses is presented along with the resultant findings.

Chapter 6 describes the limitations of Phase II. It also presents a discussion of the Phase II results. Chapter 7 presents the conclusions of this research project. This includes a discussion of the contributions of the research project and recommendations for future research.

There are ten appendices to this dissertation. Appendix A is a list of references and Appendix B is a bibliography for the research. Appendix C is the Institutional Review Board Submission required for Phase I. Appendix D is the instrumentation used for data collection during Phase I. Appendix E includes a summary of the raw data from Phase I, along with data analysis output from *SAS*®. Appendix F is an example data analysis for the Phase II work using the Phase I data. Appendix G is the Institutional Review Board Submission required for Phase II. Appendix H is the instrumentation used for data collection during Phase II. Appendix I includes a summary of the raw data from Phase II, along with data analysis output from *SAS*® and *Analyse-it for Microsoft Excel*. Appendix J is an example of the Personal Change Profile that individuals could request during Phase II of the project.

# Chapter 2. Change Management Theory

Change management theory provides a theoretical framework for the research. Change management theories present processes and guidelines for changing organizations and tasks, with limited emphasis on individuals involved in change. However, resistance of people is the primary reason for failure of organizational change (Maurer 1997).

This chapter discusses change management theory as it relates to this research. Specifically, two portions of change theory are included: resistance to change and the connection between attitudes and behaviors.

## *2.1 Resistance to Change*

This section of the dissertation presents resistance to change as represented in the literature. The theoretical background on resistance to change provides a context for the study. This section also includes a discussion of the aspects of resistance that were investigated in this research, as well as identifying those aspects that were not included. Four aspects of resistance to change are presented: (1) resistance to change vs. resistance to beneficial change, (2) the framework of resistance to change, (3) the timing of technology adoption, and (4) the timing of resistance. Each of these aspects are elaborated below.

### 2.1.1 Resistance to Change vs. Resistance to Beneficial Change

Whether one sees change as a battle that must be won, or as a learning and growing experience, depends only on one's perspective. Typically, resistance to change is viewed as the enemy, which must be overcome at all costs in order for the change to be successful (Waddell and Sohal 1998). Tied in closely with the view that resistance is bad is the notion that innovation is always good. Rogers refers to this as the 'pro-innovation bias' – the implication that an innovation should be accepted without modification and quickly adopted by all members of a social system (Rogers 1995). "This viewpoint regards any resistance as a merely irrational reaction to innovation, or simply something to be ignored as unimportant" (Herling 1996, p. 49).

Waddell and Sohal (1998) examined the literature and discovered that this negative view of resistance has no theoretical support. In fact, a number of researchers have found that much

value can be gained from resistance to change (Albanese 1973; Bauer 1995; Kanter 1985; Klein 1973; Mabin et al. 2001; O'Connor 1993b; Rogers 1995; Zander 1973). Resistance to change has many advantageous aspects. For example, it is "better than apathy, it avoids group-think, it provides alternative ideas for consideration, and a wider set of people involved in the evaluation of alternatives may overcome the problem that many managers have of failing to consider or evaluate properly enough alternatives" (Mabin et al. 2001, p. 170). Bauer (1995) says that resistance is an alarm signal warning that more evaluation of the possible consequences of the innovation adoption need to take place. However, if resistance is used randomly or irresponsibly, it can have a significant negative effect on views about the change (O'Connor 1993b).

There are times when resistance to change may be good. As Maurer (1996a) points out, "resistance keeps us from attaching ourselves to every boneheaded idea that comes along." Resistance to change is a protective function. It provides a way to say 'no' to a change and allows individuals to express different views about it. It encourages a search for alternative solutions and promotes additional thought regarding the proposed change (Waddell and Sohal 1998). Resistance "plays a crucial role in drawing attention to aspects of change that may be inappropriate, not well thought through, or perhaps plain wrong" (Waddell and Sohal 1998, p. 545). Sometimes the proposed change is not the right one for the social system and is a threat for all involved; resistance is quite appropriate here (Kanter 1985). It is also important to "learn how to differentiate between change which may pose real threat and change which is resisted simply because it is new and feels alien" (Klein 1973, p. 433).

Even Freud emphasized "that resistances were a necessary and even desirable aspect of the therapy. He pointed out that without resistance patients might be overwhelmed by the interventions of the therapist, with the result that inadequate defenses against catastrophe would be overthrown before more adaptive ways of coping with inner and outer stimuli had been erected" (Klein 1973, p. 425).

"It is important, therefore, for those seeking change to consider the costs of ignoring, overriding, or dismissing as irrational those who emerge as their opponents. To ignore that which is being

defended may mean that the planned change itself is flawed; it may also mean that the process of change becomes transformed into a conflict situation in which forces struggle in opposition and in which energies become increasingly devoted to winning rather than to solving the original problem" (Klein 1973, p. 432).

Similar to the thought that resistance to change should be viewed as a good thing, lack of resistance to change can often be bad. Apathy should be regarded as an indication that there is a problem with the existing system or the method of introduction of the proposed change (Albanese 1973). Resistance contributes energy to the change process and the lack of resistance can indicate that implementing the change will be very difficult (Waddell and Sohal 1998).

Finally, it is possible for change to be a bad thing for the system. "[I]t is a fallacy to consider change itself to be inherently good. Change can only be evaluated by its consequences, and these cannot be known with any certainty until the change effort has been completed and sufficient time has passed" (Hultman 1979, p. 53). It is impossible to predict whether the change will achieve the goals it sets out to and what unintended consequences may occur in the process.

This research measures resistance to information technology change without making a distinction between positive resistance and negative resistance. Determining whether resistance is positive or negative is situational and requires not only a change, but also an opinion about the effect of the resistance. Likelihood of resistance is measured independent of a change occurring, so distinguishing between positive and negative resistance is not possible.

### 2.1.2 Framework of Resistance to Change

People have a natural resistance to change, but not everyone reacts in a similar fashion, or for similar reasons. The amount of the resistance also varies between people. These discrepancies may be the root of the technology implementation problem. There is no visible consistency to resistance, making the implementation of technology change a very difficult goal to achieve.

Resistance to change is a combination of three factors: cause of resistance, level of resistance, and manifestation of resistance.

The first factor in resistance to change, cause of resistance, examines why the person resists the change. Hultman (1998) ascertains that there are eight common reasons:

1. There is no incentive for change to occur. The person is content with the status quo.
2. The change is a threat to the status quo, is viewed as harmful, and protection is sought.
3. The risks associated with change are seen as greater than the benefits.
4. There is no awareness of the ensuing crisis that is driving the change.
5. There is dissatisfaction with the method used for implementing the change.
6. There is little confidence that the change will be successful.
7. The change is not consistent with values and beliefs.
8. There are doubts about the honesty and openness of the leadership responsible for the change.

This research does not address the cause of resistance. Causal relationships are quite difficult to establish and there are few studies that go beyond anecdotal explanations of the cause of resistance due to this difficulty.

The second factor in resistance to change, level of resistance, measures how much resistance is present. It is measured subjectively and exists along a continuum from no resistance to extreme resistance (Hultman 1998).

This research measures the level of likelihood of resistance using an index created from nine variables that are indicative of resistance to change. It measures likelihood of resistance as opposed to actual resistance for two reasons. First, the index measures the variables independent from a change occurring. Second, resistance is a subjective measurement with no formal, direct way of measuring it. Any analysis of likelihood of resistance is limited to relative comparisons (i.e., higher likelihood vs. lower likelihood).

The third factor in resistance to change, manifestation of resistance, identifies what behaviors the person exhibits to show their resistance. These manifestations reveal themselves in different ways. They may be active displays of resistance, such as sabotaging or arguing, or they can be passive, like procrastinating or withholding information (Hultman 1998). They can also be

exhibited in physiological ways like an increase in blood pressure, or in a specific emotion like fear (Maurer 2001). O'Connor proposed a two-by-two matrix for the manifestations of resistance: conscious vs. unconscious crossed with covert vs. overt (O'Connor 1993a).

This research does not identify the manifestation of resistance. As stated previously, likelihood of resistance is measured independent of a change occurring. Without a longitudinal study examining individuals before and after a change occurs, manifestation is not possible to accurately measure.

### 2.1.3 Timing of Technology Adoption

In order to discuss resistance to change properly, it is helpful to understand how individuals distribute themselves throughout the change diffusion process timeline. This is a timeline illustrating when individuals or groups adopt a change, with respect to the establishment of the change. The most widely recognized model of the diffusion process is Rogers' diffusion of innovations model (Rogers 1995). Diffusion here is defined as "the process by which an innovation is communicated through certain channels over time among the members of a social system" (Rogers 1995, p. 5) and innovation is defined as "an idea, practice, or object that is perceived as new by an individual or other unit of adoption" (Rogers 1995, p. 11).

Rogers' model categorizes potential adopters of an innovation into five groups, based on innovativeness – the time at which an individual adopts an innovation. Figure 2-1 illustrates this model. Innovators represent the first 2.5% of adopters within a social system. Innovators are adventurous individuals willing to accept the uncertainty surrounding an innovation at the time of adoption. Early adopters represent the next 13.5% of individuals in the system adopting the innovation. Early adopters are respected individuals within the system that are generally thought to be role models for the group. This category includes a majority of the opinion leaders in the social system (those whose opinions are sought by others considering the adoption). The next 34% of adopters are known as the early majority and are sometimes described as the deliberators. Their decision process is longer than for the innovators or the early adopters, but they are very willing to adopt new innovations once they have learned enough to make the decision. The late majority (34%), on the other hand, adopt because of economic necessity or pressure from others within their social system. They are generally very skeptical about the innovation and wait until

most of the uncertainty surrounding the innovation has vanished. The last group to adopt an innovation are the laggards, which represent the final 16% of adopters in the system. They tend to be suspicious of all aspects surrounding the change and are usually individuals at the perimeter of the system. They need to know that all of the uncertainty has been removed from the innovation. It is important for them to know that the innovation will definitely succeed. It is important to note that Figure 2-1 only accounts for adopters of the innovation. Non-adopters (those that never adopt) are not represented in this model.

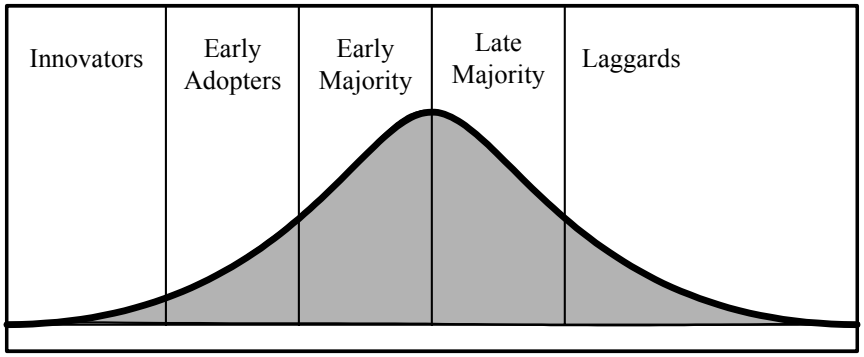


**Figure 2-1 Rogers' Adopter Categorization During the Technology Adoption Process**
(adapted from Rogers 1995, p. 262)

This research does not identify the timing of an individual adopting a technology. Likelihood of resistance is measured independent of a change occurring. Without a longitudinal study examining individuals and when they choose to adopt during a change, timing of adoption is not possible to accurately measure.

### 2.1.4 Timing of Resistance

It is important to note that some resistance is initial resistance to using a technology and some resistance is delayed. Initial resistance means that an individual does not wish to begin using the technology. This was discussed in the above section regarding the timing of adoption.

Delayed resistance means that an individual begins using the technology and decides at a later time to stop or significantly reduce their usage. Delayed resistance is not being measured because, again, it is necessary to examine individuals undergoing a change, which was not included in this research.

### 2.1.5 Summary

This section of the dissertation presented resistance to change as represented in the literature to provide a context for the study. This section also included a discussion justifying the aspects of resistance that were investigated in this research, as well as identifying those aspects that were not included. To summarize, this research:

- Does not make a distinction between positive resistance and negative resistance;
- Does not address the cause of resistance;
- Does measure the level of likelihood of resistance using an index created from nine variables that are indicative of resistance to information technology change;
- Does not identify the manifestation of resistance;
- Does not identify the timing of an individual adopting a technology; and
- Does not measure delayed resistance.

## *2.2 The Attitude-Behavior Connection*

To continue the discussion of change management theory as it relates to this research, this section presents the connection between attitudes and behavior as represented in the literature. This research measures level of likelihood of resistance using variables that are indicative of resistance to information technology change. Many of these variables are attitudinal in nature. The connection between attitudes and behaviors provides the link needed to use an individual's attitudes in this research to forecast their intentions, and in future research to predict their behavior.

The predominant theories relating attitudes and behavior are the Theory of Reasoned Action and the Theory of Planned Behavior. A discussion of each theory is presented below.

### 2.2.1 The Theory of Reasoned Action

It is commonly believed that a person's attitudes about an object or action are related to the person's behavior with respect to that object or action. Fishbein and Ajzen proposed the theory of reasoned action to support this idea (see Figure 2-2 below). In this theory, beliefs about an object lead to an attitude about it. Attitudes are defined as "the predisposition to evaluate or respond to a person, a situation, or an event in a certain way, favorable or unfavorable" (Melvin

1979). Attitudes are likely to be unconscious, whereas beliefs, though defined essentially the same, are more likely to be verbalized.

Beliefs are gathered from many sources, including past experiences and what other people may have said about the object. The attitudes that are formed, in turn, lead to behavioral intentions regarding the object, such as intentions to use it or avoid it. These behavioral intentions affect the actual behavior of the person toward the object. The behavior of the person has a feedback loop returning to the person's beliefs. If there is a positive behavioral experience, the belief is reinforced in a positive manner, and if there is a negative behavioral experience, the belief is reinforced in a negative manner.

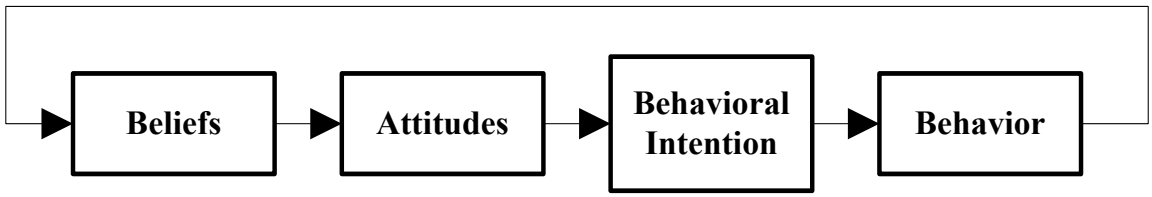


**Figure 2-2 Theory of Reasoned Action** (adapted from Fishbein and Ajzen 1975)

Much empirical research has been performed using this theory with mixed success. A review of available research (109 investigations) was completed by Ajzen & Fishbein (1977). Their findings indicate that when the attitudes measured closely corresponded with the behaviors measured, the correlation between the attitude and the behavior was quite high. In other words, when the researchers were careful to use appropriate measures of attitude, a person's attitude could be used to predict their behavioral intentions, and consequently, their behavior.

Based on this theory, an appropriate measure of attitude must correspond to the behavior of interest in terms of Target, Action, Context, and Time to be completely accurate for prediction purposes. Target and Action were found to be the most important elements that needed to be matched between the attitude and the behavior of interest (Ajzen and Fishbein 1977). For example, if the behavior of interest is the use of computers, the Target is computers and the Action is use of computers. The attitude measurements need to be related to computers (Target),

and more specifically, to the use of computers (Action) for prediction of behavior to be possible. A general attitude cannot be used to predict a specific behavior (Ajzen 1991).

### 2.2.2 The Theory of Planned Behavior

The theory of planned behavior is an extension of the theory of reasoned action (Ajzen 1991). The attitude and belief portions of Figure 2-2 were first combined, and then split into three new categories: attitude toward the behavior, subjective norm, and perceived behavioral control (see Figure 2-3).

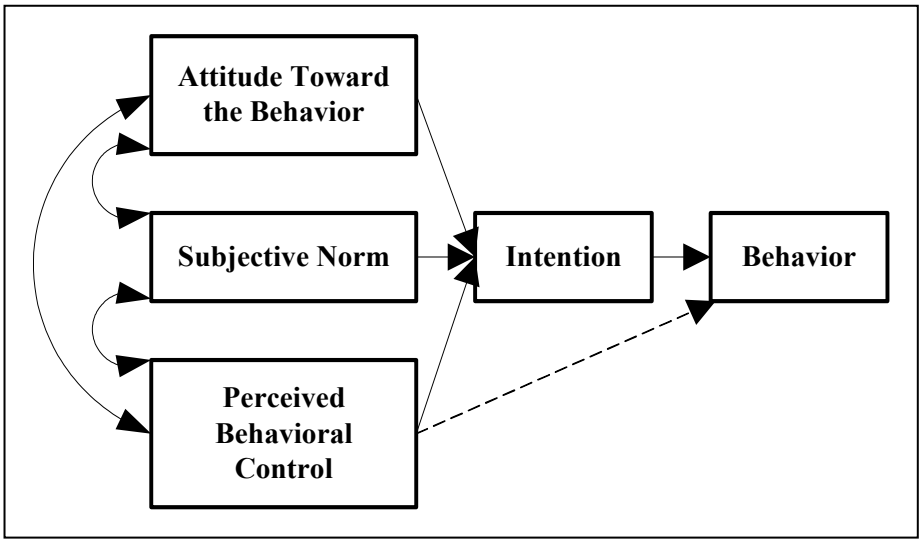


**Figure 2-3 Theory of Planned Behavior**

The attitude toward the behavior now consists specifically of attitudes formed based on the individual's evaluation of the behavior. Subjective norms are those attitudes resulting from perceived social pressure from family, friends, and other important persons. Perceived behavioral control reflects the person's confidence that they are capable of performing the behavior of interest. All of these aspects influence the person's intention to perform the behavior. This intention, combined with the person's perceived ability to perform the behavior, will result in the behavior of interest.

Based on a review of 16 research studies using the theory of planned behavior, it was concluded that "Attitudes toward the behavior, subjective norms with respect to the behavior, and perceived control over the behavior are usually found to predict behavioral intentions with a high degree of

accuracy. In turn, these intentions, in combination with perceived behavioral control, can account for a considerable proportion of variance in behavior" (Ajzen 1991, p. 206).

As stated in the previous section, a general attitude cannot be used to predict a specific behavior, but it can be used to predict aggregate behaviors (Ajzen 1991). A single example of behavior is influenced by many factors unique to the occasion being observed. By aggregating behaviors over different situations and times, the influences tend to cancel each other out, making the general attitudes much better predictors of behavior. "Many studies performed in recent years have demonstrated the workings of the aggregation principle by showing that general attitudes and personality traits do in fact predict behavioral aggregates much better than they predict specific behaviors" (Ajzen 1991, p. 180-1).

The Theory of Planned Behavior is used as a theoretical basis for this research. This theory is an extension of the Theory of Reasoned Action and is therefore more comprehensive and more appropriate as a foundation for this research. The Theory of Planned Behavior provides the link needed in this research to use an individual's attitudes to forecast their behavioral intentions, and in future research, to ultimately predict their behavior.

## *2.3 Summary*

This chapter discussed resistance to change as represented in the literature, coupled with an identification of the aspects of resistance to change that were and were not investigated in this research. The chapter also included a discussion of the connection between attitudes and behaviors of an individual as represented in the literature. These aspects of change management theory provide a theoretical framework for the research.

# Chapter 3. Social Architecture Factor Model

This chapter discusses the creation and development of the social architecture factor model associated with impeding/promoting use of technologies. This model was created to provide a framework for research involving change. It is general enough to represent nearly any type of change, but can be specialized for specific types of change by supplementing it with additional information, as appropriate. For example, the model was used in this research to create a social architecture assessment survey for data collection on resistance to information technology change by individuals in the AEC industry.

The initial framework of the model, shown in Figure 3-1, represents the basic change process: one or more parties initiate a change, the change is later introduced to other parties, and individuals and organizations choose to accept or reject the change along a continuum. The behaviors of individuals in the process influence behaviors of the organization and vice versa.

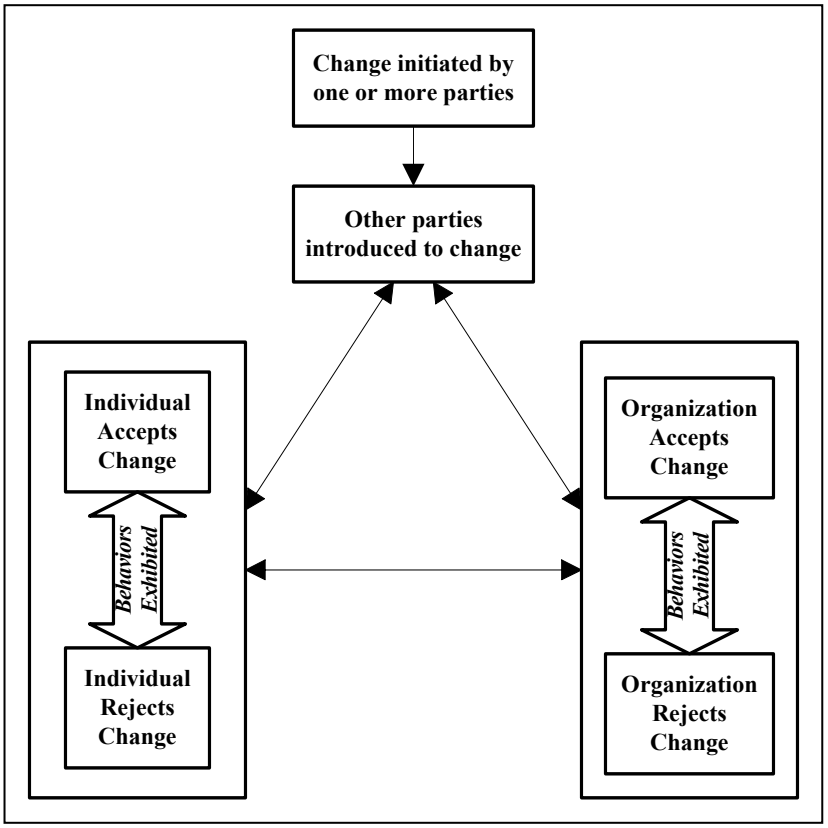


**Figure 3-1 Basic Change Process Model**

The basic change process model (Figure 3-1) was augmented through a literature review identifying aspects that affect an individual encountering an information technology change. This augmentation resulted in the creation of the social architecture factor model (Figure 3-2). This model illustrates the change process from an individual perspective.

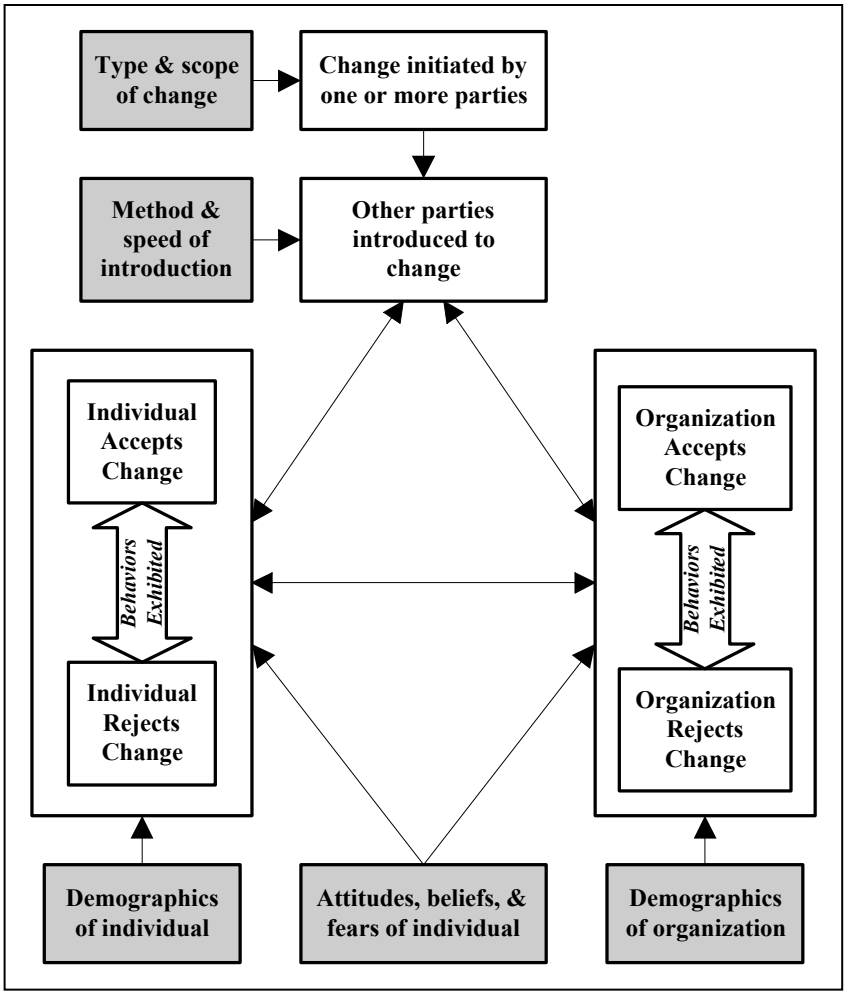


**Figure 3-2 Social Architecture Factor Model**

When a change is initiated, the type and scope of change are significant to the continuation of the change process and can indirectly affect an individual's response. As the change is introduced to others, the method and speed of the introduction affect its success. Individuals and organizations exhibit behaviors indicating acceptance or rejection of the change, with the behaviors of one interacting with, and quite possibly altering, the behaviors of the other. Each individual brings their own demographic characteristics with them, as well as their attitudes, beliefs, and fears, all of which may influence their behavior towards change. Organizational demographics and the

influence of individuals' attitudes, beliefs, and fears on the organization also influence reactions to change.

The broad categorical measures indicative of individuals' resistance to information technology change represented in the model are: type and scope of change; method and speed of introduction; demographics of individual; attitudes, beliefs, and fears of individual; and demographics of organization. The remainder of this chapter provides a discussion of the specific measures of technological change identified for each of these categories and presents the components that comprise the social architecture assessment survey used in Phase I for data collection (see Appendix D.2 for complete Phase I questionnaire).

## *3.1 Type and Scope of Change*

There are three primary types of change – incremental, tactical, and systemic – ranging from relatively minor to extensive. Incremental change is a low risk, small improvement change aimed at a specific target. A routine software upgrade is an example of an incremental change. Tactical changes involve greater risk, introduce new processes, and are more encompassing. An organization that changes from manual drafting to CAD experiences a tactical change. Systemic changes have the greatest risk and involve significant changes. Mergers, acquisitions, and collaborations with suppliers are examples of systemic changes (Mische 2001).

Each of these types of change is likely to influence an individual's behavior, but an incremental change is likely to produce a different reaction than a systemic one. Incremental changes can be streamlined so that they are imperceptible to many people, causing little or no reaction, especially since a person's job or the general way they perform their job is unlikely to be at stake. A merger with another company, however, is unmistakable and likely to instill a different reaction; people's job duties may change dramatically, or they may lose their job during the change.

To measure type of change, this research investigates perceived changes in the company. Because a given change affects individuals differently, it is important to understand what each individual perceives as technological change in their company. This helps to establish a lower

level boundary for change, below which the individual does not recognize that there is a change occurring. The researcher developed the questions used in the social architecture assessment survey, as no existing measures of this factor were located in the literature.

The scope of change is the extent to which the change pervades the system and ranges from enterprisewide to individual behavior (Mische 2001). Enterprisewide change affects more people than individual change and is therefore more complex in nature. To measure scope of change, this research focuses on tasks requiring information technology and their interdependence with other tasks. If an individual has no tasks that require the technology involved in the change, they are not likely to be affected by the change and are outside of its scope. If an individual has tasks requiring the technology but those tasks have no interdependence with others, the scope of the change is minimal. If the individual has tasks requiring the technology and those tasks have a high interdependence with others, the scope is much greater. The researcher developed the questions used in the assessment survey, due to a lack of existing measures in the literature.

Table 3.1 summarizes the factors identified for Type and Scope of Change and the measures used in the social architecture assessment survey.

**Table 3.1 Type and Scope of Change: Factors and Measures**

| Factor | Measure | Number of Questions | Question Numbers in Phase I Survey |
|---|---|---|---|
| Perceived changes in company | Researcher's questions | 2 | Q275-Q276 |
| Tasks requiring information technology and their interdependence with other tasks | Researcher's questions | 2 | Q278-Q279 |

## *3.2 Method and Speed of Introduction*

The method and speed of introducing change greatly affects the reactions of individuals. Specific measures used to evaluate the method and speed of change include decision-making, training, resources available, and rewards and punishments used. For example, if an individual

participates as a decision-maker in the change process, resistance to the change is much less likely to occur (Bemmels and Reshef 1991; Coch and French 1948).

Training in the specific technological change may not directly benefit employees during the change process. "A common weakness of training programs is their inability to transfer skills to the workplace" (Rusaw 2000). However, the training may help lessen risks associated with the change and improve the employee's confidence that the change will succeed. If implemented properly, it can also alleviate some of the attitudes, beliefs, and fears present, such as boosting computer confidence.

The resources available to an employee during a technological change can affect their reaction. By providing appropriate strategic, economic, financial, material, and human resources, much resistance can be avoided (Todd 1996).

Rewards and punishments used in the technology implementation impact reactions and results (Leonard-Barton and Kraus 1985). If the policies of the organization do not reward those using the new technology and/or punish those not using it, passive resistance is likely to be high; those not moving to the new technology have no reason to do so.

Table 3.2 summarizes the factors identified for Method and Speed of Introduction and the measures used in the social architecture assessment survey. The researcher developed the questions used in the assessment survey for each of the factors in this section, due to a lack of existing measures in the literature.

**Table 3.2 Method and Speed of Introduction: Factors and Measures**

| Factor | Measure | Number of Questions | Question Numbers in Phase I Survey |
|---|---|---|---|
| Decision-maker? | Researcher's questions | 2 | Q280-Q281 |
| Training in the specific technological change | Researcher's questions | 2 | Q282-Q283 |
| Resources available | Researcher's questions | 2 | Q284-Q285 |
| Rewards and punishments used | Researcher's questions | 4 | Q286-Q289 |

## *3.3 Demographics of Individual*

Demographic information about an individual often correlates with resistance to technological change (Bemmels and Reshef 1991; Heinssen et al. 1987; Loyd and Gressard 1984a; Potosky and Bobko 1998). The demographic information included in the model consists of profession, age, gender, education level, whether they are a member in a union, whether they have a professional license or registration, and their level in the organization. The researcher created the questions used in the assessment survey for each of these factors. Two additional demographics in the model, personality type and computer use, are discussed further below.

An individual's personality type was included in the model using the Keirsey Temperament Sorter II (Keirsey 1998), a 70-question version of the Myers-Briggs Type Indicator (MBTI). The MBTI is a well-documented, commonly accepted measure of personality type. Both tests are based on the work of the Swiss psychiatrist, Carl Jung. The Keirsey Temperament Sorter II version of the MBTI was chosen for the assessment survey due to its availability, its ease of use without formal training, and its brevity. Not all individuals taking this version can be classified into one of the 16 MBTI types. Because of its brevity, some individuals fall exactly in the middle of two categories, resulting in up to 81 possible groupings. There were 20 groupings in Phase I and 34 groupings in Phase II due to this test's failure to classify individuals precisely. This imprecision was accommodated in the analysis of the data.

The Keirsey Temperament Sorter II (Keirsey 1998) has four dichotomous subsets – E/I, S/N, T/F, and J/P. The first subset, E/I (Extroversion/Introversion), represents a person's preference

for the focus of their attention and whether they get their energy from the outer world of people and activity (extroversion) or their inner world of ideas and experiences (introversion). The second subset, S/N (Sensing/Intuition), represents a person's preference for gaining new information. Sensors focus on what is real and actual, whereas Intuitors focus on patterns and meanings in data and prefer to trust their intuition. The third subset, T/F (Thinking/Feeling), represents a person's preference for decision making. Thinkers prefer to use logical analysis, whereas Feelers are guided more by concern for their impact on others. The fourth subset, J/P (Judging/Perceiving), represents a person's preference for dealing with the outer world. Judgers prefer to go through life in a planned orderly way, whereas Perceivers prefer a life that is flexible and spontaneous.

Computer use gives a baseline of the individual's computer understanding and experience. Computer use was measured with three existing metrics: classification questions (Weinsier and Leutner 1988), a self-report of Computer Experience (Gardner et al. 1993), and the Computer Understanding and Experience Scale (CUE) (Potosky and Bobko 1998). Two researcher developed questions were also included in the assessment survey to address newer computer technologies that were less common at the time these measures were created.

The classification questions included in the assessment survey establish typing skills and computer ownership (Weinsier and Leutner 1988). The self-report of Computer Experience measures experience individuals have using computers to do various tasks (in average hours per day), as well as their confidence to learn to use new computers or software programs by different methods (Gardner et al. 1993).

The Computer Understanding and Experience Scale (CUE) is a general measure of computer experience based on usage, and knowledge about computers that is independent of usage. One study found a significant correlation between gender and the CUE score, but the author questions generalizing this correlation to other populations as this finding is not supported by other studies (Potosky and Bobko 1998).

Table 3.3 summarizes the factors identified for the Demographics of the Individual and the measures used in the social architecture assessment survey.

**Table 3.3 Demographics of Individual: Factors and Measures**

| Factor | Measure | Number of Questions | Question Numbers in Phase I Survey |
|---|---|---|---|
| Profession | Researcher's questions | 3 | Q530, Q531, Q536 |
| Age | Researcher's questions | 1 | Q550 |
| Gender | Researcher's questions | 1 | Q551 |
| Education level | Researcher's questions | 1 | Q552 |
| Member in a union | Researcher's questions | 1 | Q553 |
| Professional license or registration | Researcher's questions | 1 | Q554 |
| Level in the organization | Researcher's questions | 4 | Q538-Q541 |
| Personality type | The Keirsey Temperament Sorter II (Keirsey 1998) | 70 | Q447-Q516 |
| Computer use | Classification questions (Weinsier and Leutner 1988) | 2 | Q394-Q395 |
| | Computer Experience (Gardner et al. 1993) | 1 | Q397 |
| | Computer Understanding and Experience Scale (Potosky and Bobko 1998) | 16 | Q398-Q410, Q412-Q414 |
| | Researcher's questions | 2 | Q396, Q411 |

## *3.4 Attitudes, Beliefs, and Fears of Individual*

An individual's attitudes, beliefs, and fears make up the single most influential category for indicating resistance to change (Arendt et al. 1995; Cunningham et al. 1991; Daamen and Van Der Lans 1995; Darling 1993; Davis et al. 1989; Heinssen et al. 1987; Herling 1996; Hultman 1998; Kanter 1985; Lawrence 1973; Mabin et al. 2001; Marjanovic 2000; Spiker 1994; Steier 1989). Attitudes are defined as "the predisposition to evaluate or respond to a person, a

situation, or an event in a certain way, favorable or unfavorable" (Melvin 1979). Attitudes are likely to be unconscious, whereas beliefs, though defined essentially the same, are more likely to be verbalized. Fear is an unpleasant emotional response caused by anticipation or awareness of danger (*Webster's* 1987). Specific measures used to evaluate the attitudes, beliefs, and fears of an individual include computer anxiety, attitudes towards computers, computer confidence, adaptability, acceptance of uncertainty, readiness for change, locus of control, irrational ideas, perceived interpersonal power, previous technological experiences, motivation, disposition to innovation, perceived support for change, and defense mechanisms. Each of these measures are discussed in greater detail below.

Computer anxiety involves fear and apprehension towards computer technology resulting in self-doubt, resistance, and avoidance of the technology (Gardner et al. 1993; Heinssen et al. 1987). Computer anxiety often includes a physiological response such as sweating and rapid pulse (Maurer 2001) and generally relates to fear of using the computer, not fear of doing the task (Brosnan 1998). Two scales representative of computer anxiety are the Computer Anxiety Rating Scale (CARS) (Heinssen et al. 1987) and the Computer Anxiety Index (CAIN) (cited in Gardner et al. 1993; Maurer and Simonson 1984). In the Heinssen et al. (1987) study, CARS showed evidence of a negative relationship between computer experience and computer anxiety, as well as between mechanical interest and computer anxiety. The study did not show a significant gender difference in levels of computer anxiety, though women lacked similar experience levels when compared to men.

Attitudes towards computers and information technology, on the other hand, emphasize "feelings about the impact of computers on society and the quality of life, and their understanding of computers" (Heinssen et al. 1987). It is thought that positive attitudes will correlate with lower resistance and vice-versa. Attitudes towards computers were measured with two scales: Attitudes to Computers (Todman and File 1990) and the Computer Attitude Scale (CAS) (Loyd and Gressard 1984b). Both scales were designed for children and have been adapted for the research population by eliminating questions that are inappropriate for an adult population. Additionally, to ensure that respondents had an opportunity to express any remaining attitudes about computers and information technology that might have been missed, an open-ended

question about the impact of computers on technological change (Cunningham et al. 1991) was included in the assessment survey.

Computer confidence measures an individual's self-confidence to learn a new technology. It was measured with a scale for Computer Confidence (Gardner et al. 1993). Confidence is positively related to computer attitudes and negatively related to computer anxiety.

Adaptability of the individual indicates how flexible they are when encountering different situations. Adaptability was measured with two scales: Personal Rigidity (Rehfisch 1958), which indicates the need for a stable, orderly, predictable environment; and an Emotional Intelligence EQ Map sub-scale indicating resilience (Cooper and Sawaf 1997).

Acceptance of uncertainty is the degree to which a person tolerates vague or unclear situations. The Intolerance of Ambiguity scale measures the "tendency to perceive ambiguous situations as sources of threat" (Budner 1962; Robinson and Shaver 1973a).

Readiness for change is an individual's attitude towards change. Three metrics were used for measurement: the Change Scale (Trumbo 1961); the Reaction-to-Change Inventory (De Meuse and McDaris 1994); and the Change Opinion Survey (Hultman 1998). The Change Scale has shown significant differences in attitude with respect to gender and education level (Trumbo 1961).

Locus of control is the degree to which a person perceives that their destiny is within their control (internal control), as opposed to controlled by an outside force or individual (external control). As an individual's control of change increases, resistance decreases (Kyle 1993). This was measured with the Internal vs. External Control scale (Robinson and Shaver 1973b).

Individuals often have irrational ideas about change and they create their own interpretations of how the change will occur. The Irrational Belief Scale (Malouff and Schutte 1986) was used for measurement. The level of irrational ideas has shown a positive correlation to resistance to change (Bovey and Hede 2001b).

There are five types of interpersonal power: legitimate, reward, coercive, expert, and referent (French and Raven 1959). When a person has one or more of these, they can influence decisions and use manipulation to successfully resist changes. The Emotional Intelligence EQ Map subscale indicating Personal Power (Cooper and Sawaf 1997) was included in the assessment survey as a measure of referent power, the hardest type of interpersonal power to directly quantify. The other types of interpersonal power were measured using questions created by the researcher, such as 'Do you have the power to reward or punish employees?' Because interpersonal power was measured with self-reported information, as opposed to reported by others, it was labeled "perceived" interpersonal power.

Previous positive or negative technological experiences can influence an individual's reactions to anticipated technological changes. If an individual has undergone numerous negative experiences with technology, he or she is likely to expect that their next experience will be negative as well. Conversely, if an individual has predominantly positive past experiences, his or her vision of the future is much brighter. The researcher developed the questions used in the social architecture assessment survey, as no existing measures of this factor were located in the literature.

An individual's motivation to use new technology affects their reaction to the implementation of new technology. A strong motivation to use the new technology can overcome many difficulties, whereas a strong motivation not to use the technology can cause an individual to erect additional barriers as protection. The researcher developed the questions used in the social architecture assessment survey, as no existing measures of this factor were located in the literature.

An individual's disposition to innovation is a measure of a person's propensity to adopt innovations quickly versus waiting for the products to acquire stability. For example, does the individual rush to the store to purchase the latest consumer electronics product as soon as it is available or do they wait several months or more to see how well the product is received and whether it will be around long-term? A person with a low disposition to innovation is more likely to resist technological change because they would rather wait to see if the technology is

worth adopting. The researcher developed the questions used in the social architecture assessment survey, as no existing measures of this factor were located in the literature.

Each individual in an organization has a perception of the organization's support for change. Two metrics were used for measurement of this perceived support for change: the Support for Change Questionnaire (Maurer 1996b) and the Psychological Need Fulfillment Inventory (Hultman 1998). The Support for Change Questionnaire looks at how the organization as a whole supports or opposes change based on individuals' perceptions. The Psychological Need Fulfillment Inventory assesses how well the organization meets the psychological needs of the individual in the subcategories of mastery, meaning and purpose, respect, and acceptance. The mastery subcategory measures an individual's perception of their personal competency – are they self-confident? The meaning and purpose subcategory measures their perception of social competency – are they contributing in a meaningful way? The respect subcategory measures their perception of their personal integrity – are they ethical and honest? The acceptance subcategory measures their perception of social integrity – are they accepted by others? Individuals with unmet needs in these four subcategories often exhibit resistance to change (Hultman 1998).

The defense mechanisms of the individual during change are generally unconscious responses of the individual to perceived danger (Bovey and Hede 2001a). Three measures of defense mechanisms were included in the assessment survey: a Defence Mechanisms scale (Bovey and Hede 2001a), an Emotional Intelligence EQ Map subscale indicating Constructive Discontent (Cooper and Sawaf 1997), and a Job Investment measure (Trumbo 1961), as well as five additional researcher developed questions.

The Defence Mechanisms scale includes adaptive mechanisms such as humor and anticipation of change and maladaptive mechanisms such as acting out, denial, dissociation, isolation, and projection. In a study by Bovey and Hede (2001a), the adaptive mechanism of humor negatively correlated with the level of resistance to change and the maladaptive mechanisms had a positive correlation, although these cannot be generalized to other populations due to the use of purposive instead of random sampling.

Constructive Discontent relates to how well a person deals with conflict in a constructive manner (Cooper and Sawaf 1997). Because change always involves some sort of conflict, it is expected that if an individual does not manage conflict constructively, they are more likely to exhibit resistance to change.

Job investment was defined as an "employee's identification with the work force, the economic need for the job, and length of service with the company" (Trumbo 1961, p. 338). Greater Job Investment has been hypothesized in prior research to be related to favorable change attitudes, though little support for this has been documented (Trumbo 1961).

Table 3.4 summarizes the factors identified for Attitudes, Beliefs, and Fears of Individual and the measures used in the social architecture assessment survey.

**Table 3.4 Attitudes, Beliefs, and Fears of Individual: Factors and Measures**

| Factor | Measure | Number of Questions | Question Numbers in Phase I Survey |
|---|---|---|---|
| Computer anxiety | Computer Anxiety Index (CAIN) (cited in Gardner et al. 1993; Maurer and Simonson 1984) | 26 | Q334-Q359 |
| | Computer Anxiety Rating Scale (CARS) (Heinssen et al. 1987) | 18 | Q360-Q377 |
| Attitudes towards computers and technology | Attitudes to Computers (Todman and File 1990) | 15 | Q378-Q392 |
| | Human Fears of Technological Change (Cunningham et al. 1991) | 1 | Q393 |
| | Computer Attitude Scale (CAS) (Gardner et al. 1993; used in Loyd and Gressard 1984b) | 26 | Q415-Q417, Q419-Q441 |

| Factor | Measure | Number of Questions | Question Numbers in Phase I Survey |
|---|---|---|---|
| Computer confidence | Computer Confidence (Gardner et al. 1993) | 4 | Q443-Q446 |
| Adaptability | Personal Rigidity (Rehfisch 1958) | 6 | Q1-Q6 |
| | Emotional Intelligence EQ Map Scale 9 – Resilience (Cooper and Sawaf 1997) | 13 | Q130-Q142 |
| Acceptance of uncertainty | Intolerance of Ambiguity (Budner 1962; Robinson and Shaver 1973a) | 16 | Q100-Q115 |
| Readiness for change | The Change Seeker Index (CSI) (Garlington and Shimota 1964) | 92 | Q6, Q8-Q98 |
| | Reaction-to-Change Inventory (De Meuse and McDaris 1994) | 1 | Q156 |
| | The Change Scale (Trumbo 1961) | 9 | Q200-Q208 |
| | The Change Opinion Survey (Hultman 1998) | 40 | Q292-Q331 |
| Locus of control | Internal vs. External Control (Robinson and Shaver 1973b) | 23 | Q157-Q179 |
| Irrational ideas | Irrational Belief Scale (discussed in Bovey and Hede 2001b; Malouff and Schutte 1986) | 20 | Q180-Q199 |
| Perceived interpersonal power | Emotional Intelligence EQ Map Scale 16 – Personal Power (Cooper and Sawaf 1997) | 13 | Q517-Q529 |
| | Researcher's questions | 6 | Q533, Q537, Q539-Q541, Q552 |

| Factor | Measure | Number of Questions | Question Numbers in Phase I Survey |
|---|---|---|---|
| Previous positive or negative technological experiences | Researcher's questions | 2 | Q418, Q442 |
| Motivation to use new technologies | Researcher's questions | 2 | Q290-Q291 |
| Disposition to innovation | Researcher's questions | 2 | Q7, Q99 |
| Perceived support for change | Support for Change Questionnaire (Maurer 1996b) | 8 | Q269-Q274, Q332-Q333 |
| | Psychological Need Fulfillment Inventory (Hultman 1998) | 60 | Q209-Q268 |
| Defense mechanisms of the individual during change | Defence Mechanisms (Bovey and Hede 2001a) | 14 | Q116-Q129 |
| | Emotional Intelligence EQ Map Scale 11 – Constructive Discontent (Cooper and Sawaf 1997) | 13 | Q143-Q155 |
| | Job Investment (Trumbo 1961) | 4 | Q542-Q545 |
| | Researcher's questions | 5 | Q532-Q535, Q537 |

## *3.5 Demographics of Organization*

While it is acknowledged that demographic information about the organization has a large influence on how individuals react to technological change, it is outside of the scope of this research project, as previously discussed in *Limitations of the Research* (section 1.5.2). Organizational aspects of technological change will be the focus of future research.

This model includes two aspects of the organization, however: industry sector and company size. These aspects were included to understand how the sample population compared with the industry population and provide an opportunity to recognize any obvious bias of the sample.

The researcher created the questions used in the assessment survey for the industry sector and company size factors. Industry sectors include: Architecture, Engineering, General Building Construction (manufacturing, industrial, commercial, institutional), Residential Building Construction (single and multifamily housing), Heavy Construction (highways, streets, bridges, tunnels, utilities), and Construction Management.

Company size was measured with size groupings (i.e., 5 or less, 6-20, etc.), as individuals are better at choosing a group that matches their situation than knowing the exact number of employees. Additionally, groupings provide enough information for relative comparisons. Both industry sector and company size were asked at two levels: the company location the individual worked in, as well as at all company locations combined.

Table 3.5 summarizes the factors identified for Demographics of Organizations and the measures used in the social architecture assessment survey.

**Table 3.5 Demographics of Organizations: Factors and Measures**

| Factor | Measure | Number of Questions | Question Numbers in Phase I Survey |
|---|---|---|---|
| Industry sector | Researcher's questions | 2 | Q548-Q549 |
| Company size | Researcher's questions | 2 | Q546-Q547 |

## *3.6 Summary*

This chapter discussed the creation and development of the Phase I social architecture factor model associated with impeding/promoting use of technologies. The broad categorical measures indicative of individuals' resistance to information technology change represented in the model are: type and scope of change; method and speed of introduction; demographics of individual; attitudes, beliefs, and fears of individual; and demographics of organization. The chapter also included a discussion of the specific measures of technological change identified for each of these categories.

# Chapter 4. Phase I Methodology

The social architecture factor model from Chapter 3 identified 39 factors consisting of 76 variables associated with technological change within the AEC industry. This was far too many variables to adequately investigate in this research project. Therefore, the Phase I study collected data from a 50-person sample of the population to discover the most significant factors and provide a focus for the remainder of the study (Phase II). The results of the data collection were analyzed to examine patterns and relationships of the variables to determine whether the measures could be reduced to a smaller number of factors. A refined social architecture assessment survey for measuring individual factors was the product of this step of the research.

Once the variable reduction was completed, a Resistance to Change Index (RTCI) was created. The RTCI was used during Phase II of this research to investigate hypothesized relationships with demographic variables.

The Phase I research methodology included data collection and data analysis, each of which is elaborated further in the sections that follow. Figure 4-1 illustrates the Phase I methodology conceptually. Following the sections on data collection and data analysis, this chapter presents the limitations of Phase I and a discussion of the results of this phase of the research.

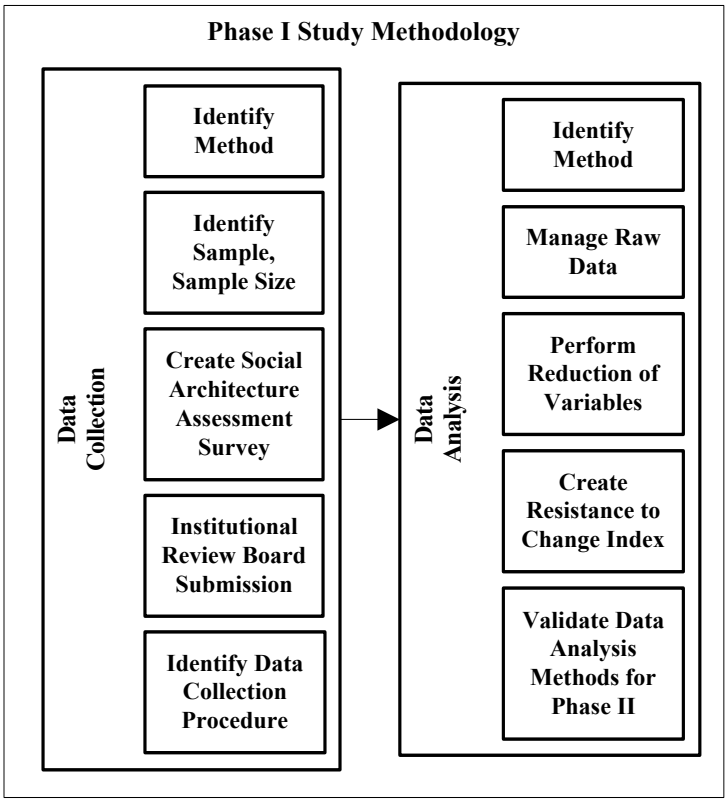


**Figure 4-1 Phase I Study Methodology**

## *4.1 Objectives Identified for Phase I*

The primary objective of Phase I of the research was to reduce the number of variables in the social architecture factor model. In addition to achieving this primary objective, the Phase I study also served as a pilot for the data collection of the Phase II study. It provided an opportunity:

- To establish how to best identify the sample population;
- To estimate the probable response rate;
- To estimate the data collection duration;
- To estimate the actual costs involved; and
- To validate the data analysis techniques.

A second objective of Phase I of the research was to create an index representative of an individual's level of likelihood of resistance to information technology change. This objective was achieved with the creation of the Resistance to Change Index (RTCI). The RTCI was

created using the variables remaining from the variable reduction that were indicative of resistance to information technology change.

## *4.2 Data Collection*

The data collection process involved determining the method of collection, establishing the sample population, creating the social architecture assessment survey instrument, creating a submission for the Institutional Review Board (IRB), and establishing a data collection procedure. Each of these steps is explained in more detail below. Additionally, this section includes a profile of the sample population.

### 4.2.1 Data Collection Method

Several methods were proposed for data collection, including organizational case studies, structured interviews, and survey instruments. The survey instrument was chosen in order to provide a broad picture of the industry as a whole, rather than focused pictures of small portions.

Survey instruments have many advantages in the data collection process. They provide a larger geographical coverage for the sample population (Bourque and Fielder 1995) than case studies or interviews could provide. Survey instruments also permit anonymity, helping to ensure that the individual is responding with their true beliefs and feelings, which is especially important in research involving attitudes. Because the researcher is not conversing directly with the respondent, they are unlikely to influence the answers of the respondent. Surveys also provide a uniform situation for data collection, because each person has exactly the same questionnaire presented in the same manner (Henerson et al. 1978).

Surveys have a few disadvantages as well. They may not provide a great deal of details because the researcher cannot probe the respondent to discover why they answered a question in a particular way. They are typically more expensive to administer due to high printing and mailing costs, and can slow the data collection process if high response rates are desired. Additionally, identifying the sample population can often be the most difficult part of a mail survey (Bourque and Fielder 1995).

Case studies and interviews have their own advantages and disadvantages. One advantage of case studies and interviews is that either of these options are likely to be less expensive than the survey instrument. Another advantage is that identifying the sample population is much simpler and usually based purely on convenience. Case studies and interviews also provide greater flexibility than survey instruments. Items can be clarified and comments made by the respondent can be followed using probing questions to learn additional information. This provides a very detailed illustration, especially when compared to a survey. Additionally, the strength of an attitude can be measured by the way a person answers the question, though this can be difficult to interpret and quantify (Henerson et al. 1978).

However, case studies and interviews sacrifice generalizability because of their lack of sample size and lack of random selection. They are also much more time consuming for the researcher to conduct and may actually take longer for data collection than a survey.

Ultimately, the survey instrument was chosen for data collection in Phase I, instead of case studies or interviews. While each method has advantages and disadvantages, the aim of this research was to provide a broad representation of how individuals within the AEC industry as a whole resist to information technology change. This overall picture will provide an excellent starting point for future research investigating more focused aspects of resistance to information technology change.

### 4.2.2 Sample Size and Sample Identification

The sample population for this research consisted of English-speaking architecture, engineering, contractor, and construction management organization employees in the US. The research included all sizes of organizations, from sole proprietorships to 1,000+ employee firms within the AEC industry. Additionally, all positions and all levels within an AEC organization were included in the sample population because technological changes in the industry can affect all employees within an organization.

The initial survey sample relied on quota sampling to ensure that enough data from each stratum of interest was obtained. Strata of interest included company size and industry sector, as well as profession, age, and gender of the individual. A minimum of fifty completed surveys were

desired to perform the analysis of Phase I. Assuming a 50% response rate, the total sample size was planned to be approximately 100 individuals. This non-probability sampling method was appropriate to determine whether a given factor warranted further study or not (Henry 1990).

Architecture, engineering, construction, and construction management companies within a 50-mile radius (approximately) of Blacksburg, Virginia, USA were identified by searching the Yellow Pages of Yahoo! at http://yp.yahoo.com on July 16, 2002[†]. The following classification headings for type of business were used:

- Architect
- Drafting services
- Engineers
- Engineers-civil
- Engineers-consulting
- Engineers-electrical
- Engineers-general
- Engineers-structural
- Construction and Real Estate > Administration and Preconstruction > Management
- Acoustical contractors
- Air conditioning contractors
- Building contractors
- Caulking contractors
- Concrete contractors
- Demolition contractors
- Dry wall contractors
- Electric contractors
- Excavating contractors
- Floor laying, refinishing, resurfacing contractors
- Foundation contractors
- General contractors-commercial
- General contractors (construction, repair, improvement)
- General contractors-heavy construction
- General contractors-residential
- Heating contractors
- Home builders
- Insulation contractors
- Landscape contractors
- Masonry contractors
- Mechanical contractors
- Paint and wall covering contractors
- Piping contractors
- Plastering contractors
- Plumbing contractors
- Roofing contractors
- Steel erectors
- Waterproofing contractors

### 4.2.3 Instrumentation – Social Architecture Assessment Survey

The social architecture assessment survey was based on the factors identified during the creation of the social architecture factor model (discussed in Chapter 3). For many of the 39 factors

[†] All Yahoo! Yellow Pages business listings are obtained from BellSouth and InfoUSA and are updated at least quarterly ("Yahoo!" 2002).

identified, existing published measures were incorporated into the survey. These were noted in Table 3.1 through Table 3.5.

For aspects identified where existing measures were not available, a Likert scale question design was used. In a Likert scale design, each respondent is asked to make a decision from several choices on a response scale (Trochim 2000). A typical response scale might have four choices of (1) Agree Strongly, (2) Agree Somewhat, (3) Disagree Somewhat, and (4) Disagree Strongly. An even number of choices forces a respondent to decide whether they lean towards agreement or disagreement. An odd number of choices allows respondents to respond with a neutral opinion. Response choices were identified on the scales to help ensure that ratings were consistent from respondent to respondent.

All existing measures appearing in the survey used response scales identical to the original measures. When researcher-created questions were used, the responses followed the form of surrounding questions in the survey, where appropriate, to provide consistency for the respondent. In other words, if a question created by the researcher appeared in the midst of a section of questions that all had four possible choices, the researcher's question was given the same four possible choices as well. One section of researcher-created questions was independent from existing measures (Questions 278-291 in the Phase I survey). This section used six choices in the response options. Having an even number of choices forced the respondents to decide whether they liked or disliked the aspect in question without giving them the option to choose a neutral position. The remainder of the researcher-created questions were demographic type questions that did not follow this style of formatting for responses.

The initial survey design format was pretested for clarity of understanding, discovery of errors, and to determine a realistic estimate of the time required to complete the survey. The pretest involved having six individuals take the entire survey and noting any comments or questions they thought of during the process. Several misspellings, wording errors, and awkward layouts were identified and consequently revised. Results from two individuals in the pretest sample were incorporated into the Phase I survey results, as they were members of the sample

population. The remainder of the pretest results were discarded. A copy of the final version of the Phase I survey is included in Appendix D - *Phase I Instrumentation*.

### 4.2.4 Institutional Review Board (IRB) Submission

Because this research involves human subjects, a review of the research plan was required by the Institutional Review Board (IRB). The complete submission to the IRB consisted of a 'Request for Exemption of Research Involving Human Subjects' form, a synopsis of the research protocol in non-technical language, an 'Informed Consent' form for the subjects, and a copy of the survey. A copy of the exemption form, the research protocol, the informed consent form, and the approval letter from the IRB are included in Appendix C - *Institutional Review Board Submission for Phase I*. As noted in the previous section, a copy of the Phase I survey is included in Appendix D - *Phase I Instrumentation*.

### 4.2.5 Data Collection Procedure

As noted in section 4.2.2, architecture, engineering, construction, and construction management companies within a 50-mile radius (approximately) of Blacksburg, Virginia, USA were identified for the sample population. Companies were contacted by telephone or in person to request participation of some or all of their employees. Businesses in Blacksburg and Christiansburg were targeted for this phase of the research. Some employees of member companies in the Virginia Tech Construction Affiliates program were also requested to participate. Additionally, superintendents of local construction sites were approached to encourage participation of individuals working in the field as well as those in the office.

Individuals that agreed to participate were given a cover letter introducing the research study, an informed consent form, and the questionnaire, along with an envelope in which to place the completed questionnaire to be either picked up later or mailed back. The total time involved for participants was approximately one hour to complete the questionnaire. The total elapsed time involved for the return of a questionnaire varied significantly from a few hours to approximately eight weeks. Follow-up phone calls and office/site visits were performed to serve as reminders for unreturned surveys.

Some individuals requested that the survey be mailed to them. These mailings were done similar to the anticipated procedure of the Phase II study. A postage-paid envelope was included for

them to mail the completed survey back. A reminder postcard was sent out for those surveys that were not returned within two weeks.

At the completion of the Phase I data collection, 89 surveys were distributed and 52 were returned, resulting in a 58.4% response rate. This provided an adequate number of completed surveys to perform the data analysis for Phase I.

### 4.2.6 Sample Profile

The Phase I survey sample relied on quota sampling to ensure that enough data from each stratum of interest was obtained. Strata of interest included company size and industry sector, as well as the profession, age, and gender of the individual. The total sample size analyzed in the Phase I study was 50 individuals. Figure 4-2 through Figure 4-6 show the Phase I sample population as compared with the U.S. architecture/engineering/construction industry populations.

With respect to company size, the industry population is heavily skewed to the smaller companies (U.S. Census Bureau 1999b), with 90% of firms having less than 20 employees, whereas the Phase I sample has a much more uniform distribution (see Figure 4-2). Note that the graphs cannot be directly compared because the company size categories are not the same. Larger companies were more willing to participate in the Phase I survey than smaller companies were. It was suspected that a shorter survey would help achieve a better representation of the smallest companies.

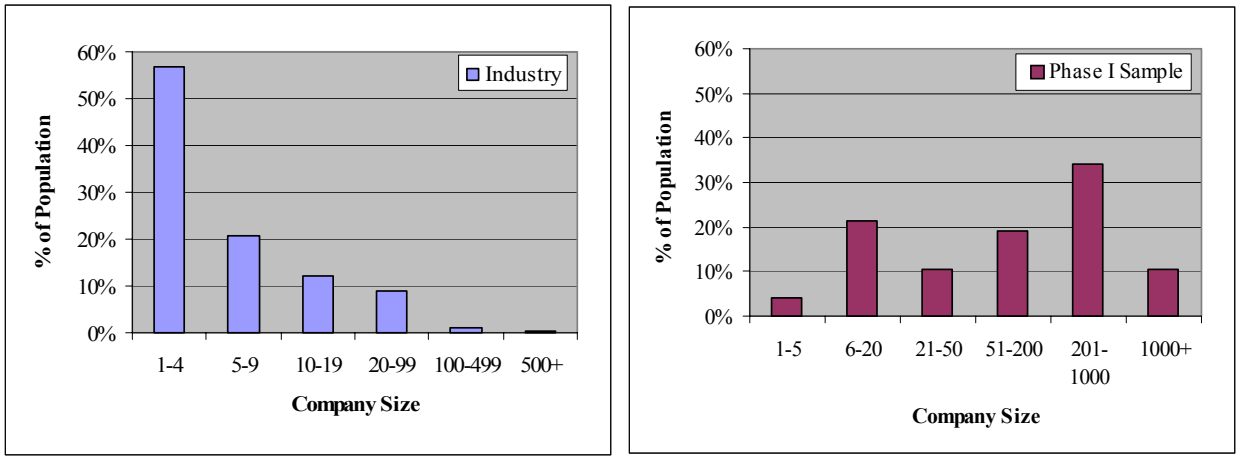


**Figure 4-2 Company Size: Industry Population vs. Phase I Sample Population**

When looking at the industry sector (see Figure 4-3), the Phase I sample population was very similar to the industry population (U.S. Census Bureau 1999b). Firms providing architecture and engineering services were somewhat overrepresented and firms providing general building construction/special trade construction/construction management services were underrepresented by a similar amount.

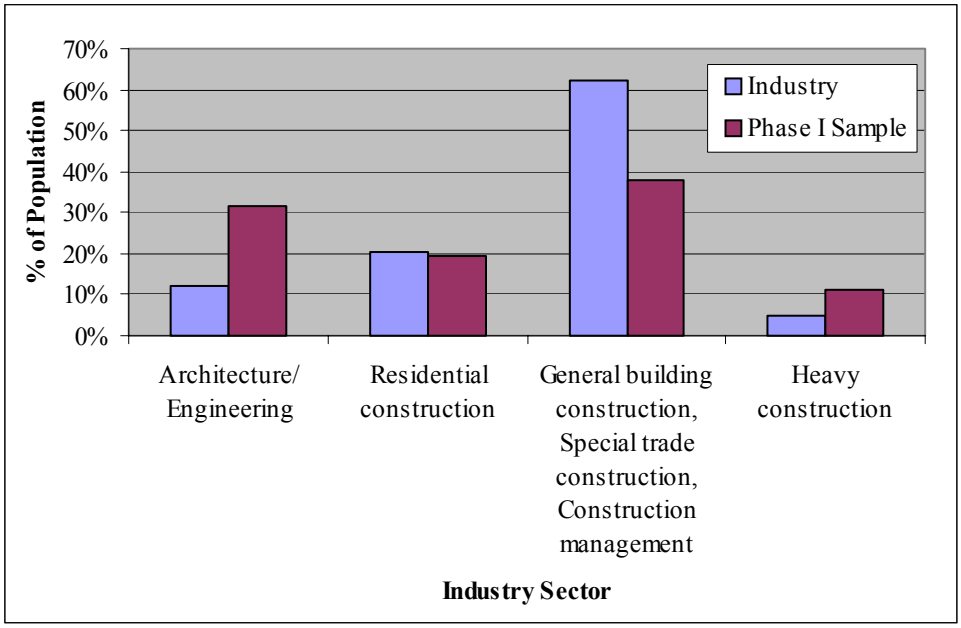


**Figure 4-3 Industry Sector: Industry Population vs. Phase I Sample Population**

The representation of professions in the Phase I sample does not match the industry population very well (see Figure 4-4). The Phase I sample is heavily skewed towards office, managerial, and supervisory positions, whereas the industry population is predominantly construction tradesmen and laborers (U.S. Department of Labor 2000). While not ideal, this is to be expected and is considered satisfactory as the Phase I sample does represent the population most likely to directly use new technologies (as defined within this study) when they are implemented. The "other" category includes executive, management, and administrative positions, none of which were specifically included in the industry population shown.

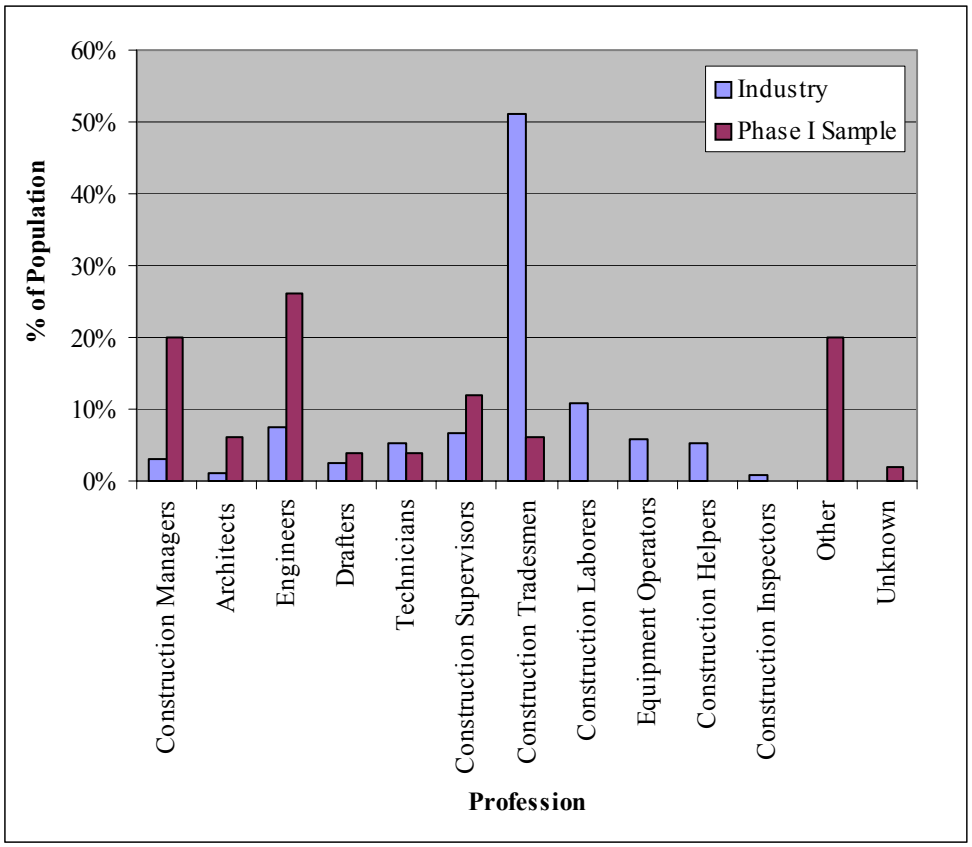


**Figure 4-4 Profession: Industry Population vs. Phase I Sample Population**

For age, the Phase I sample is compared with the U.S. civilian labor force in general (see Figure 4-5). The Phase I sample is skewed somewhat more towards younger workers than the general civilian labor force (U.S. Census Bureau 2000). The Phase I sample may be more representative of the AEC industry in age than the general civilian labor force distribution though, due to the AEC industry's reliance on manual labor.

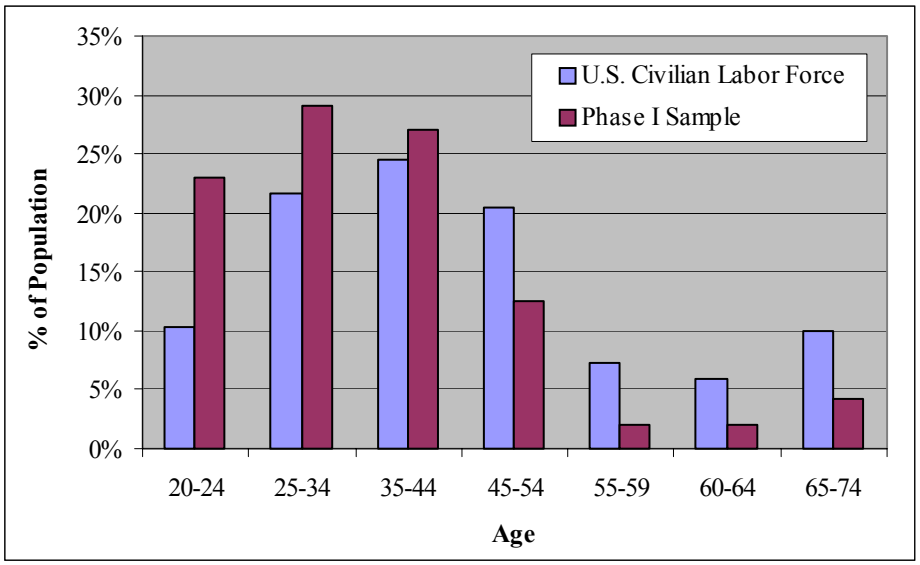


**Figure 4-5 Age: U.S. Civilian Labor Force Population vs. Phase I Sample Population**

Women are overrepresented in the Phase I sample when compared with the industry population (see Figure 4-6), in which less than 4% of all employees are female (U.S. Census Bureau 1990). Because they form a small, but growing population within the industry, it was important to obtain enough responses to ensure fair representation. Interestingly, women contacted for the Phase I study were much more receptive to participating in the study than men were.

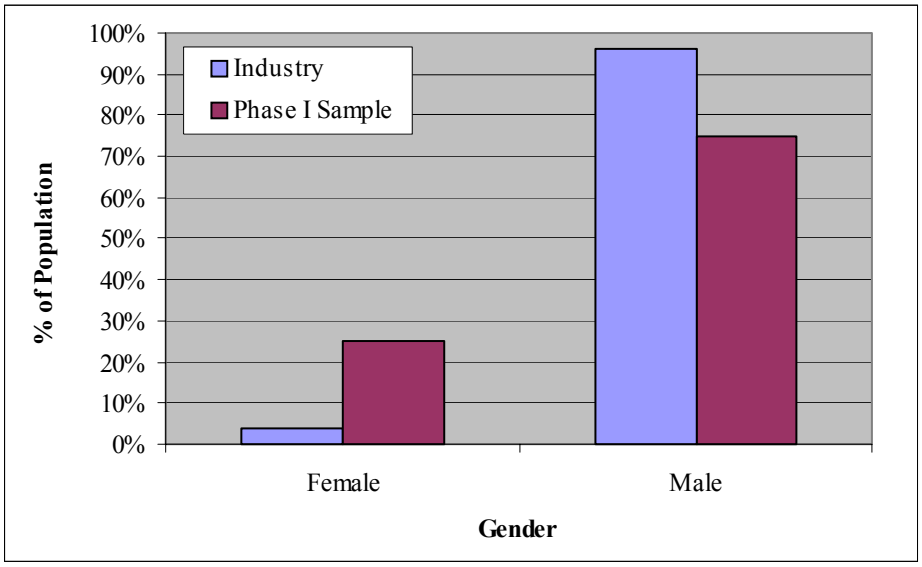


**Figure 4-6 Gender: Industry Population vs. Phase I Sample Population**

Overall, the Phase I sample was deemed acceptably similar to the AEC industry population. The Phase II study attempted to increase the representation of smaller companies, as this is the most notable departure from the industry population.

## *4.3 Data Analysis and Findings*

After completing the data collection process, the data was analyzed to examine patterns and relationships of the variables to determine whether the measures could be reduced to a smaller number of factors. A refined social architecture assessment survey for measuring individual factors was the first product of this step of the research. The remaining variables were then used to create an index representative of an individual's level of likelihood of resistance to information technology change. This resulted in the creation of the Resistance to Change Index (RTCI), the second product of this portion of the work. Data analysis was also performed on the Phase I data to demonstrate the planned methods of data analysis for the Phase II study. The Phase II study data analysis closely resembled the example analysis. This example analysis is included in Appendix F.

The remainder of this section describes the management of the raw data and the data analysis procedure for reducing the number of variables, as well as the corresponding findings. It also describes the creation of the Resistance to Change Index (RTCI).

### 4.3.1 Management of Raw Data

Some incomplete surveys were expected during the data collection process due to respondents' refusal to answer certain questions or their refusal to complete the instrument once they began. Additionally, some respondents marked more than one answer for questions that required only one answer (duplicate data). Inputting the raw data into the computer in a usable format with the minimum number of errors also had to be addressed. Each of these issues is discussed further below.

#### *4.3.1.1 Missing & Duplicate Data*

If a survey is returned with an answer or two missing, the researcher has several options. First, it must be determined whether the missing data occurred in a random pattern or not. If the missing data are not random, the researcher should consider omitting the question(s) from the survey analysis, because it is likely that there is a problem with that question.

If, however, the missing data are random, then the researcher has three primary options. The first option is to remove that respondent altogether. This is undesirable for this study because it would greatly reduce the sample size available for analysis, a rather extreme measure in this instance.

The second option is to impute the data using one of a number of different methods. Procedures include substituting the mean value of a variable from all other respondents in place of missing values, using regression analyses to estimate what the observations would have been, based on other variables that are available, and collecting more data to replace what is missing. All of these procedures involve a method of "making up" data to fill in the gaps. If the individual had actually answered the question, they may not have answered it with the value imputed, and this can skew results. It was decided that imputation was not desirable.

The third option is to omit that respondent's missing questions from analysis. Since a majority of the factors for this research are made up of multiple questions, rather than use totals for factors and impute data that is not there, average values were used instead. For a factor that includes 10 questions, each having a scale from 1 to 5, if a total score was used, the possible range is 10 to 50. When a respondent omits a question, they are then being compared on an unequal scale with respondents who answered all questions (i.e. 9 to 45 for one omitted question). Using averages, the possible range is 1 to 5 for all respondents regardless of how many questions each answered, enabling all to be compared on an equal scale. This option was chosen as the method to address missing data.

Because it is impossible to discern what the respondent's intentions were when they responded with multiple answers to a question requiring one answer, duplicate data was treated as though it were missing. This was deemed the only alternative for questions where the respondent chose all possible answers. For instances where the respondent marked too many answers, but not all answers available, other options existed including randomly choosing one of the marked answers, averaging the marked answers, or choosing one of the marked answers based on the distribution of responses for that question from all other respondents. Treating the duplicate data

as missing (using the third option from above) was determined to be the best alternative in this situation as well.

Most of the questions on the assessment survey were answered by all respondents. One question was omitted by 22% of respondents. This question was omitted from the refined social architecture assessment survey because of the high non-response rate. All other missing/duplicate data exhibited a random pattern and were omitted using average values for factors as discussed above.

If a survey is returned incomplete and, consequently, is missing large portions of data, there are two major options available to the researcher. It can be treated as a refusal and not included in the data analysis at all, or the survey questions that were answered can be used in the data analysis. For the Phase I study, the sample size was small (50 persons). Any additional data available was useful for the reduction of variables and it was therefore desirable to use any questions that were answered, even if the majority of the survey was incomplete.

A majority of respondents skipped three or less questions on the 610-question survey (41 out of 50 respondents). One respondent answered only the first 100 questions, but the questions this respondent did answer are included in the Phase I data analysis.

*4.3.1.2 Data Entry Errors*

Due to the high number of reverse scored items and different scales used to match the original tests on the assessment survey, inputting the raw data directly into the computer for analysis was time-consuming and deemed inappropriate. Instead, data was entered assuming no reverse scored items and everything used a 1, 2, 3… scale into an Excel spreadsheet. Another spreadsheet was created to reverse the scoring on items requiring it, as well as to adjust the scale of each item as needed. This reduced the input time from approximately 45 minutes per survey to about 10 minutes each and drastically reduced errors in data entry. Additionally, the spreadsheet was set up to flag missing/duplicate data and entries outside of the allowable range of answers, further reducing data entry errors.

### 4.3.2 Data Analysis for Reduction of Variables

The purpose of this first portion of the data analysis was to reduce the number of variables in the model and reduce the length of the survey to approximately 15-25% of the original. Correlation tests were performed and analyzed between each of the original variables to attain these reductions in scale. Correlation tests, the analysis of the correlations, and the reduction of variables is discussed further below. A discussion of factor analysis for the reduction of variables is also included.

#### *4.3.2.1 Correlation Tests*

All variables can be classified as either continuous or discrete. A continuous variable is one that has an order and has an infinite number of possible values (Schulman 2001), allowing comparisons of differences between variables. An example of a continuous variable is time. A discrete variable is countable and limited in the values it can have (Schulman 2001). An example of a discrete variable is the value obtained from the roll of a die (Schulman 1992).

For the purposes of statistical analysis, three other classifications of variables are helpful: numeric, categorical, and ordered categories. Numeric variables are all measurements that result in numeric quantities. All continuous variables and some discrete variables are numeric (Schulman 1992). Categorical variables are discrete variables that are not numeric (Schulman 1992). They are also known as nominal variables. They only have qualitative classification and there is no order or difference in level of importance of nominal variables (StatSoft Inc. 2002). An example of a nominal variable is gender. Ordered variables are categorical variables that have ordered categories. These are also known as ordinal variables. An example of an ordinal variable would be amount of education.

Because of the requirements of the statistical tests employed, three of the above categories of variables are used in this work: nominal, ordinal, and continuous variables. Discrete numeric variables are often treated as continuous for the purpose of statistical analyses and are listed as continuous throughout this dissertation. Appendix E.1 lists each of the variables, the variable type (nominal, ordinal, or continuous), and for the continuous variables, whether the variable is normal using the Shapiro-Wilk W test for normality. It also lists the question numbers used in the Phase I survey for each variable.

For the Shapiro-Wilks' W test, if the p-value is significant, then "the hypothesis that the respective distribution is normal should be rejected. The Shapiro-Wilks' W test is the preferred test of normality because of its good power properties as compared to a wide range of alternative tests" (StatSoft Inc. 2002). A p-value represents the probability of the obtained results, or results even more extreme, if the null hypothesis were true (Kleinbaum and Kupper 1978). The smaller the p-value, the more sure we are that the null hypothesis is wrong.

Though it is the preferred test, there are drawbacks of the Shapiro-Wilks' W test. Even if a majority of the data is pretty close to normal, the test may still reject normality. The test is sensitive to sample size as well as the normality issues it is testing (Schulman 2003).

Normality was tested for each of the variables using the Shapiro-Wilks' W test and those found to be normal with a level of significance of $\alpha = 0.05$ were determined. In addition, because of the test's drawbacks, normal plots were also subjectively used in the determination of normality. The results of normality are indicated in Appendix E.1.
Correlation tests were performed on each pair of variables according to Table 4.1 below. A table of all correlations is provided in Appendix E.3.

**Table 4.1 Correlation Tests Performed**

| **Variable Type 1** | **Variable Type 2** | **Test Performed** |
|---|---|---|
| Continuous, normal | Continuous, normal | Pearson's *r* correlation coefficient |
| Continuous | Continuous, normal | Spearman's $r_s$ correlation coefficient |
| Continuous | Continuous | Spearman's $r_s$ correlation coefficient |
| Ordinal | Continuous, normal | Spearman's $r_s$ correlation coefficient |
| Ordinal | Continuous | Spearman's $r_s$ correlation coefficient |
| Ordinal | Ordinal | No test necessary |
| Nominal | Continuous, normal | ANOVA, used $\sqrt{R^2}$ for comparisons |
| Nominal | Continuous | Kruskal Wallis test |
| Nominal | Ordinal | Kruskal Wallis test |
| Nominal | Nominal | Chi-square test ($\chi^2$) or Fisher's exact test |

For the Pearson correlations, $r$ is provided in the correlation table (Appendix E.3). Pearson's $r$ represents the degree of linear association between two variables and ranges from -1 to +1. The closer $r$ is to ±1, the more linear the relationship is, whereas if $r$ is close to zero, the points are essentially random. The Pearson's $r$ correlation coefficient is appropriate for use with continuous, normal variables.

For the Spearman correlations, $r_s$ is provided. Spearman's $r_s$ also represents the degree of linear association between two variables and ranges from -1 to +1, similar to Pearson's $r$, but is computed using ranks rather than the actual variable values. Spearman's $r_s$ correlation coefficient is appropriate for use with non-normal continuous variables and can also be used to evaluate linear association between continuous variables (normal or non-normal) and ordinal variables.

For the ANOVA analyses, $\sqrt{R^2}$ was used. $R^2$ is known as the coefficient of determination and represents "the proportion of common variation in the two variables (i.e., the "strength" or "magnitude" of the relationship)" (StatSoft Inc. 2002). The absolute value of the square root of $R^2$ is equivalent to Pearson's $r$ or Spearman's $r_s$ for comparison purposes. ANOVA is appropriate for use in evaluating relationships between normal, continuous variables and nominal variables.

The Kruskal Wallis analyses are noted as *NS* for non-significant associations ($\alpha = 0.05$) and *S: p-value* for significant associations. The Kruskal Wallis test is appropriate for use in evaluating relationships between non-normal, continuous variables or ordinal variables and nominal variables.

The Chi-square test ($\chi^2$) results are noted as *NS* for non-significant associations ($\alpha = 0.05$) and *S: p-value* for significant associations. The Chi-square test is appropriate for use in evaluating relationships between two nominal variables. For variables with more than two categories, 80% of the combinations must have at least five members expected, or the test is suspect with respect to validity. The correlation table (Appendix E.3) only shows Chi-square associations meeting these criteria. When each variable has only two categories, each combination must have at least

four members expected. If this was not met in the 2 x 2 case, the Fisher's exact test was used instead, as it is more appropriate in that situation.

All industry sector variables (12), company size variables (2), and the variables for education, profession, age, and gender were omitted from the analysis and are not included in the correlation table in Appendix E.3 because they were kept in the assessment survey after reduction, regardless of their correlations with other variables. Variables where no test was performed due to lack of sufficient data are noted with a dash.

*4.3.2.2 Analysis of Correlations & Reduction of Variables*

By analyzing the correlations between each of the variables, the number of variables in the survey was reduced from 39 factors consisting of 76 variables to 17 factors consisting of 34 variables. Six factors (industry sector, company size, education level, profession, age, and gender) consisting of 18 variables were omitted from analysis because they were kept in the assessment survey regardless of their correlations. The procedure used was an iterative process involving a great deal of subjectivity in the final selection of the variables kept versus discarded. Pairs of variables with absolute value correlations of 0.40 or higher were felt to provide enough similarity in data collected to justify keeping one variable and discarding the other. Highly correlated pairs were noted and the variables involved were identified. The variables in the correlated pairs were examined to determine whether they belonged to a group that included other highly correlated pairs. In this manner, groups of correlated pairs were identified. The resultant groups of variables were then subjectively weighed to determine the best variable in each group to choose for retention. The iterative process is presented in Table 4.2 in the order of variable reduction. A discussion of the limitations of this method is presented in section 4.4.3 - *Analysis Limitations*.

## Table 4.2 Reduction of Variables

| Factor | Variable Selected | Why? | Variables Deleted & Correlation |
|---|---|---|---|
| Profession | PROF | Important demographic variable to be kept in refined survey. | None deleted |
| Age | AGE | Important demographic variable to be kept in refined survey. | None deleted |
| Gender | GENDER | Important demographic variable to be kept in refined survey. | None deleted |
| Education level | EDUCAT | Important demographic variable to be kept in refined survey. | None deleted |
| Industry sector | COSEC (6 options)<br>OFSEC (6 options) | Important demographic variables to be kept in refined survey. | None deleted |
| Company size | COMSIZ<br>OFFSIZ | Important demographic variables to be kept in refined survey. | None deleted |
| Member in a union | None selected | Not useful, only 2% of sample population was a member in a union. | UNION |
| Attitudes towards computers and technology | CAS | CAS better choice based on literature | ATTCOM ($r$ = -0.77)<br>CAIN ($r$ = -0.75)<br>CARS ($r$ = -0.84)<br>NEGPRE ($r$ = -0.58)<br>POSPRE ($r$ = 0.75) |
| Perceived Support for Change | SUPCHG | More concise questions (8 questions vs. 60) | PNACCP ($r$ = 0.48)<br>PNMAST ($r$ = 0.62)<br>PNMEAN ($r$ = 0.63)<br>PNRESP ($r$ = 0.54) |
| Computer Use | COMPUN | COMPUN had more high correlations with each of the deleted variables than any of the deleted variables did with each other. Also IPOWEX and JOBIN2 had questions skipped by respondents. | COMPEX ($r$ = 0.57)<br>CLASSQ ($r$ = 0.55)<br>COMPCO ($r$ = 0.56)<br>IPOWEX ($r$ = -0.58)<br>JOBIN2 ($r$ = -0.63) |
| Readiness for Change | CHGSCL | More concise questions (9 questions vs. 16) | INTAMB ($r$ = -0.50) |
| Irrational Ideas | IRBSCL | Indicator of resistance to change based on literature. Also more concise questions and no skipped questions. | MADEFM ($r$ = 0.51)<br>COSURV ($r$ = 0.51)<br>JOBINV ($r$ = 0.47) |
| Interpersonal power measured by Level in organization | LEVORG | Knowing level in organization and profession will likely indicate license. | LICENS (p-value = 0.0055) |
| Personality type | KTSJP | Keirsey Temperament Sorter II is a more valid scale. | DISINN (p-value = 0.0350) |
| Perceived Interpersonal power | EIQPOW | INEXCO had many skipped questions. EIQPOW completes interpersonal power options. | INEXCO ($r$ = -0.44)<br>EIQCOD ($r$ = 0.55) |

| Factor | Variable Selected | Why? | Variables Deleted & Correlation |
|---|---|---|---|
| Personality type | KTSSN | More concise questions (20 questions vs. 92) and Keirsey Temperament Sorter II is a more valid scale. | CSINDX ($r$ = 0.49) |
| Personality type | KTSTF | Keirsey Temperament Sorter II is a more valid scale. | PRIGID (p-value = 0.0142) |
| Defense Mechanisms | ADDEFM | Indicator of resistance to change based on literature | EIQRES ($r$ = -0.41) |
| Readiness for Change | RTCINV | Indicator of resistance to change based on literature | None deleted |
| Personality type | KTSEI | Completes Keirsey Temperament Sorter II | None deleted |
| Motivation? | MOTIVA | MOTIVA had more high correlations with each of the deleted variables than any of the deleted variables did with each other. | PUNISH ($r$ = 0.45)<br>RESRCS ($r$ = 0.59)<br>TRAING ($r$ = 0.43)<br>TRTECH ($r$ = 0.49) |
| Perceived Changes | PERFUT | Need PERFUT to make MOTIV questions meaningful. | REWARD ($r$ = 0.47) |
| Perceived Changes | PERPAS | Need PERPAS to ensure consistency with PERFUT | None deleted |
| Decision-maker? | None selected | Highly correlated with variables being kept anyway. | DECISN ($r$ = -0.52 with COMSIZ,<br>$r$ = -0.41 with OFFSIZ) |

*4.3.2.3 Factor Analysis*

Factor analysis was a method discussed as a possible data analysis technique for reducing the number of variables in the survey. Unfortunately, factor analysis is inappropriate for the task at hand – reducing the size of the survey to approximately 15-25% of the original. While factor analysis involves condensing intercorrelated variables into a smaller number of relatively independent factors with a minimum loss of information (Hair et al. 1995; Kleinbaum and Kupper 1978), it does not reduce the volume of data contributing to those factors. It simply provides a method to reduce the visible factors, which is ideal for regression techniques, but inappropriate to reduce the length of the survey itself. In other words, it will make the data look cleaner, but all of the same data will need to be collected. In addition, the sample size of the Phase I data set (50 persons) is simply too small to use factor analysis methods on the entire set of variables and gain any meaningful results, even if the goal were to only make the data appear more orderly.

Factor analysis was used, however, to evaluate the reasonableness of the reductions made using the correlation method. In the iterative selection process, often one variable was selected and several others were deleted in a single step. There were six steps subjected to this factor analysis method. Each of these steps is described in more detail below. The factor analysis outputs from *SAS*® are included in Appendix E.4 - *Factor Analysis - Components*.

The communality estimates on the *SAS*® factor analysis outputs measure the amount of information that each variable has in common with all of the other variables in the factor analysis (Kleinbaum and Kupper 1978). *SAS*® uses the value of the squared correlation coefficient ($R^2$) for the estimated communality value. In the evaluation process, the $R^2$ value was not relied upon exclusively. Other factors such as information gained from the literature also entered the evaluation process.

The first occasion using factor analysis was the step keeping the variable CAS and rejecting five other variables. While CAS did not have the highest $R^2$ value (CARS was higher), it can be seen that the values are not vastly different (0.783 vs. 0.868), indicating that there are only minor variations between the two variables. Based on the data analysis alone, CARS may have been a better choice, but combined with information gained from the literature indicating that CAS is better at measuring the intended information and is becoming the "measure of choice in research on computer attitudes" (Gardner et al. 1993), CAS was a reasonable selection from these six variables.

The second occasion was the step keeping SUPCHG and rejecting four other variables. In this case, SUPCHG had the lowest $R^2$ value of the five variables. Each of the other four variables were subsets of the same test, so it is reasonable to expect that they would highly correlate with each other. For this occasion, the factor analysis indicates that any of the other variables would have been better, but brevity became the deciding factor here – SUPCHG had half the questions of any of the other variables individually.

Keeping COMPUN and deleting five other variables was the next occasion to use factor analysis. Two of the variables had higher $R^2$ values than COMPUN (IPOWEX and JOBIN2). Both of these variables used researcher designed questions, making them potentially weaker variables than those tested using previous research. Additionally, both IPOWEX and JOBIN2 had questions skipped by respondents. Based on this additional information, choosing COMPUN for the retained variable was a reasonable choice.

For the fourth use of factor analysis, IRBSCL was kept and three other variables were deleted. IRBSCL had the highest $R^2$ value of all four variables. When this is combined with the fact that it was an indicator of resistance to change based on the literature (Bovey and Hede 2001b), had more concise questions than the other variables, and had no skipped questions, it was clearly the best choice.

The fifth use of factor analysis was used to evaluate the step keeping EIQPOW and deleting two other variables. Similar to the previous analysis, EIQPOW had the highest $R^2$ value of all the variables. This variable provided a measure of referent power, completing the interpersonal power group of questions, as well as having no skipped questions. Therefore, it was clearly the best choice of the three variables.

The last use of factor analysis was to evaluate the step keeping MOTIVA and deleting four other variables. MOTIVA was the middle $R^2$ value, with two variables higher (RESRCS and TRAING). However, when looking at the intercorrelations between the five variables, MOTIVA had more high correlations with each of the deleted variables than any of the deleted variables did with each other. While this was obviously a subjective decision to choose MOTIVA over RESRCS or TRAING, it was not considered an unreasonable choice.

### 4.3.3 Findings from Data Analysis for Reduction of Variables

As mentioned previously, by analyzing the correlations between each of the variables, the number of variables in the survey was reduced from 39 factors consisting of 76 variables to 17 factors consisting of 34 variables. Because of this, the number of questions in the survey was reduced from 554 questions to 186 questions, 33% of the original survey. Additional subjective evaluation was performed to confirm that the overall intent of the research was not lost with the

reduction of variables. This involved reviewing the remaining variables to ensure they were representative of resistance to information technology change, as well as reviewing the deleted variables to ensure that none were essential to accurately portraying resistance. In addition, factor analysis of portions of the reduction process was performed to further evaluate the reduction of variables (see section 4.3.2.3). A refined social architecture assessment survey for measuring individual factors was the product of this step of the research. A copy of the refined survey is included in Appendix H.6.

### 4.3.4 Creation of Resistance to Change Index

Figure 4-7 shows a model depicting the focus for the remaining research work on this project. Of the 17 remaining factors, seven factors (representing nine variables) that were left from the reduction discussed above are represented on the right side of the model in the *Attitudes, beliefs, & fears of individual* block. These factors were combined to create the Resistance to Change Index, representing the likelihood of an individual to accept or reject information technology change. The variable reduction stage of the work also consolidated some of the demographic variables, which are represented on the left side of the model. The Phase II work investigated the hypothesized relationships between the demographic variables and the Resistance to Change Index created.

Figure 4-8 shows the model in its expanded form and includes all of the factors underlying each group. The remainder of this section discusses the relevance of each factor included in the index and discusses specifically how the index was created.

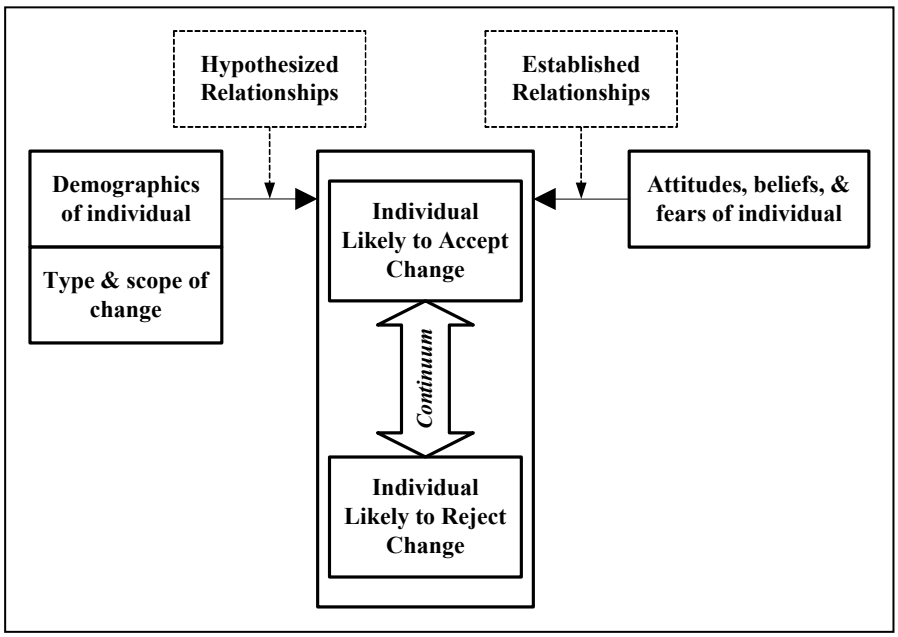


**Figure 4-7 Model Depicting Level of Resistance to Change**

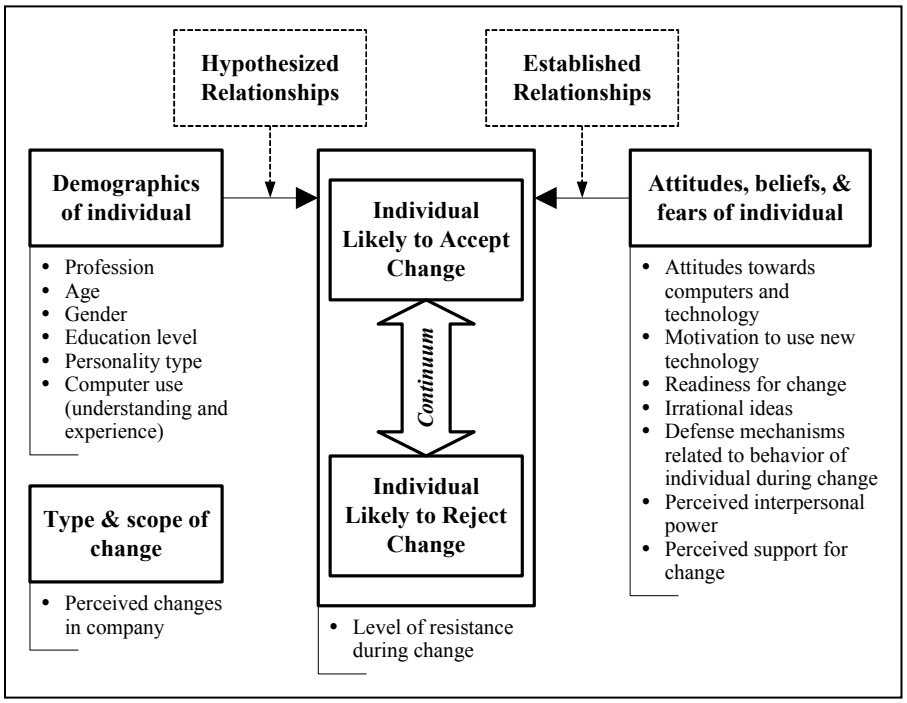


**Figure 4-8 Expanded Model Depicting Level of Resistance to Information Technology Change**

*4.3.4.1 Relevance of Factors Included in Index*

Attitudes towards computers and information technology emphasize "feelings about the impact of computers on society and the quality of life, and their understanding of computers" (Heinssen et al. 1987). Attitudes towards computers was measured with the Computer Attitude Scale (CAS) (Loyd and Gressard 1984b). Three types of attitudes are represented in this scale: computer anxiety, computer liking, and computer confidence. The Cronbach's coefficient alpha[‡] for the CAS total score based on the literature was 0.95 (Loyd and Gressard 1984b). The Phase I data also had a coefficient alpha of 0.95. A positive attitude towards computers is an indication of lower resistance towards technological change and vice-versa. CAS is becoming the "measure of choice in research on computer attitudes" (Gardner et al. 1993).

An individual's motivation to use new technology will affect their reaction to the implementation of new technology. A strong motivation to use the new technology can overcome many difficulties, whereas a strong motivation not to use the technology can cause an individual to erect additional barriers as protection. The researcher developed the two questions used, as no existing measures of this factor were located in the literature.

Readiness for change is an individual's attitude towards change. Two metrics were retained for use: the Change Scale (Trumbo 1961) and the Reaction-to-Change Inventory (De Meuse and McDaris 1994). The Change Scale indicates that "individual differences in attitudes toward change may reflect differences in the capacity to adjust to change situations" (Trumbo 1961). A high score indicates a "favorable change attitude", which is interpreted to mean low resistance to change. A low score is interpreted to mean a high resistance to change. The Reaction-to-Change Inventory measures an individual's perceptions about change. Higher scores indicate stronger support for change, whereas lower scores indicate stronger resistance to change (De Meuse and McDaris 1994).

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[‡] Cronbach's coefficient alpha is the most common measure of internal reliability – how closely do the questions within a measure report the same thing (StatSoft Inc. 2002)? Cronbach's alpha ranges from 0 to +1. If all questions are perfectly reliable and measure the same aspect, then Cronbach's alpha will be one, whereas if alpha is close to zero, the questions are essentially random in their meaning.

Individuals often have irrational ideas about change and they create their own interpretations of how the change will occur. The Irrational Belief Scale (Malouff and Schutte 1986) was chosen for measurement. The coefficient alpha reliability for the Irrational Belief Scale was 0.80 based on the literature (Malouff and Schutte 1986). The Phase I data had a coefficient alpha of 0.87. The level of irrational ideas has shown a statistically significant positive correlation to resistance to change (Bovey and Hede 2001b).

The defense mechanisms of the individual during change are generally unconscious responses of the individual to perceived danger (Bovey and Hede 2001a). Defense mechanisms include adaptive mechanisms such as humor and anticipation of change and maladaptive mechanisms such as acting out, denial, dissociation, isolation, and projection. The measure of defense mechanisms retained is the adaptive portion representing humor from the Defence Mechanisms scale (Bovey and Hede 2001a). The adaptive mechanism of humor showed a statistically significant negative correlation with the level of resistance to change, although this cannot be generalized to other populations due to the use of purposive instead of random sampling (Bovey and Hede 2001a).

There are five types of interpersonal power: legitimate, reward, coercive, expert, and referent (French and Raven 1959). When a person has one or more of these, they can influence decisions and use manipulation to successfully resist changes. The Emotional Intelligence EQ Map subscale indicating Personal Power (Cooper and Sawaf 1997) was retained as a measure of the individual's perception of their referent power. A higher level of referent power indicates a lower level of resistance to change. The other types of interpersonal power were indirectly measured by the individual's level in the organization, obtained using questions created by the researcher. An individual with a higher level in their organization will exhibit less resistance to change because they have a more powerful position and are more likely to be able to influence changes to satisfy their needs.

The metric retained for measurement of an organization's support for change was the Support for Change Questionnaire (Maurer 1996b). This questionnaire looks at how the individual perceives

that their organization supports or opposes change. Lower scores indicate higher likelihood of resistance to change and vice-versa.

These factors and the measures used are summarized in Table 4.3 below, along with the variable name, the reported Cronbach's coefficient alpha score when available, and the Phase I data Cronbach's coefficient alpha score.

**Table 4.3 Factors and Variables in Resistance to Change Index**

| **Factor** | **Measure** | **Variable Name** | **Reported Cronbach's alpha from literature** | **Phase I Data Cronbach's alpha** |
|---|---|---|---|---|
| Attitudes towards computers and technology | Computer Attitude Scale (CAS) (Gardner et al. 1993; used in Loyd and Gressard 1984b) | CAS | 0.95 | 0.95 |
| Motivation to use new technologies | Researcher's questions | MOTIV | N/A | N/A |
| Readiness for change | Reaction-to-Change Inventory (De Meuse and McDaris 1994) | RTCINV | N/A | N/A |
| | The Change Scale (Trumbo 1961) | CHGSCL | N/A | N/A |
| Irrational ideas | Irrational Belief Scale (discussed in Bovey and Hede 2001b; Malouff and Schutte 1986) | IRBSCL | 0.80 | 0.87 |
| Defense mechanisms of the individual during change | Adaptive Defence Mechanisms (Bovey and Hede 2001a) | ADDEFM | N/A | N/A |
| Perceived interpersonal power | Emotional Intelligence EQ Map Scale 16 – Personal Power (Cooper and Sawaf 1997) | EIQPOW | N/A | N/A |
| | Researcher's questions | LEVORG | N/A | N/A |
| Perceived support for change | Support for Change Questionnaire (Maurer 1996b) | SUPCHG | N/A | N/A |

*4.3.4.2 Creation of Index*

These seven factors (representing nine variables) were combined to create the Resistance to Change Index (RTCI), representing the likelihood of an individual to accept or reject information technology change. Since each variable was collected independently from its own set of questions, there was no common scale for all of the variables. The first step in the creation of the RTCI was to algebraically modify the scale of each variable to a common 1 to 10 scale indicating resistance to information technology change in a common direction. One (1) was representative of a low resistance to change and ten (10) was representative of a high resistance to change for each individual variable in the common scale.

Two common methods for establishing weighting of the variables were evaluated. The first method evaluated involved performing a regression analysis with the nine variables as the independent variables used to predict a dependent variable of resistance to information technology change. This method could not be used, however, due to the lack of an objective measure of resistance to change that could be measured independently and could serve as the dependent variable for the regression. The other method of determining weighting of the nine variables evaluated involved using the factor scores from the first principle factor in a factor analysis of the nine variables. This method is helpful when the first principle factor accounts for a significant portion of the variance in the original set of variable.

When evaluating the factor analysis in the creation of the RTCI, the first factor accounted for only 27% of the total variance before rotation, with the second, third, and fourth factors contributing 15%, 14%, and 11% respectively. The first factor did not account for a majority of the variance – it was distributed across nine factors – and consequently the factor scores from the first factor were not used for weighting purposes. The factor analysis output from SAS® is included in Appendix E.7.

Since regression analysis and factor analysis both failed to provide an appropriate method for weighting the nine variables in the creation of the RTCI, each of the variables was given equal weight in the RTCI. RTCI is expressed on a continuous scale from 1 to 10 with one indicating a

low likelihood of resistance to information technology change and ten indicating a high likelihood of resistance to information technology change.

The index was created by taking the average value of the nine factors, after the algebraic modifications to a common scale and common direction were performed. One variable (motivation) is only measured if the individual perceives a present or future change. If they do not perceive a present or future change, their RTCI is determined by the average value of the eight remaining variables.

The RTCI, based on the Phase I data, had an approximately normal distribution with a mean of 4.23 and a standard deviation of 0.66. Figure 4-9 shows a histogram of the Phase I sample population with a normal curve superimposed. The RTCI represents the likelihood of an individual to accept or reject information technology change. A person with a higher RTCI is more likely to resist information technology change than a person with a lower RTCI would. The remainder of this work investigated the hypothesized relationships between the demographic variables (the left side of Figure 4-8) and the Resistance to Change Index created (the center of Figure 4-8).

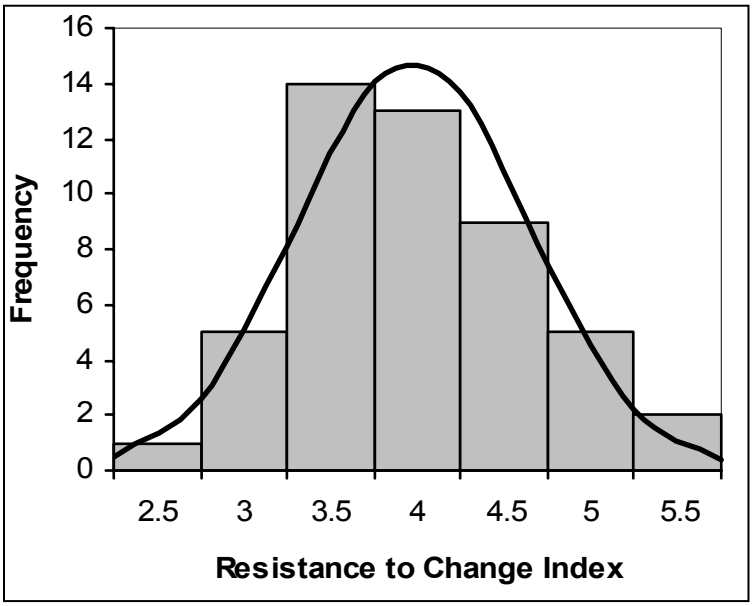


**Figure 4-9 Resistance to Change Index (RTCI)**

## *4.4 Limitations and Discussion of Phase I*

This phase of the research collected data from a 50-person sample of the population to discover the most significant factors. This data was analyzed to examine patterns and relationships of the variables to determine whether the measures could be reduced to a smaller number of factors. A refined social architecture assessment survey for measuring individual factors was the product of this step of the research. The Resistance to Change Index (RTCI) was also created. The limitations of Phase I of the research are presented below, along with a discussion of the results of this phase. Scope limitations of the research project were previously addressed in section 1.5.

### 4.4.1 Sample Limitations

There were three primary limitations in the sampling of Phase I: selection methods, sample size, and response rate. Each of these are elaborated further below.

#### *4.4.1.1 Selection Methods*

The first primary limitation of the sampling in Phase I was the selection methods used. This phase was limited to companies represented in the area in and around Blacksburg, VA. Companies that were not listed in the Yahoo! Yellow Pages on July 16, 2002 were not likely to be asked to participate. Companies where no one answered the telephone number listed and had an empty or non-existent business office were eliminated. Those companies that were contacted were dependent upon the receptionist (or other employee) answering the phone or receiving visitors in the office. Often, that person was the decision-maker as to whether anyone in the company might participate in this phase of the research.

The selection methods used also indicated bias towards larger companies and office, managerial, and supervisory positions within the companies, as shown by the comparisons between the Phase I sample and the industry population (see section 4.2.6 - *Sample Profile*).

These limitations only have a minimal impact on the study. Because the sample was a convenience-based sample, skipping a company or an individual due to difficulty reaching them was not a great concern; they may not have been willing to participate anyway. The bias towards larger companies and individuals working in office type positions means that the results of this portion of the research may not be applicable to the entire industry. Since this was an initial

study only intended to reduce the complexity of the model, this was acceptable. The Phase II study obtained a more appropriate distribution of company sizes and employee work positions through random selection of the sample population.

*4.4.1.2 Sample Size*

The sample size presented the second primary limitation of the sampling in Phase I. Since the Phase I sample size was very small, it is inappropriate to draw any formal conclusions from the example data analysis presented in Appendix F. Instead, this should only be used as an example of the analysis performed with the Phase II data. The sample was also not a random sample and should not be generalized to the population as a whole.

*4.4.1.3 Response Rate*

The third primary limitation of the sampling in Phase I was the response rate obtained. The response rate for Phase I was very high, given the length of the survey. At the completion of the Phase I data collection, 89 surveys were distributed and 52 were returned, resulting in a 58.4% response rate. Although this response rate does not provide any reason for concern, without 100% participation, there is always the possibility of bias of the sample. No non-respondent analysis was performed to determine if the non-respondents were significantly different than respondents because very little was known about the non-respondents.

### 4.4.2 Instrumentation Limitations

In addition to the sample limitations, there were seven primary limitations with respect to the instrumentation of Phase II. These included: (1) the length of the survey, (2) the survey was a self-report type, (3) the survey had an unsupervised administration, (4) the survey had questions created by other researchers, (5) the survey had literacy and language limitations, (6) the survey had collection procedure limitations, and (7) there were limitations of the measurements possible from the survey. This section elaborates on each of these limitations.

*4.4.2.1 Length of Survey*

The first limitation with respect to the instrumentation of Phase I was the length of the survey. The survey took approximately one hour to complete and influenced the willingness of persons to participate. Many refusals were due to the survey being too long. The high response rate, however, implies that the length of the survey was not a significant limitation.

*4.4.2.2 Self-Report Survey*

The second limitation of the instrumentation was that the survey was a self-report type of instrumentation. Self-report surveys are reliant upon the research participant accurately responding to the survey questions. This is in contrast to a researcher objectively measuring the data. Since this survey had a high amount of attitude seeking questions, the self-reporting was reasonable. A researcher would have a difficult time measuring attitudes in an objective manner. "Self-report procedures represent the most direct type of attitude assessment and should probably be employed unless you have reason to believe that the people whose attitudes you are investigating are unable or unwilling to provide the necessary information" (Henerson et al. 1978, p. 21). The sections of the questionnaire requesting information about a participant's experience and knowledge about computer technologies could have been more accurately measured in an objective fashion, for example, by observation of each participant. This presents other limitations, such as coder error, where the observations are subject to some interpretation and, as a result, the possibility of introducing bias and error. From a practical standpoint, the self-report method was a much more sensible choice for the variety of information desired from respondents in Phase I.

With a self-report instrument, the respondent can answer the questions in any order they wish and can complete the questionnaire over an extended length of time. If multiple similar questions are asked, providing validity checks within the survey, the respondent has the opportunity to change their answers to match. It is important that the survey does not have sets of questions that can influence the responses of other sets of questions in the survey (Bourque and Fielder 1995). The Phase I survey, to the best of the researcher's knowledge, did not have any "contaminating" sections in the questionnaire.

*4.4.2.3 Unsupervised Administration*

The third limitation of the instrumentation was that the survey had an unsupervised administration. While a survey is consistent for all respondents (there is no variation in the questions or in the manner in which they are asked), the questionnaire must stand alone (there is no one to provide help in interpreting a question) (Bourque and Fielder 1995). It is possible that respondents might have misinterpreted items in the survey or that the available responses did not reflect their true opinion. This was addressed in the pretest of Phase I and minor changes were

made to fix any issues that were discovered at that time. In evaluating the completed questionnaires, there were not any obvious misinterpretations or problem areas that needed resolution. This phase also became a pretest for the Phase II study, eliminating any additional issues that seemed to be present. Despite taking every precaution to ensure clarity in the survey, respondents still might have misinterpreted items or been unhappy with the responses available to them. This limitation is associated with self-administered survey assessments in general, and is not unique to this research.

*4.4.2.4 Questions Created by Other Researchers*

Other researchers created a majority of the questions in the survey. This was a limitation to this research because the reliability and validity of those measures were accepted as is. These researchers were experts in their respective fields and their research was accepted as such. Other than eliminating questions that were inappropriate for the sample population (these are noted elsewhere), the measures were taken in their entirety. The questions created by the researcher had no formal measures for reliability or validity, but were generally only used for demographic questions where reliability and validity are less problematic.

*4.4.2.5 Literacy and Language*

Another limitation of the instrumentation relates to literacy and language. The survey was only provided in English, requiring that the respondent be able to read and understand English. It was written at approximately a seventh grade level, requiring a certain level of literacy and vocabulary to adequately understand the questions in the survey instrument.

*4.4.2.6 Collection Procedure*

The collection procedure used was also a limitation of the instrumentation. It was primarily dependent upon a drop-off and pick-up procedure. "The success of the procedure depends on the quality of original contacts and persistence of follow-ups" (Dillman 1985, p. 374). Given the high response rate, this limitation appeared to be minimal in its effects.

*4.4.2.7 Measurements Possible*

Lastly, as discussed in section 2.1, there is no formal way to precisely measure resistance to information technology change, which limits the assessments possible from the survey instrument. This portion of the research only measured aspects of likelihood of resistance using the variables discussed in Chapter 3. There may be other variables that affect resistance to

information technology change that were not included. Section 1.5.2 discussed that organizational and group aspects were specifically neglected in this research.

### 4.4.3 Analysis Limitations

There were three primary limitations with respect to the data analysis of Phase I: the subjective nature of the variable reduction, correlations occurring by chance, and the weighting method for the Resistance to Change Index. These limitations are elaborated further below.

#### *4.4.3.1 Subjective Nature of Variable Reduction*

The first limitation of the data analysis in Phase I was the subjective nature of the variable reduction described previously in section 4.3.2.2. The fact that this analysis procedure was subjective means that it is not the only variable reduction solution possible from the correlations found. Instead, it was the researcher's best effort at reducing the number of variables while still maintaining the intent of the research – to investigate individuals' resistance to information technology change. The factor analysis performed afterwards (see section 4.3.2.3) helped to reinforce the reasonableness of some of the choices made in the reduction, but even it involved subjective evaluation.

#### *4.4.3.2 Correlations Occurring by Chance*

The second limitation of the data analysis in Phase I was the possibility of significant correlations occurring by chance. Due to the high number of correlations in the correlation matrix (see Appendix E.3) used to reduce the number of variables used for the research, some of the correlations (approximately 5% since $\alpha = 0.05$) were likely to have significance that occurred by chance. This limitation was addressed by considering groups of correlations, as well as individual correlations, and looking for consistency within the groups of variables, in hopes of catching any suspect correlations.

#### *4.4.3.3 Weighting Method for Resistance to Change Index*

The third limitation of the data analysis in Phase I was the weighting method used in the Resistance to Change Index (RTCI) (as discussed in section 4.3.4). Neither of the two common methods for determining the weighting of the variables, regression analysis and factor analysis, was able to provide an appropriate method for weighting the nine variables in the creation of the RTCI. Due to this, each of the variables was given equal weight in the RTCI. This was the

researcher's best choice in this situation given the available information, but still may not be the optimal solution for weighting the variables.

### 4.4.4 Discussion of Results

The primary objective of Phase I of the research was to reduce the number of variables in the social architecture factor model (see section 4.1). By analyzing the correlations between each of the variables, the number of variables in the survey was reduced significantly. This reduced the number of questions needed in the assessment survey. Even with all of the limitations discussed in the previous sections, this objective was accomplished in a reasonable fashion. Most of the limitations discussed are typical of this type of methodology and all of the limitations were mitigated as much as possible to lessen their effects.

The second objective of Phase I of the research was to create an index representative of an individual's level of likelihood of resistance to information technology change using the remaining variables indicative of resistance to change. This objective was achieved with the creation of the Resistance to Change Index (RTCI).

The RTCI was crucial to the Phase II portion of the research. The RTCI represents the likelihood of an individual to accept or reject information technology change. A person with a higher RTCI is more likely to resist information technology change than a person with a lower RTCI would. The remainder of this work investigated the hypothesized relationships between the demographic variables (the left side of Figure 4-8) and the Resistance to Change Index created (the center of Figure 4-8).

## *4.5 Summary*

This chapter discussed the methodology of Phase I of the research. A social architecture factor assessment survey was created based on the social architecture factor model. A 50-person sample of the population was identified and data was collected using the assessment survey. The results of the data collection were analyzed to reduce the number of variables being used in the research to a smaller number. A refined social architecture assessment survey for measuring individual factors was the product of this step of the research. Additionally, a Resistance to

Change Index (RTCI) was created from the remaining variables in preparation for Phase II of the research.

# Chapter 5. Phase II Methodology

At the completion of Phase I of the study, the social architecture assessment survey was reduced significantly in size and the Resistance to Change Index (RTCI) had been created. Each of these outcomes provided a starting point for the Phase II study.

The RTCI provides estimations of the intensity of resistance an individual is likely to exhibit using the personality traits and behavioral characteristics identified in the revised social architecture factor model. Phase II of the research investigated relationships between the RTCI and demographics of individuals using a 156-person sample of the AEC population. This phase of the research determined whether different demographic groups within the AEC population exhibited differences in their RTCI.

This chapter presents the research methodology used in Phase II. The methodology is comprised of data collection and data analysis steps. General methodological steps for the Phase II study included:

1. Establish specific hypotheses for the research based on the Phase I data analysis (see section 4.3) and example data analysis (see Appendix F).
2. Identify the method for data collection for the Phase II study.
3. Construct a revised social architecture assessment survey instrument for measuring individual factors using the findings of the Phase I study (see section 4.3).
4. Establish the sampling procedure for the Phase II study.
5. Prepare and submit a new research plan for the Institutional Review Board.
6. Identify the data collection procedure.
7. Collect data using the refined assessment survey instrument.
8. Identify the analysis methods for the data analysis.
9. Manage the raw data from the data collection.
10. Analyze the relationships between social variables and demographics of the individual to identify any relationships that might exist using statistical analysis techniques.

11. Create benchmark statistics for the investigation. AEC participants will be compared and contrasted and individuals' likelihood of resistance and the relationship to their demographics will be identified.

The remainder of this chapter discusses each of these steps in more detail. Figure 5-1 illustrates the Phase II methodology conceptually.

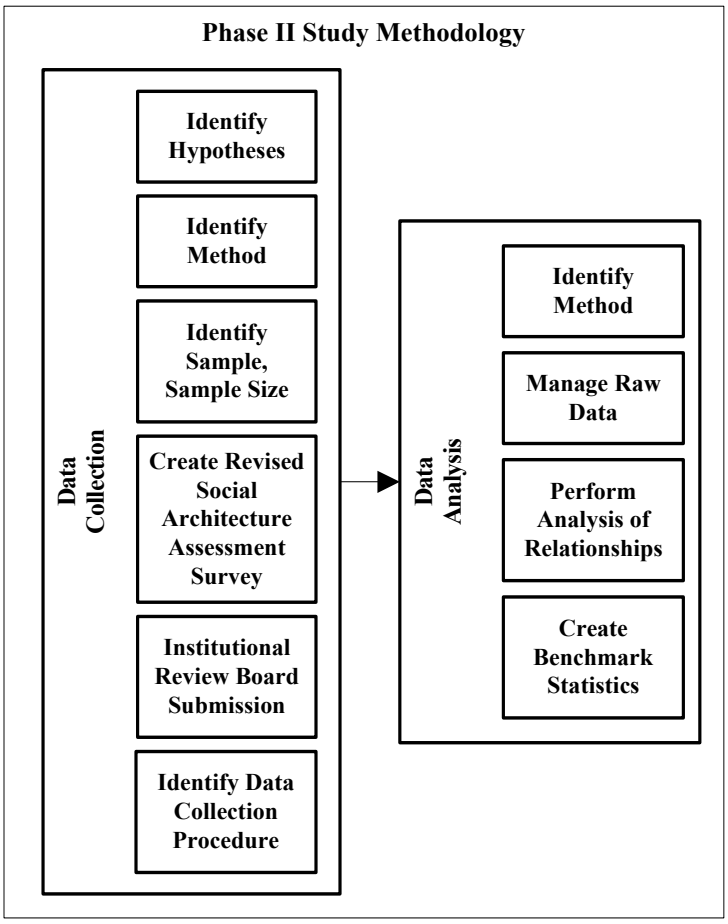


**Figure 5-1 Phase II Study Methodology**

## *5.1 Hypotheses Identified for Phase II*

This phase of the work investigated the hypothesized relationships between the demographic variables and the Resistance to Change Index created in Phase I. The demographic variables considered in the hypotheses were: profession, gender, age, personality type, education level, computer understanding and experience, and perceived past and future information technology

changes. The specific hypotheses tested are presented below, along with background information from the literature. Industry stereotypes are also presented as background.

### 5.1.1 Profession

Stereotypically, architects, engineers, construction managers, and contractors are regarded as very different groups of people. Architects and engineers are generally used to working with information technology in their jobs. This prior exposure suggests that they will have a lower resistance to technology change. Construction managers are also likely to have used information technology, but not to the same extent as architects and engineers. This suggests moderate resistance by construction managers. Based on their stereotype of low technology experience, contractors are expected to present the most resistance.

"Existing research on individual and organizational behavior suggests that employee reactions to technology may differ according to the relative positions they occupy in the organizational hierarchy" (Haddad 1996, p. 146). Managers at the top of the hierarchy see change as an opportunity to improve the company and advance their careers. For other employees, the change is unwelcome (Strebel 1996). In other words, top management is likely to have a low resistance to the change because they are in control and were the decision-makers. Employees lower down in the organizational hierarchy have little or no say in the change process and are likely to have higher resistance to the change.

No other literature was found that investigated resistance to information technology change and how it might have different effects in the various professions within the AEC industry. This is a needed area of research, regardless of the industry in question (Keil et al. 2001). This need, as well as the stereotypes about different professions in the industry led to the first hypothesis.

***Hypothesis 1:* Profession**

- Null: There is no difference in the mean RTCI value for different professions.
- Alternate: At least one profession has a different mean RTCI value.

This hypothesis was tested using one-way ANOVA with six possible professions: administrator, architect, construction manager, construction tradesman, engineer, and management. Groups represented by less than five individuals in the Phase II study were omitted from this analysis.

### 5.1.2 Gender

Based on stereotypes, males will exhibit low resistance to information technology change. Culturally, males are brought up to value science, math, and technology. Even if they have no natural abilities in these fields, they will likely not resist, in order to protect their cultural image. Females are expected to exhibit moderate resistance. U.S. culture does not yet believe that men and women have the ability to be equal and this difference may carry through to the resistance shown.

In the literature, the relationship between gender and attitudes regarding computer technologies is still a very much debated topic. Several researchers have found that males have more positive attitudes toward computers than females (Dambrot et al. 1985; Jay 1985) and that women exhibit more computer anxiety than men (Igbaria and Chakrabarti 1990; Jordan and Stroup 1982). Both of these findings imply that men have a lower resistance to implementation of information technologies. Other researchers found that women were less frequent computer users (Heinssen et al. 1987; Hoxmeier et al. 2000; Potosky and Bobko 1998) and less confident computer users (Hoxmeier et al. 2000; Temple and Lips 1989), also consistent with men having a lower resistance to information technology change.

There are some researchers, however, that have found no significant differences between genders with respect to computer attitudes (Loyd and Gressard 1984a; Pope-Davis and Twing 1991). This is supported by 1997 U.S. Census Bureau statistics which indicate that there is no gender gap in rate of computer usage (47.0% of men and 47.3% of women) and, in fact, women use computers more often in their jobs than men (56.5% vs. 44.1%) (Newburger 1999). In construction, "men are more likely to be machine operators or craft workers, and women, office workers. This accounts for the very sizable gender differences in computer use" (Newburger 1999, p. 8). In fact, 15.8% of men use a computer at work in construction compared to 65.2% of women (Newburger 1999).

Since there is such a discrepancy among findings, gender is an appropriate topic to evaluate for differences in resistance to information technology change between genders within the AEC industry. This led to the second hypothesis.

***Hypothesis 2:* Gender**

- Null: There is no difference in the mean RTCI value for different genders.
- Alternate: The mean RTCI value for females is higher than the mean RTCI value for males.

This hypothesis was tested using a one-sided t-test with two groups: male and female. The stereotypes and research presented above generally indicate that females have a higher resistance to computer technologies than males. Therefore, a one-sided test was warranted for this hypothesis, rather than a two-sided test (i.e., Alternate: There is no difference in the mean RTCI value for different genders).

### 5.1.3 Age

Based on stereotypes, younger persons are likely to show low resistance. They are presumed to have used many technologies throughout their life and generally easily adapt to new ones. Older persons are expected to present moderate resistance. Due to the high value they often place on the organization always being right, they are likely to be willing to try new technology if their organization requests it of them. Those in the middle are likely to present high resistance. They did not grow up around lots of new technology and are not used to making the adaptations needed. Additionally, they are unlikely to have the strong feelings that the company is always right.

> "Rosen and Jerdee (1976) noted that age-related stereotypes depict older workers as more resistant to change. It has also been shown that older individuals have more trouble mastering computer software in a training setting than do younger people (Gist, Rosen, & Schwoerer, 1988). However, results of a study conducted among bank employees in Holland suggested that older employees who have experienced previous job changes actually respond better to technologically-changed jobs than do younger employees (Grey & Corlett, 1984)…. In essence, results of the study indicated that employees who had faced more technologically-created job changes in the past adjusted to subsequent

technological change with grater [sic] ease than did less experienced employees" (Parsons et al. 1991 p. 1335-6).

Age does appear to have a slightly negative statistical significance when compared to computer attitudes (Igbaria and Parasuraman 1989) (i.e., older persons have less favorable computer attitudes and vice versa). Age has a slightly positive significance with computer liking, although it does not appear to have any clear trend (Loyd and Gressard 1984a; Pope-Davis and Twing 1991). It has also been shown to have a positive correlation with a person's need to change (Garlington and Shimota 1964). However, no correlation was found between computer understanding and experience vs. age (Potosky and Bobko 1998) and no relationship between computer anxiety and age was found (Igbaria and Chakrabarti 1990). Since RTCI includes aspects relating to each of these findings and there is such a discrepancy among them, it is difficult to ascertain whether there will be a relationship between resistance to information technology change and age. This led to the third hypothesis.

***Hypothesis 3:* Age**

- Null: There is no linear relationship between the RTCI value and an individual's age.
- Alternate: There is a linear relationship between the RTCI value and an individual's age.

There is a discrepancy between stereotypes and research findings, with several observing that there is a positive relationship and others observing a negative relationship with respect to age and resistance to computer technologies. Therefore, this hypothesis will be tested as a two-sided test, rather than a one-sided test favoring observations from one group over another, especially since none of the findings are from construction related industries. Because age is measured as a continuous variable, Pearson's correlation test was used.

### 5.1.4 Personality Type

Many researchers acknowledge that an individual's personality plays a role in their attitudes and behaviors surrounding information technology (Bauer 1995; Davis et al. 1989; Herling 1996; Mabin et al. 2001; Minsky and Marin 1999; New and Singer 1983; Singh 2002). In a stressful situation, such as a major technological change, individuals are likely to react based on their dominant personality traits (Carr 2000; Wankat and Oreovicz 1993).

Using the Keirsey Temperament Sorter II (Keirsey 1998), a person's dominant personality type can be identified (Wankat and Oreovicz 1993). Each person is represented by four dichotomous subsets – E/I, S/N, T/F, and J/P. These subsets were previously discussed in section 3.3 - *Demographics of Individual*. Based on the preferences each subset represents, and extending those preferences to likelihood to resist an information technology change, predictions were made. For the S/N subset, S is likely to have a higher resistance than N because S prefers established routines, whereas N sees the possibilities of new situations. For the T/F subset, F is likely to have a higher resistance than T. T is very logical and impartial when making decisions and F evaluates a situation based on intuition and subjective values. For the J/P subset, J is likely to have a higher resistance than P. J lives life in a very planned and orderly manner with a desire to control events, whereas P prefers spontaneity and adapts well to new situations (Wankat and Oreovicz 1993). It is expected that there will be no difference in the E/I subset. The E/I subset represents a person's preference for the focus of their attention and whether they get their energy from the outer world of people and activity (extroversion) or their inner world of ideas and experiences (introversion). This subset is unlikely to have any influence on an individual's resistance to information technology change. This led to the fourth hypotheses (4A, 4B, 4C, and 4D).

***Hypothesis 4A:* Personality Type (S/N)**

- Null: There is no difference in the mean RTCI value for the S and N subsets of personality type using the Keirsey Temperament Sorter II.
- Alternate: The mean RTCI value for the S subset of personality type is higher than the mean RTCI value for the N subset of personality type.

***Hypothesis 4B:* Personality Type (T/F)**

- Null: There is no difference in the mean RTCI value for the T and F subsets of personality type using the Keirsey Temperament Sorter II.
- Alternate: The mean RTCI value for the F subset of personality type is higher than the mean RTCI value for the T subset of personality type.

***Hypothesis 4C:* Personality Type (J/P)**

- Null: There is no difference in the mean RTCI value for the J and P subsets of personality type using the Keirsey Temperament Sorter II.
- Alternate: The mean RTCI value for the J subset of personality type is higher than the mean RTCI value for the P subset of personality type.

***Hypothesis 4D:* Personality Type (E/I)**

- Null: There is no difference in the mean RTCI value for the E and I subsets of personality type using the Keirsey Temperament Sorter II.
- Alternate: There is a difference in mean RTCI value for the E and I subsets of personality type.

Hypothesis 4A was tested using a one-sided t-test with two groups: S vs. N (sensing vs. intuition). Hypothesis 4B was also tested using a one-sided t-test with two groups: T vs. F (thinking vs. feeling). Similarly, Hypothesis 4C was tested using a one-sided t-test with two groups: J vs. P (judging vs. perceiving). Hypothesis 4D, however, was tested using a two-sided t-test with two groups: E vs. I (extrovert vs. introvert).

### 5.1.5 Education Level

Based on stereotypes, persons with a bachelor's degree or higher exhibit a low resistance to information technology change. They tend to be open to the idea of change and are also likely to have familiarity using technologies. Persons with some college or an associate's degree are expected to exhibit moderate resistance. They may not be as open to changes and may not have used many technologies. Persons with a high school diploma, GED, or less are expected to present the highest resistance to information technology change. It is likely that they have had little exposure to technologies.

The literature shows some support for these stereotypes (Herling 1996; Igbaria and Parasuraman 1989; Rogers 1995, p. 269; Trumbo 1961). The stereotypes also closely resembles the demographics of computers used on the job: 75.0% of people with a bachelor's degree or more used a computer on the job, compared with 11.9% of people without a high school diploma (Newburger 1999). Education has also been found to be negatively related to computer anxiety (Igbaria and Parasuraman 1989), although there was no relationship found in similar study

(Igbaria and Chakrabarti 1990). Given the stereotypes and the findings from the literature, one would expect a negative linear relationship between education and resistance to information technology change – a person with more education is less resistant to change and vice versa, which led to the fifth hypothesis.

***Hypothesis 5:* Education Level**

- Null: There is no linear relationship between the RTCI value and an individual's education level.
- Alternate: There is a negative linear relationship between the RTCI value and an individual's education level.

Because education level is a discrete, ordered variable, Spearman's correlation test was used to test Hypothesis 5.

### 5.1.6 Computer Understanding and Experience

Stereotypically, one would expect a person with a good understanding of computer technologies and high amount of experience with the technologies to have a low resistance to information technology change. The findings from the literature are consistent with this view – more computer experience is related to positive attitudes about computers and higher computer confidence, and less computer experience is related to higher computer anxiety (Dambrot et al. 1985; Gardner et al. 1993; Heinssen et al. 1987; Igbaria and Chakrabarti 1990; Levine and Donitsa-Schmidt 1997; Loyd and Gressard 1984a).

Only two studies were found to contradict this view. One found no relationship between computer experience and computer attitudes (Pope-Davis and Twing 1991) and the other indicated that "Students who showed a high level of computer knowledge often indicated a lower desire to learn more about computers, while students who indicated a lower level of knowledge often expressed greater desire to gain more knowledge" (Levine and Donitsa-Schmidt 1997, p. 96). It was expected that this research would follow the majority of studies, which led to the sixth hypothesis.

***<u>Hypothesis 6:</u> Computer Understanding and Experience***

- Null: There is no linear relationship between the RTCI value and an individual's computer understanding and experience.
- Alternate: There is a negative linear relationship between the RTCI value and an individual's computer understanding and experience.

Because computer understanding and experience was measured as a continuous variable, Pearson's correlation test was used for Hypothesis 6.

### 5.1.7 Perceived Past (Future) Information Technology Change

One would expect that individuals would be less likely to resist a change if they are aware of it. They are able to mentally prepare for the change, decreasing their potential resistance. The idea that advance notification of a change is positively related to attitudes toward new information technology is supported by the literature (Haddad 1996). Additionally, participation in a decision has also been found to improve individual's response to a change (Burdett 1999; Coch and French 1948; Lawrence 1973; Trist and Bamforth 1951). This led to the seventh hypotheses (7A and 7B).

***<u>Hypothesis 7A:</u> Perceived Past Information Technology Change***

- Null: There is no difference in the mean RTCI value for individuals that perceived an information technology change in the last 12 months vs. individuals that did not perceive an information technology change in the last 12 months.
- Alternate: The mean RTCI value for individuals that did not perceive an information technology change is higher than the mean RTCI value for individuals that did perceive an information technology change.

***<u>Hypothesis 7B:</u> Perceived Future Information Technology Change***

- Null: There is no difference in the mean RTCI value for individuals that perceived an information technology change in the next 12 months vs. individuals that did not perceive an information technology change in the next 12 months.
- Alternate: The mean RTCI value for individuals that did not perceive an information technology change is higher than the mean RTCI value for individuals that did perceive an information technology change.

Both of these hypotheses were tested using one-sided t-tests with two groups: change perceived and no change perceived.

### 5.1.8 Prediction of RTCI from Demographics

With demographic relationships established, the next step is to create prediction models. An attempt at prediction of resistance using linear regression based on the demographics measured was made, primarily as a stepping stone for future research. The linear regression test will be used to determine if a prediction of RTCI is possible with the following demographic variables: profession, gender, age, each subset of personality type (S/N, T/F, J/P, E/I), education level, computer understanding and experience, and perceived past and future changes. It is acknowledged that prediction is an important step in the study of this topic, but any further regression analysis will be left for future research. This limitation is necessary in order to maintain a manageable scope of work for the research. There is no theoretical background supporting prediction of resistance from demographics. This led to the eighth hypothesis.

***<u>Hypothesis 8:</u> Prediction of RTCI from Demographics***

- Null: No prediction of RTCI is possible from the demographic variables of profession, gender, age, each subset of personality type (S/N, T/F, J/P, E/I), education level, computer understanding and experience, and perceived past and future changes.
- Alternate: A prediction of RTCI is possible from these demographic variables.

## *5.2 Data Collection*

This section elaborates on each step in the data collection process and provides a profile of the sample population.

### 5.2.1 Data Collection Method

The survey instrument was chosen for Phase II. See section 4.2.1 - *Data Collection Method* from Phase I for a more detailed discussion of this choice.

### 5.2.2 Sample Size

In order to decide what the minimum sample size should be for the survey, each of the hypothesis tests were examined for a minimum appropriate sample size. The largest of these was the minimum sample size for the research. There were four different types of hypothesis tests being performed: tests for a difference in means (t-tests), tests for a difference in means (ANOVA), tests for linear association (correlation), and regression analysis.

To determine the minimum sample size for tests for a difference in means using t-tests, several assumptions must be made. First, the assumption was made that the standard deviation ($\sigma$) of the two samples is equal to the standard deviation of the Phase I study RTCI. Thus, $\sigma = 0.66$. Secondly, this was an exploratory type study, so detecting a statistically significant difference in means for $\mu_1 - \mu_2 = 0.3$ was acceptable. The RTCI has a possible range of 1 to 10. Therefore, a 0.3 difference in means equals a 3.3% difference in the value of the RTCI, which is a reasonable detection level. The intended power $(1 - \beta)$[§] for the t-tests is 0.80. Using $\alpha = 0.05$[**], for one-sided tests this results in $n_1 = n_2 = 51$ and for two-sided tests, $n_1 = n_2 = 64$ individuals (Ott and Longnecker 2001). Since both one- and two-sided tests were performed, the minimum sample size needed for t-tests was governed by the two-sided tests. Thus, based on intended power, n = (64 x 2) = 128 persons for t-tests.

To determine the minimum sample size for tests for a difference in means using ANOVA, again assumptions must be made. The standard deviation of the sample is assumed equal to the

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[§] Intended power is used to determine the sample size needed to make statistical judgments that are accurate and reliable, as well as to determine how likely the statistical test will be to detect effects of a given size in a particular situation. Beta ($\beta$) is the Type II error rate. This is the probability of accepting the null hypothesis when the alternate hypothesis is true. Power ($1 - \beta$) is the probability of correctly rejecting a null hypothesis (StatSoft Inc. 2002). Typically, $\beta = 0.20$ (power = 0.80) is used.

[**] Alpha ($\alpha$) is the Type I error rate. This is the probability of incorrectly rejecting the null hypothesis when it is true (StatSoft Inc. 2002). By convention, $\alpha = 0.05$ is typically used.

standard deviation of the Phase I study RTCI ($\sigma = 0.66$). The intended power is 0.80 and $\alpha = 0.05$ again. For the Phase I study, there were nine groups of professions, which was the worst-case for ANOVA tests, due to having the largest number of categories. Mean values from each profession from the Phase I study were used in the power analysis resulting in n = 4 per group represented (Ott and Longnecker 2001). Thus, the minimum sample size for ANOVA tests, based on intended power, was (9 groups x 4 persons per group) = 36 persons.

To determine the minimum sample size for linear association tests using correlation, the intended power is 0.80 and $\alpha = 0.05$ again. For detecting a statistically significant correlation of 0.5, $n \approx 30$. For detecting a statistically significant correlation of 0.4, $n \approx 50$, and for detecting a correlation of 0.3, $n \approx 80$ (Schulman 2003). To provide the most meaningful results for the correlation tests, without requiring an excessive sample size, detection of a statistically significant correlation of 0.3 was used to determine the minimum sample size required for correlations. Thus, the minimum sample size for correlations, based on intended power, was 80 persons.

To determine the minimum sample size for regression analysis, a rule of thumb recommends that the sample size (n), equals 7 times the number of predictor variables in regression analysis (Green 1991; Schulman 2003).

$$n = 7P$$

where n = sample size and P = the degrees of freedom (df) for the predictor variables in the regression analysis. For each continuous variable the degrees of freedom equals one and for each categorical variable, the degrees of freedom equals the number of categories minus one. For the regression analysis proposed, there were 13 predictor variables: profession (df = 8), gender (df = 1), age (df = 1), each subset of personality type (S/N, T/F, J/P, E/I) (df = 4), education level (df = 8), computer understanding and experience (df = 1), and perceived past and future changes (df = 2), with a total of 25 degrees of freedom. Using the equation above, n = (7 x 25) = 175.

Given these statistical tests, the minimum appropriate sample size was governed by the regression analysis with n = 175. It was expected that the non-response rate would be slightly

lower than the 58.4% achieved in the Phase I study. The Phase II sample would not have close proximity to Virginia Tech, a factor thought to help raise the Phase I response rate. It was estimated that the Phase II response rate would be approximately 40%. The sample size was adjusted upwards to reflect this non-response rate and attempt to ensure that the response rate achieved results in an appropriate sample size for the analysis. The total sample size was 443 individuals. A discussion of the actual response rate achieved is provided in section 5.2.7.2.

### 5.2.3 Sample Identification

Similar to the Phase I study, the sample population for the full study consisted of English-speaking architecture, engineering, contractor, and construction management organization employees in the U.S. The research included all sizes of organizations, from sole proprietorships to 1,000+ employee firms within the AEC industry. Additionally, all positions and all levels within an AEC organization were included in the population because technological changes in the industry can affect all employees within an organization.

In order to generalize the data to the entire AEC industry, a mail survey is the most appropriate method of achieving good coverage of the survey instrument. This allows distribution of the survey throughout the entire U.S. without requiring substantial travel time for the researcher.

ZIP codes were selected using simple random sampling from a list of all valid 5-digit ZIP codes defined as of November 1, 1999 (U.S. Census Bureau 1999a), excluding APO/FPO Military and U.S. Territory ZIP codes. There are approximately 40,000 valid 5-digit ZIP codes in the 50 states. Simple random sampling gave each ZIP code an equal probability of being selected. Microsoft Excel was used to generate random numbers between 00210 (the first ZIP code used) and 99950 (the last ZIP code used). ZIP codes were chosen by selecting those that matched the random numbers generated, in the order generated, until enough ZIP codes were selected to provide an adequate amount of businesses to meet the sample size criteria.

Within each randomly selected ZIP code, architecture, engineering, construction, and construction management companies were identified by searching the Yellow Pages of Yahoo! at http://yp.yahoo.com. The classification headings for type of business were the same as those used in the Phase I study (see section 4.2.2 for the complete list). The Landscape Contractors

heading from the Phase I study was not used in this phase, due to its lack of any AEC companies being included in Phase I.

All Yahoo! Yellow Pages business listings are obtained from BellSouth and InfoUSA and are updated at least quarterly ("Yahoo!" 2002). Duplicate businesses were deleted, so that each business appeared only once. An attempt was made to include businesses with no mailing address through the prescreening phone call (discussed in section 5.2.6). If that effort was unsuccessful, they were deleted entirely.

The companies identified from the Yellow Pages were stratified into two categories - design and construction. The design stratum included architects, engineers, and drafters. The construction stratum included all contractors and construction managers. These strata were chosen to ensure that a good variety of professions and company types was achieved. It would have been desirable to stratify the sample further to ensure that each group of interest was adequately represented, but this was impossible to do for many of the groups and still maintain a random selection process.

ZIP codes were chosen until a minimum sample from each stratum was obtained and the minimum total sample size was met. Additional ZIP codes were chosen to replace businesses that were unreachable because their phone was disconnected, they had no listed address, or the address was incorrect. A total of 178 ZIP codes were chosen. These ZIP codes are listed in Appendix H.13.

For the design stratum, 100% of the businesses identified from the selected ZIP codes were chosen for the sample. This resulted in 259 design businesses being chosen. For the construction stratum, 20% of the businesses identified were chosen. From the 178 ZIP codes selected, 2503 construction businesses were identified. Using systematic random sampling, 20% of these were chosen for the sample population. The construction businesses were ordered based on the selection order of their ZIP code and then, within each ZIP code, ordered by telephone number. A random number between one and five was selected as the starting point (four was chosen) and every fifth business thereafter was selected. This resulted in 500 construction

businesses being selected for inclusion. A map illustrating the national distribution of the ZIP codes selected is shown in Appendix H.14. A discussion of the number of surveys sent is presented in section 5.2.7 - *Sample Profile*.

The most difficult aspect of the sample identification was identifying an individual within each business. With the sampling procedure outlined above, one individual from each business was used in the sample population. The detailed method for identifying the individual in each business is discussed in section 5.2.6 - *Data Collection Procedure*.

### 5.2.4 Instrumentation – Revised Social Architecture Assessment Survey

The survey instrument was again chosen for use in the Phase II study. The survey instrument provides a broad picture of the industry as a whole, rather than focused pictures of small portions.

The revised social architecture assessment survey was based on the factors that remained after the reduction of variables discussed in section 4.3.2 - *Data Analysis for Reduction of Variables*. The complete revised survey is included in Appendix H.6. This version of the survey was not pretested, because none of the questions, nor the overall layout from the original survey design, was changed, beyond the elimination of questions.

Table 5.1 summarizes the factors kept for the Demographics of the Individual, Demographics of the Organization, and Type & Scope of Change categories, as well as the measures used in the revised social architecture assessment survey.

**Table 5.1 Demographics in Revised Survey: Factors and Measures**

| Factor | Measure | Number of Questions | Question Numbers in Phase II Survey |
|---|---|---|---|
| Profession | Researcher's questions | 3 | Q173-Q175 |
| Gender | Researcher's questions | 1 | Q185 |
| Age | Researcher's questions | 1 | Q184 |
| Personality type | The Keirsey Temperament Sorter II (Keirsey 1998) | 70 | Q90-Q159 |
| Education level | Researcher's questions | 1 | Q186 |
| Computer use | Computer Understanding and Experience Scale (Potosky and Bobko 1998) | 16 | Q47-Q59, Q61-Q63 |
| | Researcher's questions | 2 | Q46, Q60 |
| Perceived changes in company | Researcher's questions | 2 | Q33-Q34 |
| Company size | Researcher's questions | 2 | Q180-Q181 |
| Industry sector | Researcher's questions | 2 | Q182-Q183 |

Table 5.2 summarizes the factors kept for the Attitudes, Beliefs, and Fears of the Individual category, as well as the measures used in the revised social architecture assessment survey. These are the measures that make up the Resistance to Change Index (RTCI).

**Table 5.2 Attitudes, Beliefs, and Fears of Individual in Revised Survey: Factors and Measures**

| Factor | Measure | Number of Questions | Question Numbers in Phase II Survey |
|---|---|---|---|
| Attitudes towards computers and technology | Computer Attitude Scale (CAS) (Gardner et al. 1993; used in Loyd and Gressard 1984b) | 26 | Q64-Q89 |
| Motivation to use new technologies | Researcher's questions | 2 | Q36-Q37 |
| Readiness for change | Reaction-to-Change Inventory (De Meuse and McDaris 1994) | 1 | Q1 |
| | The Change Scale (Trumbo 1961) | 9 | Q24-Q32 |
| Irrational ideas | Irrational Belief Scale (discussed in Bovey and Hede 2001b; Malouff and Schutte 1986) | 20 | Q4-Q23 |
| Defense mechanisms of the individual during change | Adaptive Defence Mechanisms (Bovey and Hede 2001a) | 2 | Q2-Q3 |
| Perceived interpersonal power | Emotional Intelligence EQ Map Scale 16 – Personal Power (Cooper and Sawaf 1997) | 13 | Q160-Q172 |
| | Researcher's questions | 4 | Q176-Q179 |
| Perceived support for change | Support for Change Questionnaire (Maurer 1996b) | 8 | Q38-Q45 |

### 5.2.5 Institutional Review Board (IRB) Submission

Because this portion of the research also involved human subjects, similar to Phase I, the Institutional Review Board (IRB) required a review of the research plan. The complete submission to the IRB consisted of a 'Request for Exemption of Research Involving Human Subjects' form, a synopsis of the research protocol in non-technical language, an 'Informed

Consent' form for the subjects, and a copy of the survey. A copy of the exemption request form, the research protocol, and the informed consent form are included in Appendix G: *Institutional Review Board Submission for Phase II*. A copy of the Phase II survey is included in Appendix H.6.

As incentive to complete the survey, one portion of the informed consent form let participants know that they could request a personal change profile based on their survey responses if they desired. Ten participants in Phase II requested their change profile. An example of the cover letter and personal change profile sent to those participants is included in Appendix J: *Personal Change Profile*.

### 5.2.6 Data Collection Procedure

A prescreening phone call was successfully used for approximately half of the sample population. The intent of the phone call was to verify that the business currently existed and that they had the appropriate characteristics for inclusion in the sample – i.e., they were a business operating in the AEC industry. This prescreening phone call was also used to identify a person to whom the correspondence could be sent. The importance of having a name for improving response rates when doing surveys involving businesses is well documented (Dillman 2000). In order to maintain the random sampling, it was desirable to have the person with the most recent birthday be selected as the respondent. This was generally not known by the person answering the phone and was dropped from the prescreening script shortly after beginning the calls. Instead, it was requested that one person's name be provided for potential participation in the research project. The complete phone script used is included in Appendix H.1.

543 businesses received a prescreening phone call. Of these, 276 did not do business in the AEC industry, their phone was disconnected, there was no answer, or voice mail answered the phone. Those businesses with no answer or voice mail were tried on at least two different occasions in an attempt to make contact with an employee of the company. Of the 267 calls that were answered, 56 businesses refused to participate further in the research study. This left 211 members of the sample population that were contacted for the mail survey using the procedure for group A outlined later in this section.

Due to the difficulty in reaching many businesses by phone, the prescreening phone call was not used for the 216 remaining businesses (of the original 759 identified). There were 127 members of the sample that received unsuccessful prescreening phone calls (no answer or voice mail) that were added to this group, resulting in 343 businesses. 56 of these had no street addresses listed and were eliminated from the sample population. This left 287 members of the sample population that were contacted for the mail survey using the procedure for group B. Figure 5-2 shows this prescreening process graphically.

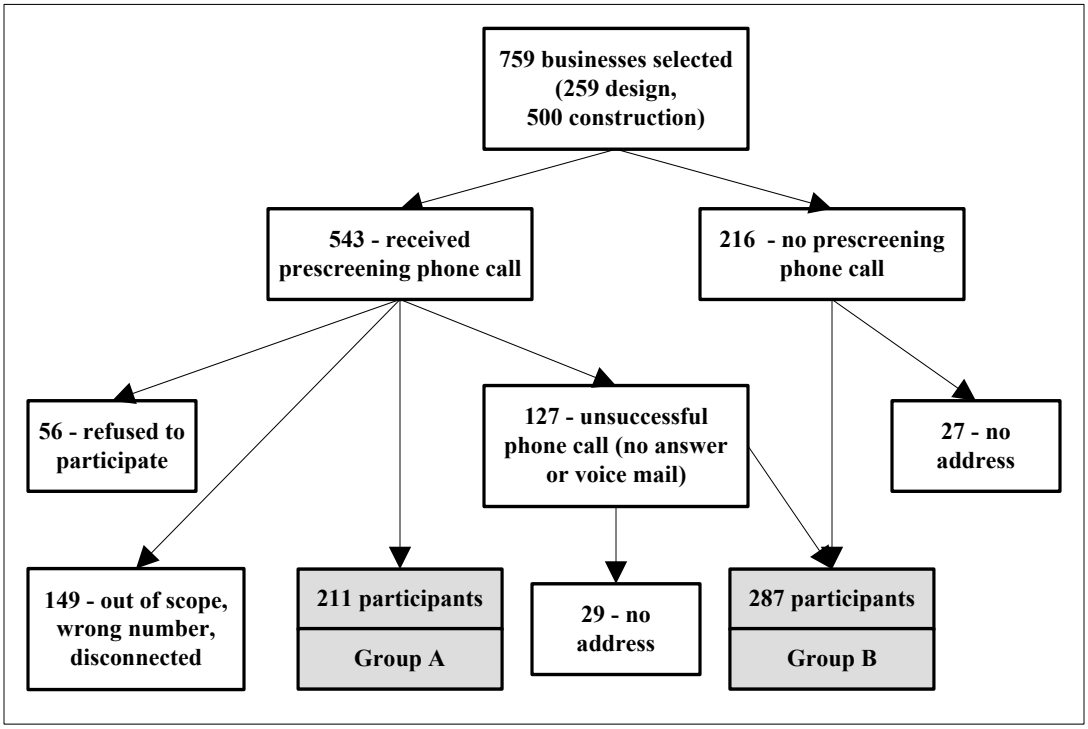


**Figure 5-2 Prescreening Process**

The primary influence on response rates of mail surveys is multiple contacts (Dillman 2000). A very effective system of five multiple contacts is described which includes:

1. Prenotice letter
2. Questionnaire mailing
3. Thank you postcard
4. Replacement questionnaire
5. Final contact

This five-contact procedure was used for both sample groups A and B. The difference between the two groups was exclusively in the wording of text for the prenotice letters, all cover letters accompanying questionnaires, and all postcards sent. Sample group A had specific individuals identified to participate in the research, whereas sample group B did not. Everyone received contacts (1), (2), and (3). Only non-respondents received contacts (4) and, if necessary, (5). Samples of all letters and postcards are included for reference in Appendix H.

The prenotice letter was personally addressed to the individual identified in the prescreening phone call for sample group A. This letter announced that the individual would be receiving a request to help with the research study in a few days. It was printed on Virginia Tech letterhead and was personally signed, helping to promote the legitimacy of the work. Sample group B received a prenotice letter similar to the group A letter, except it was addressed to the company and requested that one person in the company participate in the study.

Approximately one week after the prenotice letter was mailed, the second contact was initiated. This contact consisted of a cover letter introducing the research study, an informed consent form, and the questionnaire, along with an addressed, stamped envelope to mail the completed questionnaire back. Both sample groups (A and B) received the exact same information, with one exception: sample group B included a handwritten note attached to the cover letter requesting that one person in the company participate in the study.

Approximately one week after the questionnaire mailing (elapsed week two), a postcard thank you/reminder was sent to all individuals in the sample. This served to thank those that had already returned their survey and to remind those that had not yet done so. Sample groups A and B had postcards that were worded slightly differently to reflect the fact that the actual participant in group B was not known.

Approximately four weeks after the thank you postcard (elapsed week six), a new cover letter and replacement questionnaire were sent to non-respondents, along with another informed consent form and an addressed, stamped envelope for returning the questionnaire. This was to appeal to those that had not yet responded and might have misplaced their original questionnaire.

The cover letter for this replacement questionnaire was worded slightly differently for the two sample groups.

Approximately four weeks after the replacement questionnaire (elapsed week ten), a final contact was made with non-respondents. This was planned to be a telephone call to emphasize the questionnaire's importance and establish whether the non-respondents were truly different than those that had responded already. The switch in modes provided a contrast from the previous attempts and stressed the importance of responding to the survey. However, due to the significant drop in questionnaire returns after the replacement questionnaire, as well as the difficulty in contacting individuals discovered during the prescreening phone calls, this contact was revised to be a postcard. The postcard let the participant know that even though a month had elapsed since the last contact, their help was still needed and it was not too late to complete and return the questionnaire.

Data collection was ceased four weeks after the last final contact was mailed. The entire data collection process, from the beginning of the prescreening calls to the cessation of collection, lasted 30 weeks.

Figure 5-3 below illustrates the general timeline of the five contacts made during the data collection process.

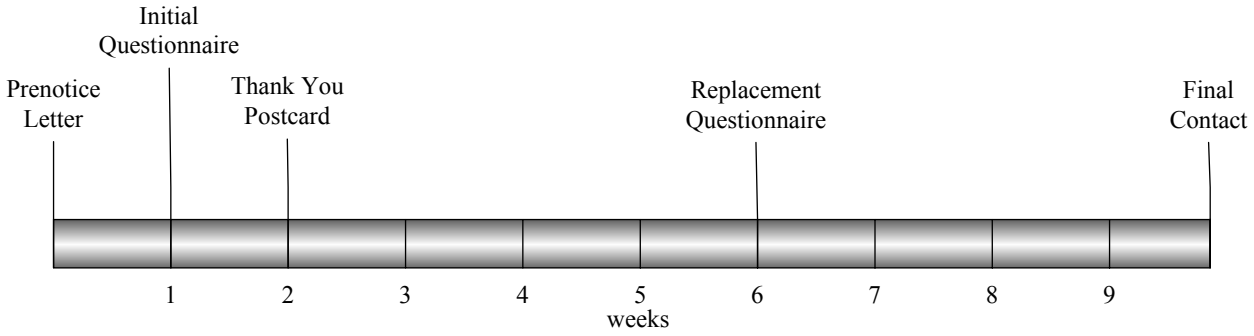


**Figure 5-3 Timeline of Five Contacts During Data Collection**

### 5.2.7 Sample Profile

The Phase II sample relied on random sampling to provide the opportunity to generalize the results to the entire AEC population. This section presents a profile of sample population based on responses from the surveys collected. The reader is directed to section 4.2.6 for a profile of the industry population in general; that information is not repeated here. A discussion of the response rates is also included in this section.

*5.2.7.1 Profile of Sample Population*

The industry population is heavily skewed to smaller companies, with 90% of firms having less than 20 employees. The Phase II sample was similar, with 80% of the sample population employed by firms having less than 20 employees (see Figure 5-4). The improvement in representation of smaller companies from Phase I is believed to be a direct result of the random selection of businesses in the sample and the shorter survey.

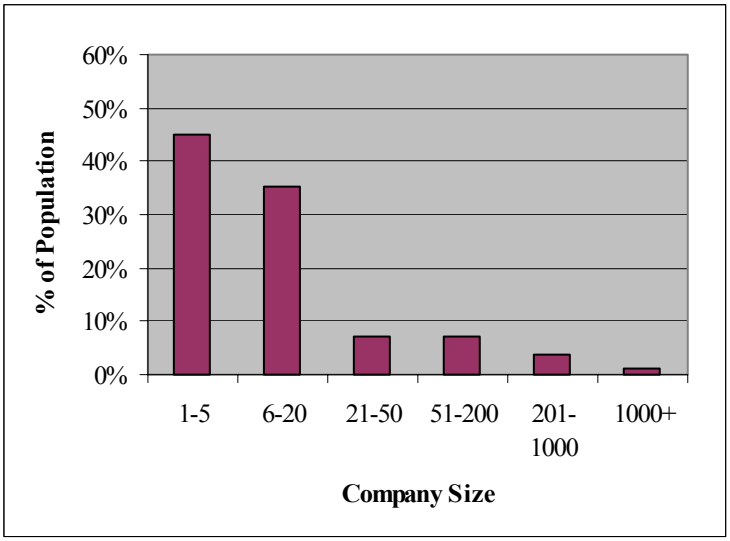


**Figure 5-4 Company Size: Phase II Sample Population**

The Phase II sample population was very similar to the Phase I sample population with respect to industry sector (see Figure 5-5). Firms providing architecture and engineering services were somewhat overrepresented and firms providing general building construction/special trade construction/construction management services were underrepresented by a similar amount.

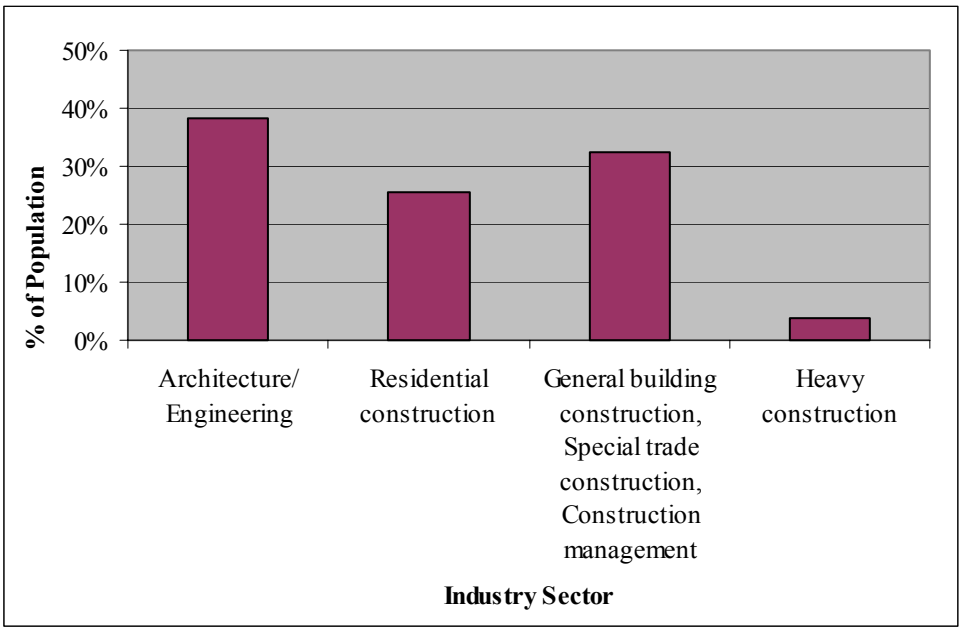


**Figure 5-5 Industry Sector: Phase II Sample Population**

The representation of professions in the Phase II sample was also similar to that of Phase I (see Figure 5-6). It was again skewed towards office, managerial, and supervisory positions, whereas the industry population is predominantly construction tradesmen and laborers. As previously discussed, this group represents the population most likely to directly use new technologies (as defined within this study) when they are first implemented.

For age, the Phase II sample was somewhat older than the Phase I sample. Here, the mean age was 47.1 years old with a standard deviation of 12.27 years. For comparison purposes, the Phase I mean age was 36.1 with a standard deviation of 12.03. Figure 5-7 shows the age distribution of the Phase II sample.

The gender distribution for Phase II was very similar to the Phase I sample. Thirty-six individuals in the sample population identified themselves as female (24.0%) and 114 identified themselves as male (76.0%). There was enough female participation in this phase to perform data analysis comparing males and females.

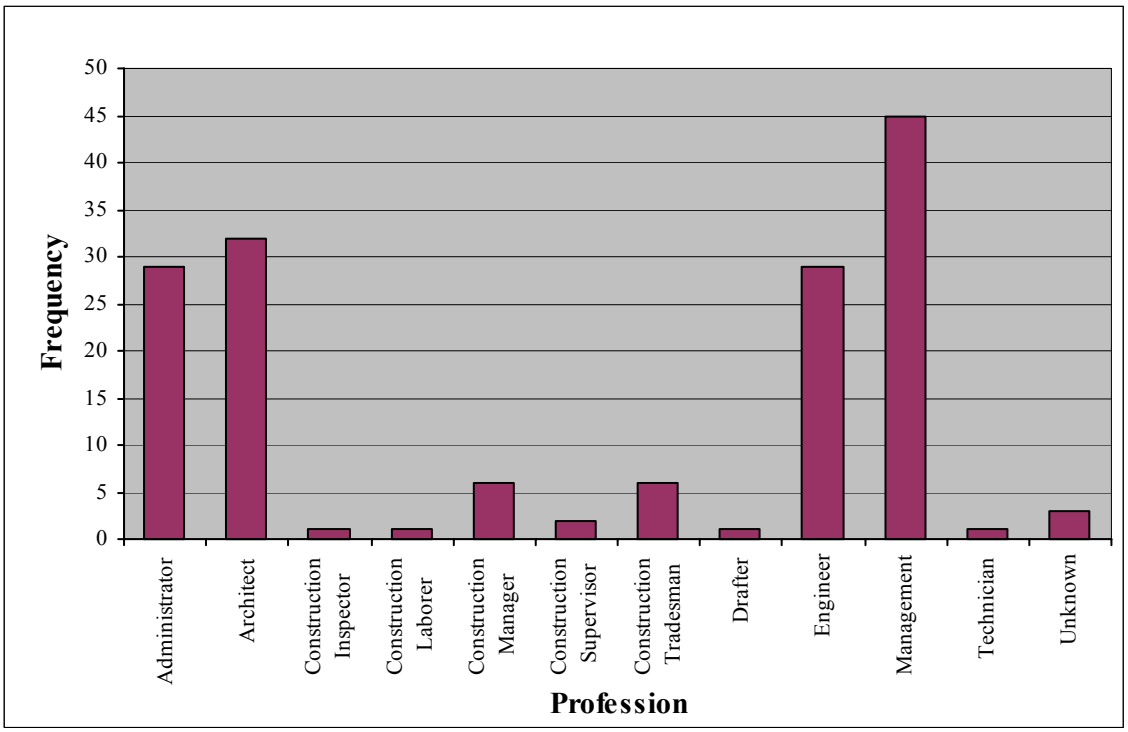


**Figure 5-6 Profession: Phase II Sample Population**

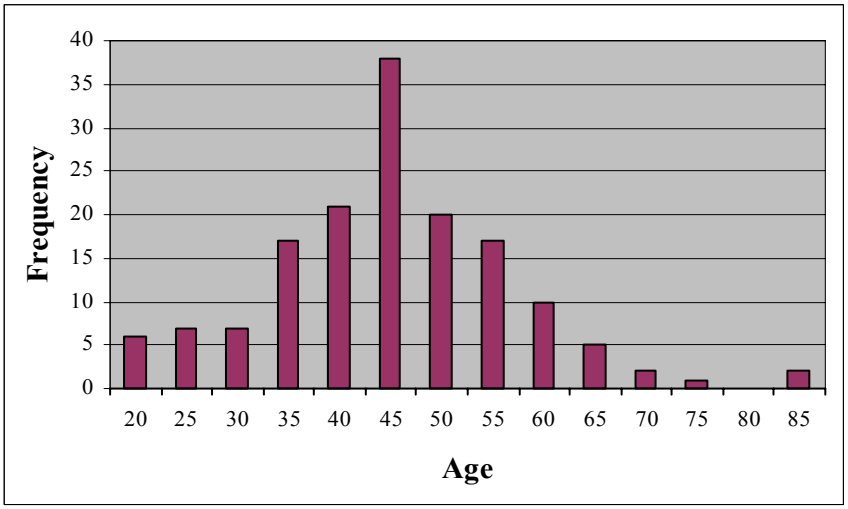


**Figure 5-7 Age: Phase II Sample Population**

Figure 5-8 shows the distribution of the highest level of education completed by those in the Phase II sample population. The group as a whole was fairly well educated. Only 16.3% of the

sample had no college whatsoever, whereas 56.9% of the sample had a bachelor's degree or higher.

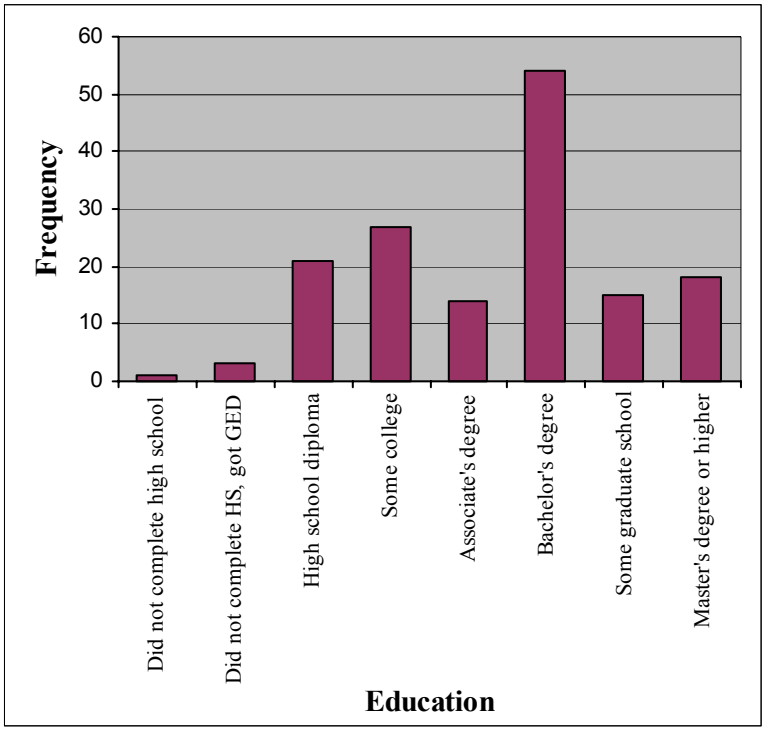


**Figure 5-8 Education: Phase II Sample Population**

Figure 5-9 shows the distribution of the demographic variable COMPUN – Computer Understanding and Experience. This variable is the average value of 18 questions, each having a one to five scale. The sample population, as a whole, ranked their computer experience and understanding slightly above the middle of the scale, with a sample average value of 3.47 (standard deviation = 0.88), implying that they felt moderately comfortable with their knowledge of computer technologies.

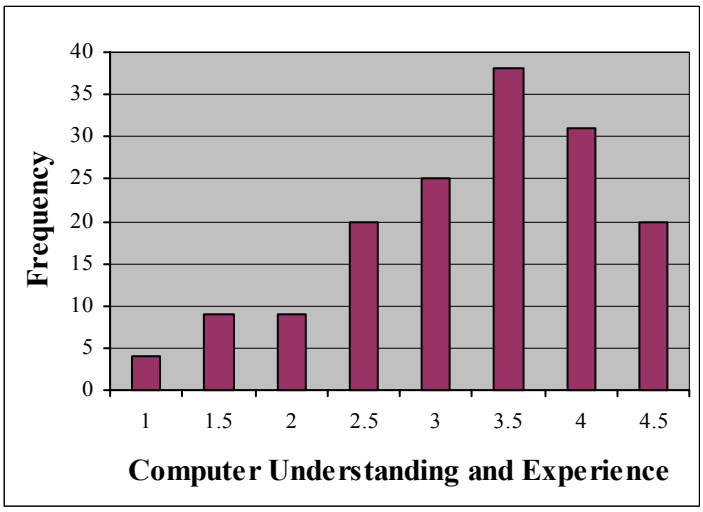


**Figure 5-9 Computer Understanding and Experience: Phase II Sample Population**

Table 5.3 shows the distribution of the different subsets of personality type for the Phase II sample. The group was relatively evenly distributed for the T/F and E/I subsets. For the S/N subset, most of the sample was classified as S and for the J/P subset, most of the sample was classified as J.

**Table 5.3 Personality Type: Phase II Sample Population**

| Subset | No. in Sample | % of Sample | Subset | No. in Sample | % of Sample |
|---|---|---|---|---|---|
| **S** | 121 | 86.43% | **N** | 19 | 13.57% |
| **T** | 66 | 46.48% | **F** | 76 | 53.52% |
| **J** | 111 | 78.72% | **P** | 30 | 21.28% |
| **E** | 77 | 55.80% | **I** | 61 | 44.20% |

With respect to experiencing technological changes in the last year, the sample group was split fairly evenly. 67 individuals reported experiencing no changes (44.97%) and 82 individuals reported experiencing information technology changes (55.03%). A majority of the changes mentioned involved new software or updates to existing software. New hardware and new uses for computers within their company were also mentioned regularly. When the sample group was asked whether they knew of any planned changes for the next year, most (109 individuals –

73.15%) stated that they were not aware of any planned future changes. Forty individuals (26.85%) reported that there would be future changes. Again, the primary changes anticipated were listed as new or updated software, new hardware, and new uses for computers within their company. Appendix I.1 includes a list of the exact responses for these questions.

The sample population was well distributed throughout the United States, with a larger representation in regions with a larger general population and a smaller representation in regions with a smaller general population. A map illustrating the distribution of the ZIP codes selected is shown in Appendix H.14.

*5.2.7.2 Response Rates*

The sample identification procedure discussed in section 5.2.3 identified 759 businesses. The prescreening phone call eliminated 149 of these businesses because they were out of the scope of the project (not an AEC company), or their phone was disconnected. Another 56 businesses were eliminated because they had no mailing address listed. 56 more businesses were eliminated because they refused to participate during the prescreening phone call. The remaining 498 businesses were mailed initial surveys over a three-month period. Of these, 166 (33.33%) were listed in the Yahoo! Yellow Pages as architecture or engineering businesses and 332 (66.67%) were listed as construction companies.

Of the 498 businesses contacted by mail with the initial survey, the post office returned 36 surveys for various reasons and two individuals returned their surveys, refusing to participate. A week later, 460 Thank You/reminder postcards were sent to the remaining sample population. In the following four weeks, the post office returned an additional 14 surveys, there were three more refusals, and 101 completed surveys were returned. Replacement surveys were then mailed to all non-respondents (342 mailed in total), resulting in two more "return to sender" returns, 17 additional refusals, and 44 more complete surveys over a four-week period. At this point, the final contact postcard was mailed to all non-respondents (279 mailed) and resulted in three "return to sender" returns, five refusals, and 11 completed surveys.

Table 5.4 provides a summary of the mailings and the associated responses for each mailing. The percentages shown are the percent of the total initial surveys sent (498). A summary of the

ZIP codes chosen, the number of businesses in each ZIP that received surveys, and the associated responses are included in Appendix H.13.

**Table 5.4 Summary of Mailings and Responses**

| Mailing | Number Mailed | Responses After Mailing | | |
|---|---|---|---|---|
| | | Returned to Sender | Refused | Completed Survey Returned |
| **Prenotice Letter** | 498 | - | - | - |
| **Initial Survey** | 498 | 36 | 2 | - |
| **Thank You Postcard** | 460 | 14 | 3 | 101 |
| **Replacement Survey** | 342 | 2 | 17 | 44 |
| **Final Postcard** | 279 | 3 | 5 | 11 |
| **Totals** | 498 (100%) | 55 (11.04%) | 27 (5.42%) | 156 (31.33%) |

Figure 5-10 shows the survey returns by week, normalized to illustrate returns compared to timing of mailings, regardless of actual dates of mailings.

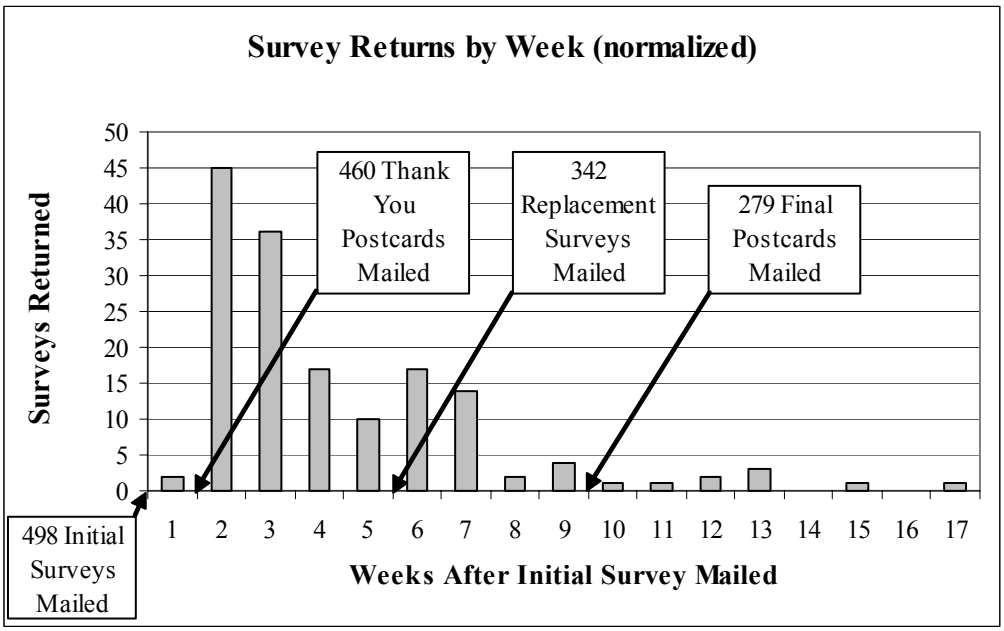


**Figure 5-10 Survey Returns by Week (normalized)**

The overall response rate of the mailings, adjusted by removing "return to sender" mailings, was 35.21% (156 returned out of 443 sent). The response rate for sample groups A (with

prescreening phone call) and B (without prescreening phone call) were significantly different. Group A had a response rate of 47.50% (95 of 200) and group B had a response rate of 25.10% (61 of 243). The higher response rate for group A was primarily because of the additional contact to help personalize the research and obtain the name of a participant for all mailings. Additionally, group B included those businesses that were not reached by phone – a possible sign of unwillingness or inability to participate.

## *5.3 Data Analysis and Findings*

After completing data collection, the data was analyzed to investigate the hypothesized relationships between the demographic variables and the Resistance to Change Index created. The method for data analysis was similar to that discussed in Appendix F: *Example Data Analysis for Phase II Using Phase I Data*. The hypotheses were modified somewhat from those in the Appendix, however (see section 5.1 for Phase II hypotheses). This section describes the management of the raw data and the data analysis procedure for investigating the hypotheses, as well as the data analysis findings.

### 5.3.1 Management of Raw Data

Management of the raw data prior to analysis was performed in the same manner as in the Phase I study. This was discussed in section 4.3.1 - *Management of Raw Data*.

All of the questions on the revised assessment survey were answered by a majority of respondents. The question skipped by the most respondents (14 respondents) was question number 90. This appeared to be due to placement on the survey page, rather than being skipped intentionally. All missing/duplicate data exhibited a random pattern, however, and were omitted using average values for factors as discussed previously in section 4.3.1.

A majority of respondents skipped three or less questions on the 186-question survey (134 out of 156 respondents – 85.9%). Of the respondents that skipped more than three questions, seven missed entire pages; it appeared that occasionally pages of the survey stuck together and the respondents did not notice. The remaining respondents skipping more than three questions did so in a random fashion. The questions respondents did answer are included in the Phase II data analysis.

### 5.3.2 Data Analysis Method

This work investigated the hypothesized relationships between the demographic variables and the Resistance to Change Index created. To test the model (Figure 4-8), statistical tests were performed to compare the RTCI values obtained from different demographic groups represented in the sample population. The main statistical methods used were ANOVA, t-tests, correlation tests, and regression analysis.

One-way ANOVA methods were used to compare the mean RTCI values of the different professions to determine whether any groups differed and was most appropriate for tests involving three or more groups. While one-way ANOVA can discern whether at least one group has a statistically significant different mean, it is unable to provide information as to which group(s) differ. Therefore, if a statistical difference was found (i.e., at least one group differs), Tukey's multiple comparison test was used to compare each group with each of the other groups to determine which groups differ on the mean RTCI value. Tukey's test is a very conservative test with an experimentwise significance level of $\alpha$.

The t-test was used to compare the RTCI values for several of the demographic groups to determine if any groups differed. While similar to ANOVA, the t-test provides more concise information when only two groups are involved in a test. Specifically, the t-test was used to compare mean RTCI values for demographic variables with two categories: subsets of personality type (S/N, T/F, J/P, E/I), gender (male/female), and perceived changes (change/no change). The t-test can provide information on whether the mean values differ, as well as which is the larger and which is the smaller, if a difference exists.

The remainder of the demographic variables used correlation tests for testing possible relationships with RTCI. Correlation tests discern the level of dependence/independence that two variables have with each other. If a relationship existed, this relationship was used to understand how the RTCI varied among the different demographic groups. Continuous variables, such as age and computer use, were tested by using Pearson's correlation test. Ordered variables, such as education level, used Spearman's correlation test.

Linear regression analysis was used to determine whether a predictive model could be created from the demographic variables to predict the RTCI. The purpose of this portion of the analysis was to determine whether the demographic variables collected could predict RTCI with a reasonable level of statistical significance or not.

For all tests, a significance level of $\alpha = 0.05$ was used.

### 5.3.3 Data Analysis and Findings for Phase II Study

The purpose of this portion of the data analysis was to investigate the hypothesized relationships between the demographic variables and the Resistance to Change Index created. The specific hypotheses tested are presented along with the results from testing the Phase II data. A discussion of the background of each hypothesis is located in section 5.1. A summary of these hypotheses and their results is presented in Table 5.5. The data analysis output for each hypothesis test from *SAS®* and *Analyse-it for Microsoft Excel* is provided in Appendix I.

#### *5.3.3.1 Hypothesis 1: Profession*

- Null: There is no difference in the mean RTCI value for different professions.
- Alternate: At least one profession has a different mean RTCI value.

This hypothesis was tested using one-way ANOVA with six possible professions: administrator, architect, construction manager, construction tradesman, engineer, and management. The remaining categories of professions were each represented by less than five individuals, which was not enough data in a single group to be valid for comparisons, and so they were therefore excluded from the analysis.

The one-way ANOVA test on the six possible professions found that at least one profession has a different mean RTCI value. The p-value was 0.0006, which is less than the significance level of 0.05 previously decided, implying statistical significance.

Since a statistical difference was found (i.e., at least one group differs), Tukey's multiple comparison test was used to compare each group with each of the other groups to determine which groups differ on the mean RTCI value. The only groups found to have statistically

different means using this test were Management < Engineers, Management < Administrators, Management < Construction Tradesmen, and Architects < Administrators.

*5.3.3.2 Hypothesis 2: Gender*

- Null: There is no difference in the mean RTCI value for different genders.
- Alternate: The mean RTCI value for females is higher than the mean RTCI value for males.

This hypothesis was tested using a one-sided t-test with two groups: male and female. This test found that the mean RTCI value for females is higher than the mean RTCI value for males (p-value = 0.0380).

*5.3.3.3 Hypothesis 3: Age*

- Null: There is no linear relationship between the RTCI value and an individual's age.
- Alternate: There is a linear relationship between the RTCI value and an individual's age.

Because age is measured as a continuous variable, Pearson's correlation test was used. If the points are nearly on a line, the magnitude of $r$ will be large (near 1.0), and if they are mostly random, the magnitude of $r$ will be close to 0. The Pearson correlation for the test of age vs. RTCI was $r = 0.03$ with a p-value of 0.6753, indicating that there is no linear relationship between RTCI value and age.

*5.3.3.4 Hypothesis 4A: Personality Type (S/N)*

- Null: There is no difference in the mean RTCI value for the S and N subsets of personality type using the Keirsey Temperament Sorter II.
- Alternate: The mean RTCI value for the S subset of personality type is higher than the mean RTCI value for the N subset of personality type.

This hypothesis was tested using a one-sided t-test with two groups: S vs. N (sensing vs. intuition). Since the Keirsey Temperament Sorter II is a shortened version of the Myers Briggs Testing Instrument (MBTI), it sometimes cannot categorize an individual and it is recommended that these persons take the longer test. Any persons that could not be categorized in a given

subset (S/N, T/F, J/P, E/I) using the Keirsey Temperament Sorter II were not included in this or the following three analyses.

This test found that there is not a significant difference in the mean RTCI value for Sensors vs. Intuitors (p-value = 0.0595). Sensors do not have a higher mean RTCI value than do Intuitors.

*5.3.3.5 Hypothesis 4B: Personality Type (T/F)*

- Null: There is no difference in the mean RTCI value for the T and F subsets of personality type using the Keirsey Temperament Sorter II.
- Alternate: The mean RTCI value for the F subset of personality type is higher than the mean RTCI value for the T subset of personality type.

This hypothesis was tested using a one-sided t-test with two groups: T vs. F (thinking vs. feeling). This test found that there is no difference in the mean RTCI value for the F subset of personality type vs. the T subset (p-value = 0.1596).

*5.3.3.6 Hypothesis 4C: Personality Type (J/P)*

- Null: There is no difference in the mean RTCI value for the J and P subsets of personality type using the Keirsey Temperament Sorter II.
- Alternate: The mean RTCI value for the J subset of personality type is higher than the mean RTCI value for the P subset of personality type.

This hypothesis was tested using a one-sided t-test with two groups: J vs. P (judging vs. perceiving). This test found that there is no difference in the mean RTCI value for the J subset of personality type vs. the P subset of personality type (p-value = 0.0606).

*5.3.3.7 Hypothesis 4D: Personality Type (E/I)*

- Null: There is no difference in the mean RTCI value for the E and I subsets of personality type using the Keirsey Temperament Sorter II.
- Alternate: There is a difference in mean RTCI value for the E and I subsets of personality type.

This hypothesis was tested using a two-sided t-test with two groups: E vs. I (extrovert vs. introvert). This test found that there was no difference in the mean RTCI value for Extroverts vs. Introverts (p-value = 0.1443).

*5.3.3.8 Hypothesis 5: Education Level*

- Null: There is no linear relationship between the RTCI value and an individual's education level.
- Alternate: There is a negative linear relationship between the RTCI value and an individual's education level.

Because education level is a discrete, ordered variable, Spearman's correlation test was used. If the points are nearly on a line the magnitude of $r_s$ will be large (near 1.0), and if they are mostly random, the magnitude of $r_s$ will be close to 0. The Spearman correlation for this test was $r_s = -0.11$ with a p-value of 0.0972, indicating that there is not a statistically significant negative correlation between RTCI value and education level.

*5.3.3.9 Hypothesis 6: Computer Understanding and Experience*

- Null: There is no linear relationship between the RTCI value and an individual's computer understanding and experience.
- Alternate: There is a negative linear relationship between the RTCI value and an individual's computer understanding and experience.

Because computer understanding and experience was measured as a continuous variable, Pearson's correlation test was used. The Pearson correlation for the test of computer understanding and experience was $r = -0.27$ with a p-value of 0.0004, indicating that there is a negative linear relationship between RTCI value and computer understanding and experience. This means that a person with more computer understanding and experience has a lower likelihood of resistance to information technology change and vice versa.

#### *5.3.3.10 Hypothesis 7A: Perceived Past Information Technology Change*

- Null: There is no difference in the mean RTCI value for individuals that perceived an information technology change in the last 12 months vs. individuals that did not perceive an information technology change in the last 12 months.
- Alternate: The mean RTCI value for individuals that did not perceive an information technology change is higher than the mean RTCI value for individuals that did perceive an information technology change.

This hypothesis was tested using a one-sided t-test with two groups: change perceived and no change perceived. This test examined past changes perceived and found that the mean RTCI value for individuals that did not perceive an information technology change was higher than the mean RTCI value for individuals that did perceive an information technology change (p-value = 0.0024).

#### *5.3.3.11 Hypothesis 7B: Perceived Future Information Technology Change*

- Null: There is no difference in the mean RTCI value for individuals that perceived an information technology change in the next 12 months vs. individuals that did not perceive an information technology change in the next 12 months.
- Alternate: The mean RTCI value for individuals that did not perceive an information technology change is higher than the mean RTCI value for individuals that did perceive an information technology change.

This hypothesis was tested using a one-sided t-test with two groups: change perceived and no change perceived. This test examined future changes perceived and found that there is a difference in the mean RTCI value for the two groups (p-value = 0.0016). Those that perceive a future change have a lower mean RTCI value than individuals that do not perceive a future change.

*5.3.3.12 Hypothesis 8: Prediction of RTCI from Demographics*

- Null: No prediction of RTCI is possible from the demographic variables of profession, gender, age, each subset of personality type (S/N, T/F, J/P, E/I), education level, computer understanding and experience, and perceived past and future changes.
- Alternate: A prediction of RTCI is possible from these demographic variables.

A linear regression test was performed to determine if a prediction of RTCI was possible with the following demographic variables: profession, gender, age, each subset of personality type (S/N, T/F, J/P, E/I), education level, computer understanding and experience, and perceived past and future changes. Because many of the variables were categorical and included more than two options, an ANOVA linear model was used instead of a regression model. The results are equivalent in meaning however. Based on this test, prediction of RTCI is possible from these demographic variables (p-value = 0.0006).

**Table 5.5 Summary of Data Analysis for Phase II**

| **Hypothesis Number** | **Null Hypothesis** | **Phase II Result** |
|---|---|---|
| Hypothesis 1 | There is no difference in the mean RTCI value for different professions. | At least one profession has a different mean RTCI value: Management vs. Engineers, Administrators, Construction Tradesmen and Architects vs. Administrators (p-value = 0.0006) |
| Hypothesis 2 | There is no difference in the mean RTCI value for different genders. | Females have a higher mean RTCI value than males (p-value = 0.0380). |
| Hypothesis 3 | There is no linear relationship between the RTCI value and an individual's age. | No linear relationship between RTCI value and age (p-value = 0.6753) |
| Hypothesis 4A | There is no difference in the mean RTCI value for the S vs. N subset of personality type using the Keirsey Temperament Sorter II. | No difference in the mean RTCI value for Sensors vs. Intuitors (p-value = 0.0595). |
| Hypothesis 4B | There is no difference in the mean RTCI value for the T vs. F subset of personality type using the Keirsey Temperament Sorter II. | No difference in the mean RTCI value for Thinkers vs. Feelers (p-value = 0.1596) |

| Hypothesis Number | Null Hypothesis | Phase II Result |
|---|---|---|
| Hypothesis 4C | There is no difference in the mean RTCI value for the J vs. P subset of personality type using the Keirsey Temperament Sorter II. | No difference in the mean RTCI value for Judgers vs. Perceivers (p-value = 0.0606) |
| Hypothesis 4D | There is no difference in the mean RTCI value for the E vs. I subset of personality type using the Keirsey Temperament Sorter II. | No difference in the mean RTCI value for Extroverts vs. Introverts (p-value = 0.1443). |
| Hypothesis 5 | There is no linear relationship between the RTCI value and an individual's education level. | No linear relationship between RTCI value and education level (p-value = 0.0972) |
| Hypothesis 6 | There is no linear relationship between the RTCI value and an individual's computer understanding and experience. | There is a negative linear relationship between RTCI value and computer understanding and experience (p-value = 0.0004) |
| Hypothesis 7A | There is no difference in the mean RTCI value for individuals that perceived an information technology change in the last 12 months vs. individuals that did not perceive an information technology change in the last 12 months. | Individuals that did not perceive a past change have a higher mean RTCI value than those that did perceive a past change (p-value = 0.0024) |
| Hypothesis 7B | There is no difference in the mean RTCI value for individuals that perceived an information technology change in the next 12 months vs. individuals that did not perceive an information technology change in the next 12 months. | Individuals that do not perceive a future change have a higher mean RTCI value than those that do perceive a future change (p-value = 0.0016) |
| Hypothesis 8 | No prediction of RTCI is possible from these demographic variables. | Prediction is possible from these demographic variables (p-value = 0.0006) |

## *5.4 Summary*

This chapter discussed the general methodological steps for Phase II of the study. These steps included: establishing hypotheses, constructing a refined survey instrument, establishing the sampling procedure, preparing a submission for the IRB, collecting data with the refined instrument, analyzing the relationships between social variables and demographics of the individual to identify any relationships that may exist, and creating benchmark statistics for the investigation.

# Chapter 6. Limitations and Discussion of Phase II

Phase II of the research collected data from a 156-person sample of the population using the revised social architecture assessment survey instrument. This data was analyzed using statistical analysis techniques to identify any relationships between an individual's likelihood of resistance (using the RTCI) and their demographics. This resulted in the creation of benchmark statistics for the investigation. This chapter describes the limitations of this phase of the research, as well as providing a discussion of the findings from the statistical analyses performed.

## *6.1 Limitations*

The Phase II limitations are separated into three broad categories: sample limitations, instrumentation limitations, and analysis limitations. Scope limitations of the research project were previously addressed in section 1.5 - *Limitations of the Research*.

### 6.1.1 Sample Limitations

There are five primary limitations in the sampling of Phase II: selection methods, sample size, response rate, internal vs. external validity, and controlling for extraneous variables. Each of these limitations are elaborated further below.

#### *6.1.1.1 Selection Methods*

Selection methods were the first primary limitation of the sampling in Phase II. This phase attempted to select the sample population in a random manner to ensure the greatest generalizability possible. Businesses were selected in a random fashion, as discussed previously in section 5.2.3. Unfortunately, ensuring that individuals within these companies were selected randomly was nearly impossible to accomplish, and even when they were selected randomly, it was impossible to enforce that they were the actual respondent. Consequently, the individuals in the sample population were not entirely random. This lessens the generalizability of the results somewhat, but was unavoidable for a mail survey without a list of the entire population from which to select the random sample.

Because of this limitation, the sample population is somewhat biased. Individuals in the sample were more likely to be persons inclined to fill out surveys and questionnaires, or those that

thought that the research sounded interesting or would be useful to themselves or their business. However, the results still provide a starting point for future studies investigating resistance to information technology change in the AEC industry.

The companies that were contacted through the prescreening phone call were generally dependent upon the receptionist (or other employee) answering the phone. That person was usually the decision-maker as to whether anyone in the company might participate in this phase of the research. This limitation excluded possible participants by the refusal of a single employee in a company.

Despite the fact that the Yahoo! Yellow Pages are supposed to be updated quarterly ("Yahoo!" 2002), many companies listed were no longer in business. Some appeared to go out of business during the data collection period (initial mailings were apparently received, whereas later mailings were returned by the post office). There were a few companies that were listed under the headings used (see section 4.2.2) that, when contacted during the prescreening phone call, denied being an architecture, engineering, or construction company of any sort, leading the researcher to believe that these companies were incorrectly listed in the Yellow Pages. These issues presented limitations to the selection process, as the business listings were obviously not as current as desired. Consequently, some newly formed companies may have been missed altogether, through no fault of the researcher.

Group B participants (those that did not receive a successful prescreening phone call) had a high rate of "return to sender" mailings (44 returned out of 287 mailings = 15.3%), compared with group A which only had 5.2% returned (11 returned of 211 mailings). Group A businesses had their mailing address verified during the phone call, lessening the mailing errors. The group B mailing issues were primarily due to the fact that the Yahoo! Yellow Pages were found to be lacking in accuracy, as discussed above. In some cases, the addresses were incomplete or clearly wrong, and in other cases, the company no longer existed.

The comparisons between the Phase II sample and the industry population (see section 5.2.7.1) indicated a bias towards office, managerial, and supervisory positions within the companies. As

in Phase I, the sample represents the population most likely to directly use new technologies (as defined within this study) when they are implemented, and this was not considered a significant limitation.

*6.1.1.2 Sample Size*

The second primary limitation of the sampling in Phase II was the sample size used. The sample size desired was determined to be 175 individuals (see section 5.2.2 for discussion). The actual sample size achieved was 156 individuals. The desired sample size was based on the largest minimum required sample size; this was from the linear regression analysis. The 175 individuals was determined using assumptions that the Phase II sample would be similar to the Phase I sample. The actual Phase II sample had less categories of profession and education represented and, consequently, the minimum sample size needed was revised to be 147 individuals, which was surpassed.

However, even though the revised minimum sample size was surpassed, none of the statistical analyses had a sample size of 156 – all were lower due to skipped questions by participants. This is addressed further in the section 6.1.3 - *Analysis Limitations*.

*6.1.1.3 Response Rate*

The third primary limitation of the sampling in Phase II was the response rate obtained. The response rate for Phase II was high, especially when compared to typical single mailing survey response rates of 10-15%. At the completion of the Phase II data collection, 443 surveys were distributed (adjusted by removing "return to sender" mailings) and 156 were returned, resulting in a 35.21% response rate. This response rate does not provide any reason for concern.

The response rate was much higher for the group A participants that received a prescreening phone call (47.5%) than for group B participants that did not receive a phone call (25.1%). The additional contact helped to personalize the research and obtained the name of a participant. Because of this, all mailings for group A were addressed to a specific participant, whereas group B mailings were addressed only to the business.

Additionally, group B included those businesses that were not reached by phone – a possible sign of unwillingness or inability to participate. It is also likely that group B included businesses that

were out of the scope of the research project. Some businesses replied informing the researcher of this, but it is assumed that many did not. Group A did not include out of scope businesses because they were eliminated through the prescreening phone call.

Group B also had a slightly higher rate of refusals at 6.3% (18 of 287) vs. group A with 4.3% (9 of 211). This is somewhat misleading however, as there were 56 refusals at the prescreening phone call stage of the research for group A.

Additionally, several participants called the researcher after receiving the thank you postcard and reported that they had not received the initial survey. A replacement initial survey was immediately sent out to these participants. It is unknown how many other surveys may have been lost in the mail and not reported to the researcher.

*6.1.1.4 Internal vs. External Validity*

The fourth primary limitation of the sampling in Phase II was the decision to achieve high external validity and, consequently, low internal validity for this phase of the research.

Internal validity relates to how well extraneous variables are controlled for in the experiment being performed (Trochim 2000). High internal validity means that all or nearly all of the externally possible causes for the relationship can be eliminated as explanations. Internal validity is relevant in studies that are trying to establish a causal relationship. Laboratory experiments tend to have very high internal validity, as the laboratory environment allows for a high degree of control of external forces. The laboratory researcher can have confidence that any relationship found is a causal one.

External validity, on the other hand, is how well the conclusions of the research can be generalized to other groups, in other times, and in other places (Trochim 2000). High external validity means that the results can be generalized to many other situations and groups of people, whereas low external validity means that the results are limited to only specific settings or groups. Laboratory experiments tend to have a very low external validity, as so many extraneous variables are controlled for that the results are no longer generalizable outside of the laboratory.

Internal and external validity compete with each other. A researcher can rule out possible extraneous variables and ensure that any relationships found are causal, but this is at the expense of being able to generalize to a larger population. A researcher can also perform research that is highly generalizable, but the results will not be able to establish any causal relationships, as there is no way to know whether the aspects measured directly affect each other or whether there is some intervening cause that is not being measured. Establishing high validity of either type is legitimate for research; the final decision should be based on the purpose of the research and the type of results desired.

This research began with the idea of providing a broad picture of the industry as a whole, rather than focused pictures of small portions. Several methods were initially proposed for data collection, including organizational case studies, structured interviews, and survey instruments. The survey instrument was ultimately chosen for its ability to provide this broad view.

Survey instruments give the researcher the ability to have a larger geographical coverage for the sample population (Bourque and Fielder 1995), though they may lack in details provided. Because of their design, surveys are limited – no probes, relatively little control for extraneous variables, no experimental situation, and consequently, no causal relationships can be established. This is a high external validity, low internal validity situation.

Case studies and interviews provide a very detailed illustration of a situation, but sacrifice generalizability because of their lack of sample size. They allow for much more control over extraneous variables, as it is possible to probe the individuals in the sample to understand why a particular relationship might or might not occur. Unfortunately, any relationships established are difficult to generalize to the rest of the population, as they tend to be so unique to each individual. This is a low external validity, high internal validity situation.

The decision was made to remain with the survey instrument and provide a high external validity, low internal validity solution. The research does not examine causality, where high internal validity is more useful. Instead, high generalizability was established.

*6.1.1.5 Controlling for Extraneous Variables*

The final primary limitation of the sampling in Phase II was the lack of controlling for extraneous variables. Specifically, the selection process used did not discriminate between sizes of businesses or between specific types of firms.

Controlling for extraneous variables is more common in high internal validity research, but was not immediately ruled out of this research for variables that could easily be controlled – size of business and type of business (architecture, engineering, general building construction, residential building construction, heavy construction, and construction management).

By limiting the sample population to only individuals working for large firms, company size could be controlled for as an extraneous variable, eliminating it as a possible intervening cause of the relationship between the Resistance to Change Index (RTCI) and the demographics of the individual. This was a reasonable option with the consequence of only being able to generalize any results to individuals working in large firms. However, the more important question here was: is this a variable that is worth controlling for? The Phase I data indicated that there was no linear relationship between the RTCI value and an individual's office size or their company size. The Spearman correlation for the test of office size was $r_s = -0.18$ with a p-value of 0.2348 and $r_s = 0.18$ with a p-value of 0.2287 for the test of company size. A visual examination of the scatter plots indicated that there was no obvious relationship of a non-linear type between RTCI and office size or company size either.

Similarly, when examining industry sector in both the office and the company, t-tests revealed no significant relationships, with the exception of companies that had engineering vs. those that did not (p-value = 0.0040 here). Even though this test showed a significant difference in mean RTCI value for the Phase I data, the remaining eleven tests did not, indicating that industry sector in general was not a significant intervening cause of the relationship between the RTCI and the demographics of the individual.

Based on the Phase I data, controlling for office or company size did not appear to be a factor that would influence the final results as there were no relationships between RTCI and size, and

only one of twelve industry sectors showed a relationship. Therefore, neither office nor company size were controlled for in the research.

This was confirmed with the same results when the Phase II data was analyzed. There was no linear relationship between RTCI and office size ($r_s$ = -0.08 with a p-value of 0.3365) or company size ($r_s$ = -0.03 with a p-value of 0.7178). Similarly, there was no difference in the mean RTCI value for the six different industry sectors in either the office or the company using t-tests.

### 6.1.2 Instrumentation Limitations

In addition to the sample limitations, there were seven primary limitations with respect to the instrumentation of Phase II. These included: (1) the length of the survey, (2) the survey was a self-report type, (3) the survey had an unsupervised administration, (4) the survey had questions created by other researchers, (5) the survey had literacy and language limitations, (6) the survey had collection procedure limitations, and (7) there were limitations of the measurements possible from the survey. This section elaborates on each of these limitations.

#### *6.1.2.1 Length of Survey*

The first limitation with respect to the instrumentation of Phase II was the length of the survey. The survey took approximately 20 minutes to complete. While it only required one-third of the time compared to the Phase I survey, it was still considered a long survey by practical standards. This, in turn, might have influenced the willingness of persons to participate. It is not known whether any of the refusals were due to the survey being too long, but it is certainly possible.

#### *6.1.2.2 Self-Report Survey*

The second limitation of the instrumentation was that the survey was a self-report type of instrumentation. This limitation was discussed previously in section 4.4.2.2 for the Phase I survey. The issues discussed there also apply for the Phase II survey.

#### *6.1.2.3 Unsupervised Administration*

The third limitation of the instrumentation was that the survey had an unsupervised administration. The Phase II limitation was very similar to the Phase I limitation discussed in section 4.4.2.3. The Phase I survey was a pretest for this phase, and any issues that seemed to be present were eliminated for the Phase II questionnaire.

One area of concern that did not occur in the Phase I survey was the issue of pages of the survey sticking together. Seven participants missed entire pages of the survey and did not notice doing so, which is definitely a hazard of unsupervised administration. Additionally, there was no way to tactfully inform the participant that they had missed pages and request that they complete those pages on a new survey. Beyond being difficult to achieve, it also might have caused the participants to lose faith in the confidentiality of their responses. Group B participants (no prescreening phone call) were impossible to trace back in this instance, as it was not known who the actual participants were.

Unfortunately, this issue occurred, despite taking every precaution to ensure that there were no issues with the survey and that it was clear and unlikely to cause confusion.

*6.1.2.4 Questions Created by Other Researchers*

Similar to Phase I, the Phase II survey used questions created by other researchers. This limitation was previously discussed in section 4.4.2.4.

*6.1.2.5 Literacy and Language*

The Phase II survey was also subject to the limitations of literacy and language. This phase of the survey was, again, only provided in English, requiring that the respondent be able to read and understand English. It was written at approximately a seventh grade level, requiring a certain level of literacy and vocabulary to adequately understand the questions in the survey instrument.

*6.1.2.6 Collection Procedure*

The collection procedure used for Phase II was dependent upon the U.S. Postal Service for mailings sent to participants and surveys returned by them. It is known that several surveys were lost in the mail. Several participants called the researcher after receiving the thank you postcard and reported that they had not received the initial survey. A replacement initial survey was immediately sent out to these participants. It is unknown how many other surveys may have been lost in the mail and not reported to the researcher.

The multiple contacts used in the collection procedure helped to lessen this limitation by contacting participants several times. The odds of multiple mailings to the same address all

being lost is slim; therefore it was likely that a majority of the mailings reached each participant. However, unless the participant contacted the researcher about missing items, there was no way for the researcher to know that items did not reach their intended destination.

*6.1.2.7 Measurements Possible*

Lastly, as discussed in section 2.1, there was no formal way to precisely measure resistance to information technology change, which limits the assessments possible from the survey instrument. This portion of the research only measured the level of likelihood of resistance using an index created from nine variables that are indicative of resistance to change. There may be other variables that affect resistance to change that were not included. For example, section 1.5.2 discussed the fact that organizational and group aspects were specifically neglected in this research.

### 6.1.3 Analysis Limitations

There were three primary limitations with respect to the data analysis of Phase II: the effects of sample size, significant relationships occurring by chance, and the probability of being selected for the sample. These limitations are elaborated further below.

*6.1.3.1 Effects of Sample Size*

The first limitation of the data analysis of Phase II was the effect of sample size. As mentioned previously in section 6.1.1.2, the actual sample size was 156 individuals. This surpassed the revised minimum sample size of 147 individuals, but still had an effect on one of the statistical analyses because of questions skipped by participants. Table 6.1 shows the desired sample size (desired *n*) for each hypotheses, based on the sample size determined for each type of test (from section 5.2.2), as well as the actual sample size (actual *n*) available for use in the test. As can be seen in the table, hypothesis 8 did not meet the desired sample size of 147 participants. This limits the reliability of any conclusions made from the findings of hypothesis 8 – prediction of RTCI from demographics.

**Table 6.1 Actual *n* vs. Desired *n* for Hypotheses**

| Hypothesis | Test Used | Actual *n* | Desired *n* | OK? |
|---|---|---|---|---|
| 1: Profession | 1-way ANOVA | 142 | 36 | OK |
| 2: Gender | 1-sided t-test | 150 | 102 | OK |
| 3: Age | Pearson's correlation test | 150 | 80 | OK |
| 4A: Personality Type S/N | 1-sided t-test | 140 | 102 | OK |
| 4B: Personality Type T/F | 1-sided t-test | 142 | 102 | OK |
| 4C: Personality Type J/P | 1-sided t-test | 141 | 102 | OK |
| 4D: Personality Type E/I | 2-sided t-test | 138 | 128 | OK |
| 5: Education Level | Spearman's correlation test | 150 | 80 | OK |
| 6: Computer Understanding and Experience | Pearson's correlation test | 150 | 80 | OK |
| 7A: Perceived Past Information Technology Change | 1-sided t-test | 149 | 102 | OK |
| 7B: Perceived Future Information Technology Change | 1-sided t-test | 149 | 102 | OK |
| 8: Prediction of RTCI From Demographics | ANOVA linear regression model | 108 | 147 | Not OK |

*6.1.3.2 Significance Occurring by Chance*

The second limitation of the data analysis in Phase II was the possibility of significant relationships occurring by chance. Twelve tests were performed in the process of testing the hypotheses and six were found to support the alternate hypothesis. One or two of these significant relationships are possible simply by chance (approximately a 5% error rate, since $\alpha = 0.05$). This is simply a hazard of performing many tests on a dataset. The discussion of Phase II results in section 6.2 addresses any specific concerns about the findings of a given hypothesis.

*6.1.3.3 Probability of Being Selected for Sample*

The third limitation of the data analysis in Phase II was the probability of being selected for the sample. Due to the selection process used (see section 5.2.3), not every member of the population had an equal chance of being selected. This was affected by two aspects of the

selection process: the stratification of the businesses into design and construction, and the selection of one person from each chosen business.

Each ZIP code had an equal chance of being selected. Once the ZIP codes were selected, because of the stratification of the businesses, each architecture and engineering firm had a 100% chance of being selected, whereas the contractor and construction manager businesses had only a 20% chance of being selected. Although this portion of the selection process was unequal, the probability of selection was known.

The selection of an individual within each selected business, however, was unequal and, additionally, had an unknown probability. This is due to the fact that the number of employees in each business differed. If only one individual is chosen from each business, the probability of any single person being chosen is inversely proportional to the size of their company.

No adjustments to the statistical analysis were made for the unequal probability of an individual being selected for the sample population. This lowers the generalizability of the results slightly, however.

## *6.2 Discussion of Results*

The primary objective of Phase II of the research was to test the hypothesized relationships between the demographic variables (the left side of Figure 4-8) and the Resistance to Change Index created (the center of Figure 4-8). A discussion of the results of each of the hypotheses follows, along with a summary of the overall results of this phase of the research.

### 6.2.1 Hypothesis 1: Profession

- Null: There is no difference in the mean RTCI value for different professions.
- Alternate: At least one profession has a different mean RTCI value.

This hypothesis was tested using one-way ANOVA with six possible professions: administrator ($n$ = 26), architect ($n$ = 31), construction manager ($n$ = 6), construction tradesman ($n$ = 6), engineer ($n$ = 29), and management ($n$ = 44). A statistical difference was found (i.e., at least one group differs) with a p-value = 0.0006. Tukey's multiple comparison test was used to compare

each group with each of the other groups to determine which groups differ on the mean RTCI value. The only groups found to have statistically different means using this test were Management vs. Engineers, Management vs. Administrators, Management vs. Construction Tradesmen, and Architects vs. Administrators.

Tukey's multiple comparison test results were somewhat misleading in this instance. Because of the fact that the different professions had a different number of people in each group (unequal *n* values – see previous paragraph for actual *n* values in each group), the results are not as one would expect when examining the mean RTCI values of each group. The unequal *n* values cause the Tukey test to provide inexact results. The reader is referred to Appendix I.2 for the full test results from *SAS*®.

To provide another, more useful view of the results, it was helpful to reexamine the data, disregarding the *n* values. Based on the mean RTCI values, the order of the professions from lowest resistance to highest is: management ($\bar{x}$ =3.6929), architects ($\bar{x}$ =3.6993), engineers ($\bar{x}$ =4.1638), construction managers ($\bar{x}$ =4.1707), administrators ($\bar{x}$ =4.2304), and construction trades ($\bar{x}$ =4.5529). Disregarding the *n* values, there are really three distinct groupings of RTCI: (1) management and architects have the lowest likelihood of resistance, (2) engineers, construction managers, and administration have a moderate likelihood of resistance, and (3) construction tradesmen have the highest likelihood of resistance. These groupings were confirmed by a manual Tukey analysis using *n* equals the average of all *n* values.

Both the groupings and the order found match up relatively well with the stereotypes and existing research presented in section 5.3.3.1. Management was expected to have low resistance because they are generally the instigators and/or decision-makers with respect to change. This corresponds well with past research (Strebel 1996). Architects and engineers were expected to have lower resistance than other groups, simply because of their likelihood to have prior exposure to information technology. They followed closely behind the management group in resistance. Construction managers were expected to present moderate resistance – behind architects and engineers – which the data analysis supports. Administrators were expected to have higher resistance due to their low level in the organization; they generally have no say in

the implementation of a new information technology. Their likelihood of resistance fell right after construction managers, closely matching the expectation. Construction tradesmen were the most resistant group based on their mean RTCI value, which also matches up with expectations.

The management and architect groups were very similar in their mean RTCI value. This makes sense because the architecture firms sampled were generally small (83.9% had 20 or less employees in the company) and a majority of the sample were individuals both practicing architecture and serving in management positions in the company. They usually answered the profession questions implying that the architecture portion of their job dominated and were consequently classified as architects by the researcher. There were occasionally other overlaps between categories of professions (i.e., management and engineers). The same procedure was followed and the dominant profession was chosen for the classification used. These did not occur at a level that would influence the remaining results.

### 6.2.2 Hypothesis 2: Gender

- Null: There is no difference in the mean RTCI value for different genders.
- Alternate: The mean RTCI value for females is higher than the mean RTCI value for males.

This hypothesis was tested using a one-sided t-test and found that the mean RTCI value for females is higher than the mean RTCI value for males (p-value = 0.0380). This finding confirms the stereotype that females have a higher resistance than males. However, when investigating the findings further, it appears that the divergence was primarily due to the difference in the person's level in the organization. Males in the sample, as a whole, were higher in the organization than females were. This hypothesis warrants further study to determine whether there is truly a difference between males and females by analyzing a data set that has more equality in the variable level in the organization (LEVORG).

There was no significant difference in any of the other variables making up the RTCI between males and females, including computer attitudes (one-sided t-test, p-value = 0.6679) and computer understanding and experience (one-sided t-test, p-value = 0.5290). The fact that there was no significant difference between the genders for computer attitudes or computer

understanding and experience is contrary to the literature (Dambrot et al. 1985; Heinssen et al. 1987; Hoxmeier et al. 2000; Igbaria and Chakrabarti 1990; Jay 1985; Jordan and Stroup 1982; Potosky and Bobko 1998; Temple and Lips 1989). It is, however, consistent with the idea that the gender gap does not exist anymore in the workplace (Newburger 1999).

### 6.2.3 Hypothesis 3: Age

- Null: There is no linear relationship between the RTCI value and an individual's age.
- Alternate: There is a linear relationship between the RTCI value and an individual's age.

The Pearson correlation for the test of age vs. RTCI was $r = 0.03$ with a p-value of 0.6753, indicating that there is no linear relationship between RTCI value and age. An examination of the scatter plot did not indicate any obvious non-linear trends. This result is contrary to the stereotypes that anticipated a relationship between age and RTCI.

Age was found to have a statistically significant negative relationship with computer attitudes (i.e., older persons have less favorable computer attitudes and vice versa), however (Pearson's correlation test, $r = -0.32$, p-value $< 0.0001$), which is consistent with the literature (Igbaria and Parasuraman 1989). Age also had a statistically significant negative relationship with computer understanding and experience (Pearson's correlation test, $r = -0.42$, p-value $< 0.0001$), contrary to the lack of findings in previous research (Potosky and Bobko 1998).

These findings imply that although a linear relationship between age and RTCI was not found, there is a relationship between age and variables specifically relating to information technology attitudes and usage. These relationships do match stereotypes of younger workers being more receptive to and knowledgeable about computer technologies than older workers.

### 6.2.4 Hypothesis 4A: Personality Type (S/N)

- Null: There is no difference in the mean RTCI value for the S and N subsets of personality type using the Keirsey Temperament Sorter II.
- Alternate: The mean RTCI value for the S subset of personality type is higher than the mean RTCI value for the N subset of personality type.

This hypothesis was tested using a one-sided t-test with two groups: S vs. N (sensing vs. intuition). The test found that there is not a significant difference in the mean RTCI value for Sensors vs. Intuitors (p-value = 0.0595). Sensors do not have a higher mean RTCI value than do Intuitors.

This was contrary to the expectation that S would have a higher resistance than N because S prefers established routines, whereas N sees the possibilities of new situations (Wankat and Oreovicz 1993). It is a reasonable conclusion, however, as Sensing types are also realistic and practical, which may help with their acceptance of a change that they believe is necessary or useful to them. Based on these results, a person's preferred method for gaining information does not directly influence their likelihood of resistance to information technology change.

This hypothesis warrants further study, due to the fact that it barely accepted the null hypothesis. There may actually be a relationship between the S/N subset of personality type and the RTCI value that was not discovered with this analysis.

### 6.2.5 Hypothesis 4B: Personality Type (T/F)

- Null: There is no difference in the mean RTCI value for the T and F subsets of personality type using the Keirsey Temperament Sorter II.
- Alternate: The mean RTCI value for the F subset of personality type is higher than the mean RTCI value for the T subset of personality type.

This hypothesis was tested using a one-sided t-test with two groups: T vs. F (thinking vs. feeling). This test found that there is no difference in the mean RTCI value for the F subset of personality type vs. the T subset (p-value = 0.1596). This test clearly accepted the null hypothesis; Feelers do not have a higher mean RTCI value than do Thinkers.

This result was contrary to the expectation that F would have a higher resistance than T because T is very logical and impartial when making decisions and F evaluates a situation based on intuition and subjective values (Wankat and Oreovicz 1993). Based on these results, a person's preferred method of decision-making does not directly influence their likelihood of resistance to information technology change.

### 6.2.6 Hypothesis 4C: Personality Type (J/P)

- Null: There is no difference in the mean RTCI value for the J and P subsets of personality type using the Keirsey Temperament Sorter II.
- Alternate: The mean RTCI value for the J subset of personality type is higher than the mean RTCI value for the P subset of personality type.

This hypothesis was tested using a one-sided t-test with two groups: J vs. P (judging vs. perceiving). This test found that there is no difference in the mean RTCI value for the Judging subset of personality type vs. the Perceiving subset of personality type (p-value = 0.0606).

Again, the result was contrary to expectations that J would have a higher resistance than P because J lives life in a very planned and orderly manner with a desire to control events, whereas P prefers spontaneity and adapts well to new situations (Wankat and Oreovicz 1993). Based on these results, a person's preferred method of dealing with the outside world does not directly influence their likelihood of resistance to information technology change.

This hypothesis warrants further study, because it was very close to accepting the null hypothesis. There may actually be a relationship between the J/P subset of personality type and the RTCI value that was not discovered with this analysis.

### 6.2.7 Hypothesis 4D: Personality Type (E/I)

- Null: There is no difference in the mean RTCI value for the E and I subsets of personality type using the Keirsey Temperament Sorter II.
- Alternate: There is a difference in mean RTCI value for the E and I subsets of personality type.

This hypothesis was tested using a two-sided t-test with two groups: E vs. I (extrovert vs. introvert). This test found that there was no difference in the mean RTCI value for Extroverts vs. Introverts (p-value = 0.1443). This matched the expectation that there would be no difference in RTCI value between extroverts and introverts. A person's preferred focus of attention and energy does not directly influence their likelihood of resistance to information technology change.

### 6.2.8 Hypothesis 5: Education Level

- Null: There is no linear relationship between the RTCI value and an individual's education level.
- Alternate: There is a negative linear relationship between the RTCI value and an individual's education level.

The Spearman correlation for this test was $r_s = -0.11$ with a p-value of 0.0972, indicating that there is not a statistically significant negative correlation between RTCI value and education level.

The results of this test are contrary to expectations of a negative correlation between education and resistance to information technology change. Upon further examination of the data, there is a positive correlation between computer understanding and experience and education level (Spearman's correlation test, $r_s = 0.40$ with a p-value $< 0.0001$), which certainly provides a basis for the idea that a person with more education has more computer knowledge and experience. There is also a positive correlation between computer attitudes and education level (Spearman's correlation test, $r_s = 0.22$ with a p-value of 0.0035), indicating that a person with more education has more favorable attitudes regarding computers. However, neither of these provide support for the hypothesis presented.

While a person with less education is likely to have less computer knowledge and experience, and have a less favorable attitude about computers, their response to information technology changes in general appears to be no different from that of persons with more education. These negative aspects of resistance to information technology change found in individuals with less education are compensated by other variables, balancing out their likelihood to resist.

### 6.2.9 Hypothesis 6: Computer Understanding and Experience

- Null: There is no linear relationship between the RTCI value and an individual's computer understanding and experience.
- Alternate: There is a negative linear relationship between the RTCI value and an individual's computer understanding and experience.

The Pearson correlation for the test of computer understanding and experience was $r = -0.27$ with a p-value of 0.0004, indicating that there is a negative linear relationship between RTCI value and computer understanding and experience. This means that a person with more computer understanding and experience has a lower likelihood of resistance to information technology change and vice versa.

This finding is consistent with stereotypes and a majority of past research studies (Dambrot et al. 1985; Gardner et al. 1993; Heinssen et al. 1987; Igbaria and Chakrabarti 1990; Levine and Donitsa-Schmidt 1997; Loyd and Gressard 1984a).

### 6.2.10 Hypothesis 7A: Perceived Past Information Technology Change

- Null: There is no difference in the mean RTCI value for individuals that perceived an information technology change in the last 12 months vs. individuals that did not perceive an information technology change in the last 12 months.
- Alternate: The mean RTCI value for individuals that did not perceive an information technology change is higher than the mean RTCI value for individuals that did perceive an information technology change.

This hypothesis was tested using a one-sided t-test with two groups: change perceived and no change perceived. This test examined past changes perceived and found that the mean RTCI value for individuals that did not perceive an information technology change was higher than the mean RTCI value for individuals that did perceive an information technology change (p-value = 0.0024).

This result matches the expectation that a person who perceived a past change would have a lower resistance than a person who did not perceive a past change. This may, in fact, be due to the person experiencing an information technology change and discovering that it was not as bad as they might have imagined and/or it was handled well. People who did not experience a past change did not have a positive experience to base their judgments on and therefore may assume the worst.

### 6.2.11 Hypothesis 7B: Perceived Future Information Technology Change

- Null: There is no difference in the mean RTCI value for individuals that perceived an information technology change in the next 12 months vs. individuals that did not perceive an information technology change in the next 12 months.
- Alternate: The mean RTCI value for individuals that did not perceive an information technology change is higher than the mean RTCI value for individuals that did perceive an information technology change.

This hypothesis was tested using a one-sided t-test with two groups: change perceived and no change perceived. This test examined future changes perceived and found that there is a difference in the mean RTCI value for the two groups (p-value = 0.0016). Those that perceive a future change have a lower mean RTCI value than individuals that do not perceive a future change.

This result matches the expectation that a person who perceives a future change will have a lower resistance than a person who does not perceive a future change. If a person is aware of an upcoming change, they are able to mentally prepare for the change, decreasing their potential resistance. This finding supports previous research that advance notification of a change is positively related to attitudes toward new information technology (Haddad 1996).

### 6.2.12 Hypothesis 8: Prediction of RTCI from Demographics

- Null: No prediction of RTCI is possible from the demographic variables of profession, gender, age, each subset of personality type (S/N, T/F, J/P, E/I), education level, computer understanding and experience, and perceived past and future changes.
- Alternate: A prediction of RTCI is possible from these demographic variables.

A linear regression test was performed using an ANOVA linear model to determine if a prediction of RTCI was possible with the following demographic variables: profession, gender, age, each subset of personality type (S/N, T/F, J/P, E/I), education level, computer understanding and experience, and perceived past and future changes. Based on this test, prediction of RTCI is possible from these demographic variables (p-value = 0.0006).

This finding supports prediction of resistance using linear regression based on the demographics measured. This is an important first step in the creation of prediction models. By establishing that a linear regression model is possible with the demographics collected, the research can progress in a forward fashion without the need to significantly reevaluate the measures that will be useful for prediction. Further regression analysis will be left for future research, however.

Unfortunately, the actual sample size available for this hypothesis test was not as large as it should have been (147 needed vs. 108 actual). This causes the result to be suspect and the analysis should be repeated with a larger dataset to confirm this finding.

#### 6.2.13 Overall Summary of Phase II Results

The demographics that indicate high likelihood of resistance to information technology change, based on the analysis, are gender (female), computer understanding and experience (low), past information technology changes (none experienced), future information technology changes (not aware of any planned), and profession (construction trades). If an individual fits into any one of these demographic groups, they are more likely to resist information technology changes than individuals who are not a member of any of these groups.

If an individual fits into two or more of these groups, it is expected that their likelihood of resistance would be higher than an individual only fitting into one group. This hypothesis will be left for future research investigating the prediction of resistance to technological change, however.

The demographics that indicate low likelihood of resistance to information technology change, based on the analysis, are gender (male), computer understanding and experience (high), past information technology changes (at least one experienced), future information technology changes (aware of at least one planned), and profession (management or architect). If an individual fits into any one of these demographic groups, they are less likely to resist information technology changes than individuals who are not a member of any of these groups.

If an individual fits into two or more of these groups, it is expected that their likelihood of resistance would be lower than an individual only fitting into one group. This hypothesis will also be left for future research investigating the prediction of resistance to technological change.

Interestingly, none of the personality type hypothesis accepted the alternate. This implies that personality type is not an important factor in understanding an individual's likelihood of resistance to technological change. Two of the hypotheses were very close to accepting the alternate and additional research should be performed to be certain that personality type is not an important factor in understanding individual's resistance.

In addition, neither age nor education level accepted the null hypothesis. This implies that they are not important factors in understanding likelihood of resistance to information technology change either. However, each of these variables had a relationship with computer understanding and experience. Computer understanding and experience accepted the alternate hypothesis; there is a relationship between computer understanding and experience and RTCI. This suggests that computer understanding and experience is an intervening variable between age and RTCI, as well as between education level and RTCI. Table 6.2 provides a summary of the Phase II results.

**Table 6.2 Overall Summary of Phase II Results**

| **Low RTCI for Information Technology Changes** | **High RTCI for Information Technology Changes** | **No Difference/No Relationship with RTCI for Information Technology Changes** |
|---|---|---|
| Management, Architect | Construction Trades | Age |
| Male | Female | Personality Type (S/N) |
| High Computer Understanding & Experience | Low Computer Understanding & Experience | Personality Type (T/F) |
| | | Personality Type (J/P) |
| Perceived Past Information Technology Change | No Perceived Past Information Technology Change | Personality Type (E/I) |
| Perceived Future Information Technology Change | No Perceived Future Information Technology Change | Education Level |

## *6.3 Summary*

This chapter discussed the limitations of Phase II of the study. These limitations included sample limitations, instrumentation limitations, and analysis limitations. This chapter also provided a discussion of the results of each hypothesis and a summary of those results.

# Chapter 7. Conclusions

The Phase I social architecture assessment survey provided a satisfactory method of determining which factors and variables should remain in the social architecture factor model and be included in the refined assessment survey. Much was learned in the process of data collection and analysis that enabled the Phase II study to proceed in a smooth and efficient manner. The Phase II study examined a number of hypotheses to determine whether any relationships existed between different demographics of the individual and their likelihood of resistance to information technology change. The data analysis found several demographic groups that were different in their likelihood of resistance, including profession, gender, computer understanding and experience, and awareness of past or future IT changes occurring in their company.

The remainder of this chapter identifies contributions to the body of knowledge, suggests recommendations for future research, and presents a summary of the research project.

## *7.1 Contributions to the Body of Knowledge*

This research contributes to the body of knowledge in several ways. The research contributions include both theoretical and practical contributions. While the practical contributions (i.e., the findings from the hypotheses) are specific to the architecture, engineering, and construction industries, the theoretical contributions are applicable to other industries that wish to improve their success in introducing new information technology changes. The remainder of this section discusses the specific contributions this research makes to the body of knowledge.

To begin, the importance of cultural issues for technological implementation is well documented, yet predominantly unresearched within the building and construction industry (Cleveland 1999; Ford et al. 2000; Mitropoulos and Tatum 2000; O'Brien 2000; Songer et al. 2001; Thorpe and Mead 2001; Todd 1996). This research study contributes to the body of knowledge by serving as an exploratory study investigating how individuals are likely to react to information technology implementation in the AEC industry. This study provides a foundation for more definitive investigations.

Second, the social architecture factor model presented in Chapter 3 (Figure 3-2) adds to the body of knowledge by providing a framework for investigating individuals' resistance to information technology change. This framework was established through a literature review identifying aspects that affect an individual encountering an information technology change. This framework can be used for additional research in the AEC industry investigating individuals' resistance to information technology change. It is also applicable to other industries that wish to improve their success in implementing new technology changes.

Next, the research expands upon the view of resistance to change as represented in the literature. The studies referenced in the creation of the social architecture factor model represent one, or occasionally two, possible facets of resistance to change. This study uses nine different indicator variables in the creation of the RTCI to provide a more balanced representation of resistance to change than provided in previous studies. Similar to the notion of having multiple questions in a survey to represent a concept rather than just one question, this research uses multiple theories about resistance to change and provides a much truer picture of an individual's resistance to change. This eliminates the reliance of determining resistance based on a single factor and instead looks at an average of many factors. Consequently, this research enhances the reliability of previous work.

Additionally, the information gained from the hypothesis tests adds to the body of knowledge by providing the industry with a better picture of which individuals are likely to resist information technology change (construction tradesmen, females, those with low computer understanding and experience, those that did not experience an information technology change in the past, and those that do not anticipate an information technology change in the future). By providing an opportunity for businesses to quickly identify individuals that are likely to resist a new information technology during its implementation, they can then begin to alter their change processes to reflect the concerns of these individuals. Without being able to identify these persons with any certainty, the change process tends to be hit or miss, and as evidenced by the poor implementation rates within the AEC industry, it is mostly misses. This research provides a starting point for bettering this change process – identifying the individuals. It also provides a preview of the next step, which is being able to predict these individuals from readily available

demographic information. The data collected in Phase II of the research supports the creation of a prediction model through regression analysis techniques, though the actual creation is left for future research.

Finally, the information gained from hypothesis tests that indicated no differences between demographic groups is also a valuable contribution. This information adds to the body of knowledge by providing sound research that can help to debunk stereotypes that currently exist within the AEC industry with respect to information technology implementation. For example, Hypothesis 3 investigated the possibility of a linear relationship between RTCI value and age. Based on stereotypes, one would expect to find a linear relationship in which younger persons have a lower likelihood for resistance and older persons have a higher likelihood for resistance. The Phase II data did not support this stereotype, and found that there is no linear relationship at all (Pearson correlation test, $r = 0.03$, p-value = 0.6753).

## *7.2 Recommendations for Future Research*

While this research has made many contributions to the AEC industry, as well as contributions of a theoretical nature to other industries interested in improving their success rate of introducing new technologies, there are also many possibilities for extending this work. These extensions can occur in three main areas: expansion of resistance to information technology change research in individuals, extension to organizations and groups, and extension to predicting resistance and creating change models.

### 7.2.1 Expansion of Resistance to Information Technology Change Research in Individuals

The first main area in which to extend the current research is an expansion of resistance to information technology change research in individuals. There are a number of topics that would be helpful in understanding individuals' resistance to information technology change that were not addressed in this research. Topics where the research actually performed could be improved are discussed first, followed by topics that were specifically excluded from this research.

Two of the hypotheses, age (hypothesis 3) and education level (hypothesis 5), were found to have no linear relationship with RTCI. These hypotheses should be expanded to include other,

more sophisticated data analysis techniques that will establish whether non-linear relationships exist.

Hypothesis 2, examining relationships between gender and RTCI, showed that females were more resistant than males, but this appeared to be a result of females in the sample generally holding lower positions in their organizations than the males in the sample did. This warrants further study to determine whether there is truly a difference between males and females by analyzing a data set that has more equality in the variable *level in the organization* (LEVORG).

Two hypotheses (4A and 4C) barely accepted the null hypothesis. There may actually be relationships between the S/N and/or J/P subsets of personality type that were not strong enough in this sample to show a significant relationship with RTCI. More data should be collected to confirm the accuracy of these results.

Hypothesis 8, prediction of RTCI from demographics, is suspect because the actual sample size for the analysis was not as large as it should have been (147 needed vs. 108 actual). The analysis should be repeated with a larger dataset to confirm the accuracy of this finding.

Phase II of the research should be repeated several times with different samples to confirm (or deny) the findings of this research. This is useful even though a majority of the hypotheses were consistent with previous research in other industries. Repeating the Phase II methodology a number of times will provide reliability and help reduce the impact of some of the limitations, such as significance occurring purely by chance. Repeatability of results is an important aspect that also validates the method used.

Other areas of individual's resistance to information technology change should also be explored. This research did not make a distinction between positive resistance and negative resistance, did not address the cause of resistance, and did not identify the manifestation of resistance. It also did not identify the timing of an individual adopting a technology or measure delayed resistance. These aspects would be best investigated using longitudinal case studies focusing on individuals as they move through the entire change process, beginning prior to the first introduction of an

information technology change and continuing until after the change has been well established. From these long-term case studies, much could be learned about how an individual changes and why they behave the way they do during the change. Although the information gathered from case studies would not be generalizable to the larger industry, it would provide valuable insight that could be used when predicting resistance and creating change models.

It is impossible to completely separate individuals from their respective organization. The culture of a workplace will have some influence on individuals and their attitudes, beliefs, and fears about information technology changes, especially if the changes will potentially affect their job. This, in turn, can affect their resistance to IT change. Phase I of the research included several possible aspects of the organization that can influence the resistance of individuals, including the resources available during the change, rewards and punishments used during the implementation, their perceived support for change from the organization, and the level of their investment in their job. During the variable reduction stage, a majority of these aspects were eliminated and not included in Phase II. It would be useful to investigate how much influence an organization and its culture really have on an individual's attitudes, beliefs, and fears about information technology changes. This would be best investigated with longitudinal case studies following individuals as their organization implements an information technology change. The results would not be generalizable to the rest of the industry, but would still provide worthwhile information about the influence organizations have on individuals.

### 7.2.2 Organizations and Groups

The second main area in which to extend the current research is a broadening of resistance to information technology change research to organizations and groups. This research was limited to technological change as it relates to individuals within the AEC community. Organizations and groups, such as inter-organizational project teams, were outside of the scope of this research project with the exception of the collection of some demographic information about the organization that employs an individual. However, organizations and groups certainly influence individuals' attitudes, beliefs, and fears, which in turn can influence reactions to change. Individuals were chosen for the current research, instead of groups or organizations, because individuals are the building blocks making up groups and organizations and it was important to understand them first. With the foundation laid, organizations and groups are an important

extension of the current research. Figure 7-1 illustrates this portion of the recommended future research.

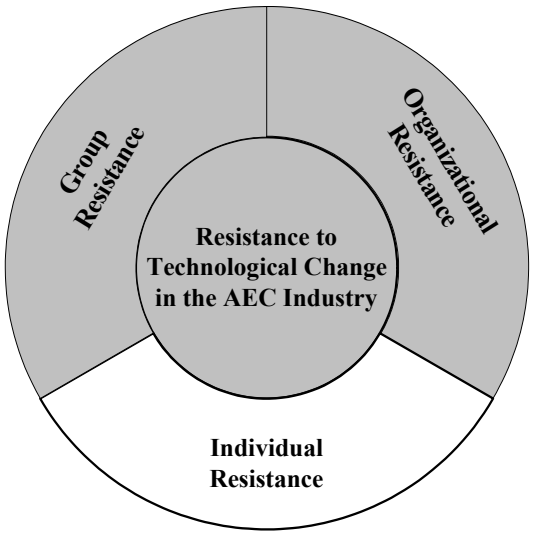


**Figure 7-1 Future Research – Organizational Resistance and Group Resistance**

Figure 7-2 presents the first step that should be taken when looking at organizational and group resistance – understanding the resistance variables present. The original social architecture factor model (Figure 3-2) provides a starting point for this research extension.

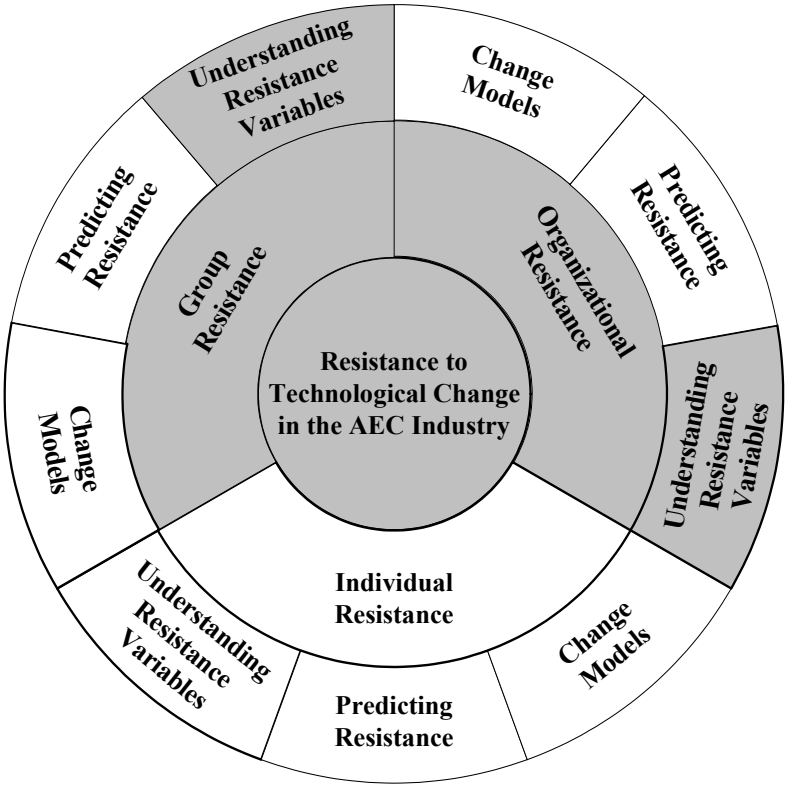


**Figure 7-2 Future Research – Understanding Resistance Variables for Organizations and Groups**

### 7.2.3 Predicting Resistance and Creating Change Models

The third main area in which to extend the current research is an extension of resistance to information technology change research to predicting resistance and creating change models. This area could be extended to predict resistance and create change models for individuals based on the current research (see Figure 7-3). Once that was completed, prediction and change models could be achieved for organizations and groups (see Figure 7-4). This plan for extension of resistance to information technology change research is based on the idea that individual, organizational, and group resistance should be investigated separately, with separate predictive tools and change models at the research completion. This plan would be appropriate if the knowledge gained from the expansion of resistance to information technology change research for individuals, and the understanding of resistance variables for organizations and groups indicated that separate prediction tools and change models were appropriate.

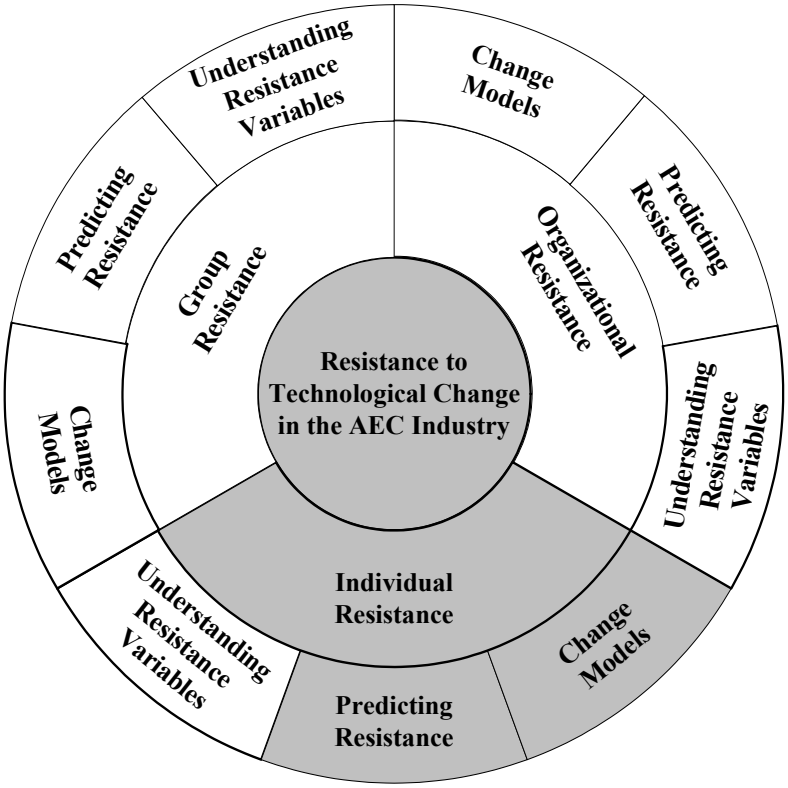


**Figure 7-3 Future Research – Predicting Resistance and Creating Change Models for Individuals**

Alternatively, prediction of resistance and the creation of change models may be more appropriate to investigate with individuals, organizations, and groups combined. This would potentially result in a single prediction tool and a single change model for implementing new information technology changes in a successful manner. This could be illustrated conceptually by combining the shaded areas of Figure 7-3 and Figure 7-4.

Regardless of whether individuals, organizations, and groups are treated separately or together, the basic steps involved in predicting resistance and creating change models are the same. The predictive tool(s) created should go beyond the ability to simply predict likelihood of resistance in order to be a truly meaningful tool. It is expected, based on the current research, that prediction will involve one or more regression equations that use known, factual type information – ideally, information that is easily obtained and measured. The results of future research will ultimately determine that, however.

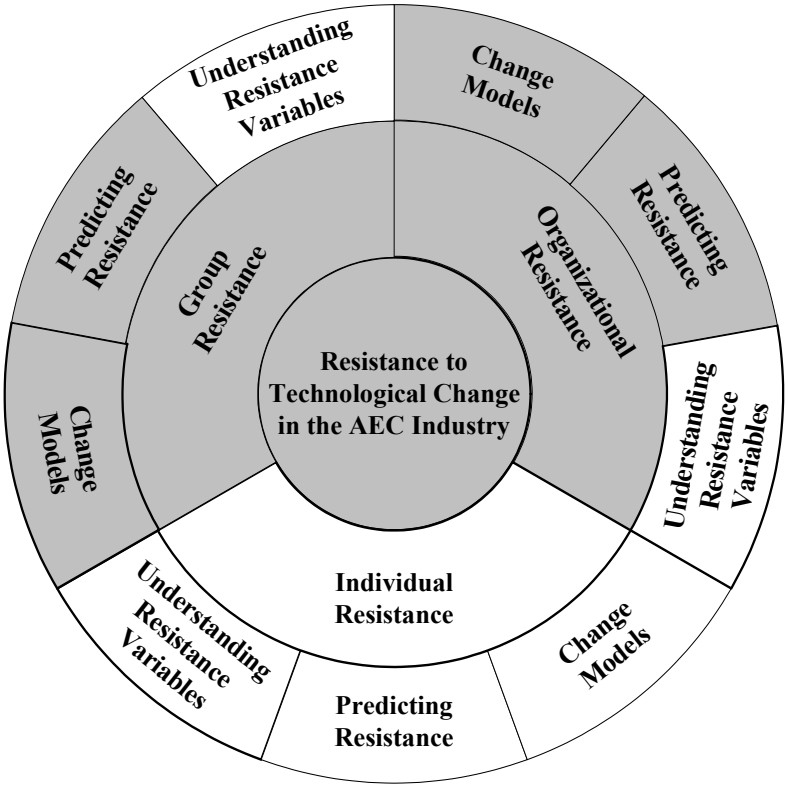


**Figure 7-4 Future Research – Predicting Resistance and Creating Change Models for Organizations and Groups**

Once a predictive tool is created, verification of the tool is necessary. Numerous tests of the tool, both before and after changes, should be performed to determine the adequacy and accuracy of the predictions. If necessary, the predictive tool should be revised until a satisfactory level of predictability is obtained.

Once a satisfactory predictive tool has been established, change models should be created to institutionalize a successful information technology change procedure. The first step in creating the change model is an extensive literature search to discover all of the successful and unsuccessful change models that may already exist in any industry. This search may provide some viable techniques to test in the AEC industry. Combining the knowledge from the literature search with the predictive tool, change models should be created and then tested multiple times to determine their validity. The information technology change models created should be revised as necessary to obtain a satisfactory level of success.

## *7.3 Summary of Research*

To summarize, this research set out to achieve several objectives:

- To isolate attitudes, fears, and beliefs that are indicative of resistance to information technology change within the AEC industry.
- To estimate the intensity of resistance an individual is likely to exhibit using the personality traits and behavioral characteristics identified.
- To identify any variances that exist between different demographic groups based on the estimates of intensity of resistance likely to be exhibited.
- To provide sound research that can help to debunk stereotypes that currently exist within the AEC industry with respect to information technology implementation.

A social architecture factor model associated with impeding/promoting use of technologies was created based on the literature review of change management theory on resistance to change and attitude-behavior connections. In Phase I of the research, the attitudes, fears, and beliefs included in the original model were reduced to a smaller number of variables indicative of resistance to information technology change and a revised social architecture factor model was created. This was based on data collected from a 50-person sample of the AEC population. At the conclusion of Phase I, a Resistance to Change Index (RTCI) was created, enabling estimations of the intensity of resistance an individual is likely to exhibit using the personality traits and behavioral characteristics identified in the revised social architecture factor model.

Phase II of the research investigated relationships between the RTCI and demographics of the individual using a 156-person sample of the AEC population. This phase of the research determined whether different demographic groups within the AEC population exhibited differences in their RTCI. The data analysis found several demographic groups that were different in their likelihood of resistance, including profession, gender, computer understanding and experience, and awareness of past or future changes occurring in their company.

Age and education level were expected to have relationships with RTCI, based on industry stereotypes. The data analysis found that these stereotypes have no scientific basis. Two other

stereotypes, gender and computer understanding and experience, were supported by the data analysis, however.

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# Appendix C. Institutional Review Board Submission for Phase I

## *C.1 Request for Exemption*

# Form 3 - EXEMPT

IRB Proposal Review #:_____

### Request for Exemption of Research Involving Human Subjects

[please print or type responses below]

Investigator(s): Kirsten A. Davis Faculty Advisor Dr. Anthony Songer

Department(s): Civil & Environ. Eng. Mail Code: 0105 E-mail: kidavis2@vt.edu Phone 961-4728 (home)

Project Title: Understanding Technological Change # of Human Subjects ±100

Source of Funding Support: X Departmental Research ____ Sponsored Research (OSP No.:_____)

[ ] All investigators of this project are qualified through completion of the formal training program or web-based training programs provided by the Virginia Tech Office of Research Compliance.

***Note:*** To qualify for Exemption, the research must be (a) of minimal risk to the subjects, (b) must not involve any of the special classes of subjects, and (c) must be in one or more of the following categories. A full description of these categories may be found in the Exempt Research section of the Virginia Tech "*IRB Protocol Submission Instructions Document* or in the federal regulations [45 CFR 46.101(b)(1-6)]. (http://ohrp.osophs.dhhs.gov/humansubjects/guidance/45cfr46.htm#46.101)

*Please mark/check the appropriate category or categories below which qualify the proposed project for exemption:*

[ ] 1. Research will be conducted in established or commonly accepted educational settings, involving normal educational practices [see item (1), page 6 of the "Instructions" document].

[X] 2. Research will involve the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures or observation of public behavior, **unless** the subjects can be identified directly or through identifiers linked to the subjects **and** disclosure of responses could reasonably place the subjects at risk or criminal or civil liability or be damaging to the subjects' financial standing , employability or reputation [see item (2), page 6 –"Instructions"].

[ ] 3. Research will involve the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures, or observation of public behavior that is not exempt under item 2) above **if** the subjects are elected or appointed public officials or candidates for public office; **or** Federal statute(s) require(s) that the confidentiality or other personally identifiable information will be maintained [see item (3), page 6 of the "Instructions" document].

[ ] 4. Research will involve the collection or study of existing data, documents, records, pathological specimens, or diagnostic specimens if these sources are publicly available or if the information is recorded by the investigator in such a manner that subjects cannot be identified directly or through identifiers linked to the subjects [see item (4), page 7 of the "Instructions" document].

[ ] 5. Research and demonstration projects designed to study, evaluate, or otherwise examine public benefit or service programs, procedures for obtaining benefits or proposed changes in such programs [see item (5), page 7 of the "Instructions" document].

[ ] 6. Taste and food quality evaluation and consumer acceptance studies [see item (6), page 7- "Instructions].

| | | |
|---|---|---|
| [redacted] | Kirsten A. Davis | 6/19/02 |
| Investigator(s) | Print name | Date |
| [redacted] | William R Knocke | 6/19/02 |
| Departmental Reviewer | Print name | Date |
| Chair, Institutional Review Board | | Date |
| [redacted] FACULTY ADVISOR | Anthony D. Songer | 6/19/02 rev. 3/30/01 |

## C.2 Protocol

# Protocol
# Understanding Technological Change

**Justification of Project**

Ever increasing technological capabilities exist in the architecture/engineering/construction (AEC) industry. Email, project specific websites, Computer Aided Drafting (CAD), and animations are but a few technologies adopted in recent years within the industry. The change methods used in the adoptions suggest a focus on technology, yet the technology itself is seen as a primary barrier to successful implementation. Fig. 1 illustrates technology centered change models.

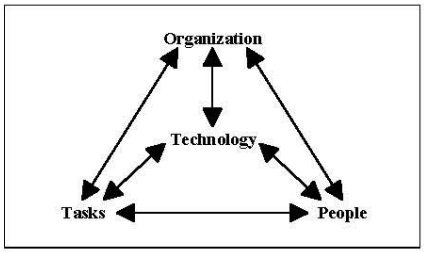


**Fig. 1.** **Technology is central to change** (Adapted from Sutton and Sutton 1990)

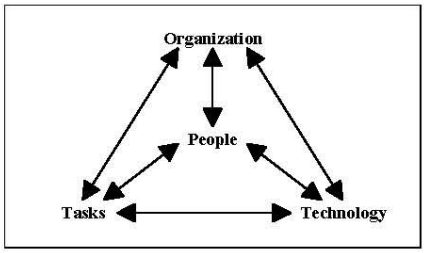


**Fig. 2.** **People are central to change** (Leavitt 1958 as adapted by Sutton and Sutton 1990)

In general, the AEC industry is extremely slow to embrace available technology. Executives often delay investing in new technologies, hoping that the rate of technological growth will stabilize. According to Moore's Law, stabilization is unlikely to occur soon (Hayes and Jaikumar 1988). The hesitation in adoption originates because technology is the driver of change, rather than an enabler of change. Therefore, technology focused change models are inappropriate to ensure successful technology implementation in the AEC industry.

Historically, changes in technologies and the inventions of new machines alter the skill requirements, tasks, and relationships among workers. Improvements in industrial technologies profoundly changed organizations (Kingsford 1964). Examples of significant changes are not limited to a single industry. The telephone, while initially thought to be only for the elite, has changed global communication. The Internet, first thought of as a curiosity of academics and government researchers, is fundamentally changing the global economy.

The importance of cultural issues for technological implementation is well documented, yet predominantly unresearched within the building and construction industry (Cleveland 1999; Ford et al. 2000; Mitropoulos and Tatum 2000; O'Brien 2000; Songer et al. 2001; Thorpe and Mead 2001; Todd 1996). Technological changes will not be successful until researchers develop a fundamental understanding of how people change and why they react the way they do. Therefore, studying individuals and their change processes is essential to successful implementation of technology change.

Fig. 2 illustrates a people focused model for technological change. This model places technology in a change enabling position rather than being a driver of change. Using a people centered paradigm for developing technology implementation models is the primary intent of this research.

This research investigates individuals' resistance to change brought about by new technology implementation in the AEC industry. Through relevant theories, potentially influential attitudes, beliefs, and fears towards technological change have been identified, as have potentially significant demographic characteristics of the individuals. Additionally, characteristics of the change itself and the individual's reactions to it have been noted.

Using the factors determined from above, a model of social architecture factors associated with impeding/promoting use of technologies was constructed. This model serves as a framework for the larger investigation into individual resistance and the creation of a social architecture assessment instrument for measuring individual factors.

The broad categorical measures indicative of individuals' resistance to change represented in the model are: type and scope of change; method and speed of introduction; demographics of individual; attitudes, beliefs, and fears of individual; and demographics of organization.

The social architecture factor model identifies 34 factors associated with technological change within the AEC industry. This initial research effort will collect data from a small sample of the population in an attempt to discover the most significant factors. The results of this effort will be analyzed using statistical analysis to examine patterns and relationships of the variables to determine whether the measures can be reduced to a smaller number of factors. A refined social architecture assessment survey for measuring individual factors will be the product of this step of the research.

**Procedures – Pilot Study**

A survey will be conducted using a researcher-developed questionnaire. The questionnaire is predominantly a compilation of existing measures identified through the literature review that are believed to be potentially significant.

The sample population consists of English-speaking architecture, engineering, contractor, and construction management organization employees. The research includes all sizes of organizations, from sole proprietorships to 1000+ employee firms within the AEC industry. Additionally, all positions and all levels within an AEC organization are included in the population because technological changes in the industry can affect all employees within an organization. No employees will be chosen that are under the age of 18.

The initial survey sample will rely on quota sampling to ensure that enough data from each stratum of interest is obtained. Strata of interest include company size, industry sector, and profession, age, and gender of the individual. It is anticipated that the total sample size will be approximately 100 individuals. This non-probability sampling method is appropriate to determine whether a given factor warrants further study or not (Henry 1990). Employees working for companies with offices located in a 50-mile radius (approximately) of Blacksburg, VA will be targeted for this initial survey.

Companies will be contacted to request participation of some or all of their employees during business hours. For those companies granting permission, a time to perform a group administration at their office will be scheduled. Additionally, a flyer will be delivered to all employees in that company, giving a brief overview of the research project and requesting their attendance at the group administration. At the scheduled time, participants will be given a cover letter introducing the research study, an informed consent form, and the questionnaire, along with an envelope in which to place the completed questionnaire. The total time involved for participants is approximately one hour to complete the questionnaire.

**Procedures – Full Study**

The refined survey will use multi-stage cluster sampling and the sample size will be as required to obtain statistically significant results.

**Risks and Benefits**

No risks or hazards have been identified with this research. Benefits to the individual are limited to individual change profiles for those persons requesting one. Company benefits are limited to company change profiles for those firms requesting one. Benefits are predominantly to the industry as a whole, in providing a better understanding of how individuals within the AEC industry react to technological change.

**Confidentiality/Anonymity**

All data collection and analysis will be conducted with strict confidentiality. Questionnaires will have identification numbers assigned by the primary investigator. These numbers will be associated with the respondent's name and home address only for those individuals requesting an individual change profile. The respondent's name and

address will be destroyed once the individual profile is forwarded to them. The respondent's home address will be used instead of their work address to help ensure that strict confidentiality is met.

The identification numbers will also be associated with the respondent's company name and address for those organizations requesting a company change profile. The company name and address will be destroyed once the company profile is forwarded. Company profiles will only include aggregate data where sample sizes are adequate to ensure confidentiality of individual respondents.

The identification numbers will also be used to track individuals in order to limit unnecessary contacts. Once an individual has returned their survey, their number will be deleted from future attempts.

The primary investigator will have access to the personal data. Subjects' names, addresses, company names, and locations will never be associated with the responses or the results, except to compile the individual and company change profiles requested and will be destroyed once the personalized profiles are forwarded.

**Informed Consent**

An informed consent form will be given to each respondent. Completing the questionnaire and returning it will be regarded as respondent's voluntary agreement to participate in this study. By not requiring respondents to sign and return the consent form, confidentiality can be maintained. This will be addressed in the cover letter. Upon request, a customized data analysis will be provided to individuals and companies. Those wishing to receive this personalized profile will need to provide their name and address to the investigator.

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## *C.3 Informed Consent Form*

### Informed Consent for Participants

**Title of Project:** Understanding Technological Change
**Principal Investigator:** Kirsten A. Davis

**I. Purpose of this Research**

You are invited to participate in a research study about individuals' perceptions of new technology implementation within the Architecture/Engineering/Construction (AEC) industry.

**II. Procedures**

This research study uses a questionnaire to collect data. The total time involved is approximately one hour to complete the questionnaire.

This study consists of architecture, engineering, contractor, and construction management organization employees at all levels and all positions. The research includes all sizes of organizations, from sole proprietorships to 1000+ employee firms within the AEC industry.

**III. Risks**

No risks or hazards have been identified with this research.

**IV. Benefits**

Your participation in this project will be used to provide information to researchers and practitioners interested in technological change by providing a better understanding of how individuals within the AEC industry react to technological change.

**V. Extent of Anonymity and Confidentiality**

The individual results of the study will be kept strictly confidential. At no time will the researcher release the individual results of this study to anyone other than the individuals working on the study without your written consent. An identification number is written on the front cover of the questionnaire. This number is used for tracking purposes to ensure that you are not bothered again once your questionnaire has been received.

If you would like to receive an individual change profile, please provide your name and home address on a separate page noting the identification number from the front cover of your questionnaire. Providing your home address instead of your business address helps to ensure that confidentiality is maintained. All information about you will have your name and address removed. No names or addresses will be used during the analysis or in any written reports of the research. This information will be destroyed once the personalized profile has been forwarded to you.

Your company may also request a company change profile. Company profiles will only include data where enough people in the company participated to ensure confidentiality of individual respondents. Information will not be provided to your company if it is determined that you could be identified in any way.

**VI. Compensation**

No compensation will be given to participants in this study. If requested, a personalized change profile will be provided.

**VII. Approval of Research**

This research project has been approved, as required, by the Institutional Review Board for Research Involving Human Subjects at Virginia Polytechnic Institute and State University and by the Department of Civil and Environmental Engineering.

**VIII. Subject's Responsibilities and Permission**

I voluntarily agree to participate in this study. I acknowledge that I am at least 18 years of age. I have read and understand this Informed Consent form and conditions of this project. I have had all of my questions answered. I hereby acknowledge the above and give my voluntary consent for participation in this project. I understand that if I participate, I may withdraw at any time without penalty.

Should you have any pertinent questions about this research or its conduct, please contact:

Kirsten Davis, principal investigator ..... (540) 961-4728 email: kidavis2@vt.edu
Dr. Anthony Songer, faculty advisor ..... (540) 231-7255 email: adsonger@vt.edu
David M. Moore, Chair, IRB Office of Research Compliance ..... (540) 231-4991 email: moored@vt.edu

## *C.4 Exemption Approval*

Virginia Tech
VIRGINIA POLYTECHNIC INSTITUTE
AND STATE UNIVERSITY

**Institutional Review Board**
Dr. David M. Moore
IRB (Human Subjects) Chair
Assistant Vice Provost for Research Compliance
CVM Phase II - Duckpond Dr., Blacksburg, VA 24061-0442
Office: 540/231-4991; FAX: 540/231-6033
e-mail: moored@vt.edu

**MEMORANDUM**

DATE: June 21, 2002

TO: Kirsten A. Davis CE 0105
Anthony Songer CE 0105

FROM: David M. Moore

SUBJECT: **IRB EXEMPTION APPROVAL** – " Understanding Technological Change" – IRB # 02-336

I have reviewed your request to the IRB for exemption for the above referenced project. I concur that the research falls within the exempt status. Approval is granted effective as of June 20, 2002.

cc: File
Department Reviewer: William R. Knocke

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*An Equal Opportunity / Affirmative Action Institution*

# Appendix D. Phase I Instrumentation

## *D.1 Cover Letter*

Virginia Tech
VIRGINIA POLYTECHNIC INSTITUTE
AND STATE UNIVERSITY

**The Vecellio Construction Engineering and Management Program**

The Charles E. Via, Jr. Department of Civil and
Environmental Engineering
200 Patton Hall, Blacksburg, Virginia 24061-0105

June 20, 2002

We need your assistance with a research study about individuals' perceptions of new technology implementation within the Architecture/Engineering/Construction (AEC) industry.

We would like your views of technological change. There are no right or wrong answers for any of the questions in the survey – we are interested in what you think! The purpose of the study is to understand how individuals within the AEC industry feel about technological change. With this information, we can help companies like yours to better understand how employees deal with change and with new technologies. When a change does occur, this knowledge can help make the transition easier for everyone involved.

Your company was selected to represent others like it all over the country. Because we are only asking employees at a small number of companies, your response is very important to us.

Your answers are confidential and will only be reported as summaries in which no individual's answers can be identified. This is explained further on the sheet entitled Informed Consent for Participants.

This research has been approved by the Institutional Review Board for Research Involving Human Subjects at Virginia Polytechnic Institute and State University. By completing this survey and returning it, you acknowledge your voluntary participation in this study and give your consent for your responses to be used in data analysis.

If you have any questions or comments about this study, we would be happy to talk with you. Please feel free to email, call, or write to us.

Thank you very much for your assistance!

Sincerely,

Kirsten A. Davis
Principal Investigator

Dr. Anthony Songer
Faculty Advisor

*A Land-Grant University – Putting Knowledge to Work*
*An Equal Opportunity/Affirmative Action Institution*

## *D.2 Questionnaire*

Copyright permission was not granted for reproduction of some survey questions. These questions were blacked out. The reader is directed to the original source for question wordings.

Blacked out Questions

Questions 6, 8-98: The Change Seeker Index (CSI) (Garlington and Shimota 1964)

Questions 209-268: Psychological Need Fulfillment Inventory (Hultman 1998)

Questions 292-331: The Change Opinion Survey (Hultman 1998)

Questions 447-516: The Keirsey Temperament Sorter II (Keirsey 1998)

# Understanding Technological Change: A Research Study

Kirsten A. Davis
The Vecellio Construction Engineering and Management Program
The Charles E. Via, Jr. Department of Civil and Environmental Engineering
Virginia Polytechnic Institute and State University
200 Patton Hall
Blacksburg, VA 24061-0105 USA

# Understanding Technological Change: A Research Study

## Section 1: Your Attitudes Towards Change

For Questions 1 to 99, please indicate whether you agree or disagree with each statement.

1. **I must admit that it makes me angry when other people interfere with my daily activity.**
   - ☐ Agree
   - ☐ Disagree

2. **I find that a well-ordered mode of life with regular hours is congenial to my temperament.**
   - ☐ Agree
   - ☐ Disagree

3. **It bothers me when something unexpected interrupts my daily routine.**
   - ☐ Agree
   - ☐ Disagree

4. **I don't like to undertake any project unless I have a pretty good idea as to how it will turn out.**
   - ☐ Agree
   - ☐ Disagree

5. **I find it hard to set aside a task that I have undertaken, even for a short time.**
   - ☐ Agree
   - ☐ Disagree

6. [redacted]
   - ☐ Agree
   - ☐ Disagree

7. **I wait until products are well established before I considering purchasing them.**
   - ☐ Agree
   - ☐ Disagree

8. [redacted]
   - ☐ Agree
   - ☐ Disagree

9. [redacted]
   - ☐ Agree
   - ☐ Disagree

10. [redacted]
    - ☐ Agree
    - ☐ Disagree

11. [redacted]
    - ☐ Agree
    - ☐ Disagree

12. [redacted]
    - ☐ Agree
    - ☐ Disagree

13. [redacted]
    - ☐ Agree
    - ☐ Disagree

14. [redacted]
    - ☐ Agree
    - ☐ Disagree

15. [redacted]
    - ☐ Agree
    - ☐ Disagree

16. [redacted]
    - ☐ Agree
    - ☐ Disagree

17. [redacted]
    - ☐ Agree
    - ☐ Disagree

18. [redacted]
    - ☐ Agree
    - ☐ Disagree

19. [redacted]
    - ☐ Agree
    - ☐ Disagree

**20.** [redacted]

☐ Agree
☐ Disagree

**21.** [redacted]

☐ Agree
☐ Disagree

**22.** [redacted]

☐ Agree
☐ Disagree

**23.** [redacted]

☐ Agree
☐ Disagree

**24.** [redacted]

☐ Agree
☐ Disagree

**25.** [redacted]

☐ Agree
☐ Disagree

**26.** [redacted]

☐ Agree
☐ Disagree

**27.** [redacted]

☐ Agree
☐ Disagree

**28.** [redacted]

☐ Agree
☐ Disagree

**29.** [redacted]

☐ Agree
☐ Disagree

**30.** [redacted]

☐ Agree
☐ Disagree

**31.** [redacted]

☐ Agree
☐ Disagree

**32.** [redacted]

☐ Agree
☐ Disagree

**33.** [redacted]

☐ Agree
☐ Disagree

**34.** [redacted]

☐ Agree
☐ Disagree

**35.** [redacted]

☐ Agree
☐ Disagree

**36.** [redacted]

☐ Agree
☐ Disagree

**37.** [redacted]

☐ Agree
☐ Disagree

**38.** [redacted]

☐ Agree
☐ Disagree

**39.** [redacted]

☐ Agree
☐ Disagree

**40.** [redacted]

☐ Agree
☐ Disagree

**41.** [redacted]

☐ Agree
☐ Disagree

**42.** [redacted]

☐ Agree
☐ Disagree

43. [redacted]

☐ Agree
☐ Disagree

44. [redacted]

☐ Agree
☐ Disagree

45. [redacted]

☐ Agree
☐ Disagree

46. [redacted]

☐ Agree
☐ Disagree

47. [redacted]

☐ Agree
☐ Disagree

48. [redacted]

☐ Agree
☐ Disagree

49. [redacted]

☐ Agree
☐ Disagree

50. [redacted]

☐ Agree
☐ Disagree

51. [redacted]

☐ Agree
☐ Disagree

52. [redacted]

☐ Agree
☐ Disagree

53. [redacted]

☐ Agree
☐ Disagree

54. [redacted]

☐ Agree
☐ Disagree

55. [redacted]

☐ Agree
☐ Disagree

56. [redacted]

☐ Agree
☐ Disagree

57. [redacted]

☐ Agree
☐ Disagree

58. [redacted]

☐ Agree
☐ Disagree

59. [redacted]

☐ Agree
☐ Disagree

60. [redacted]

☐ Agree
☐ Disagree

61. [redacted]

☐ Agree
☐ Disagree

62. [redacted]

☐ Agree
☐ Disagree

63. [redacted]

☐ Agree
☐ Disagree

64. [redacted]

☐ Agree
☐ Disagree

65. [redacted]

☐ Agree
☐ Disagree

**66.** [redacted]

☐ Agree
☐ Disagree

**67.** [redacted]

☐ Agree
☐ Disagree

**68.** [redacted]

☐ Agree
☐ Disagree

**69.** [redacted]

☐ Agree
☐ Disagree

**70.** [redacted]

☐ Agree
☐ Disagree

**71.** [redacted]

☐ Agree
☐ Disagree

**72.** [redacted]

☐ Agree
☐ Disagree

**73.** [redacted].

☐ Agree
☐ Disagree

**74.** [redacted]

☐ Agree
☐ Disagree

**75.** [redacted]

☐ Agree
☐ Disagree

**76.** [redacted].

☐ Agree
☐ Disagree

**77.** [redacted].

☐ Agree
☐ Disagree

**78.** [redacted]

☐ Agree
☐ Disagree

**79.** [redacted]

☐ Agree
☐ Disagree

**80.** [redacted]

☐ Agree
☐ Disagree

**81.** [redacted]

☐ Agree
☐ Disagree

**82.** [redacted]

☐ Agree
☐ Disagree

**83.** [redacted]

☐ Agree
☐ Disagree

**84.** [redacted]

☐ Agree
☐ Disagree

**85.** [redacted]

☐ Agree
☐ Disagree

**86.** [redacted]

☐ Agree
☐ Disagree

**87.** [redacted]

☐ Agree
☐ Disagree

**88.** [redacted]

☐ Agree
☐ Disagree

**89.** [redacted]

☐ Agree
☐ Disagree

**90.** [redacted]

☐ Agree
☐ Disagree

**91.** [redacted]

☐ Agree
☐ Disagree

**92.** [redacted]

☐ Agree
☐ Disagree

**93.** [redacted]

☐ Agree
☐ Disagree

**94.** [redacted]

☐ Agree
☐ Disagree

**95.** [redacted]

☐ Agree
☐ Disagree

**96.** [redacted]

☐ Agree
☐ Disagree

**97.** [redacted]

☐ Agree
☐ Disagree

**98.** [redacted]

☐ Agree
☐ Disagree

**99. I am likely to rush out and buy the latest new products as soon as they are available.**

☐ Agree
☐ Disagree

To what extent do you agree or disagree with the statements for Questions 100 to 129?

**100. An expert who doesn't come up with a definite answer probably doesn't know too much.**

Agree Strongly ☐ ☐ ☐ ☐ ☐ ☐ ☐ Disagree Strongly

**101. People who fit their lives to a schedule probably miss most of the joy of living.**

Agree Strongly ☐ ☐ ☐ ☐ ☐ ☐ ☐ Disagree Strongly

**102. There is really no such thing as a problem that can't be solved.**

Agree Strongly ☐ ☐ ☐ ☐ ☐ ☐ ☐ Disagree Strongly

**103. I would like to live in a foreign country for a while.**

Agree Strongly ☐ ☐ ☐ ☐ ☐ ☐ ☐ Disagree Strongly

**104. A good job is one where what is to be done and how it is to be done are always clear.**

Agree Strongly ☐ ☐ ☐ ☐ ☐ ☐ ☐ Disagree Strongly

**105. It is more fun to tackle a complicated problem than to solve a simple one.**

Agree Strongly ☐ ☐ ☐ ☐ ☐ ☐ ☐ Disagree Strongly

**106. In the long run it is possible to get more done by tackling small, simple problems rather than large and complicated ones.**

Agree Strongly ☐ ☐ ☐ ☐ ☐ ☐ ☐ Disagree Strongly

**107. Often the most interesting and stimulating people are those who don't mind being different and original.**

Agree Strongly ☐ ☐ ☐ ☐ ☐ ☐ ☐ Disagree Strongly

**108. What we are used to is always preferable to what is unfamiliar.**

Agree Strongly ☐ ☐ ☐ ☐ ☐ ☐ ☐ Disagree Strongly

**109. People who insist upon a yes or no answer just don't know how complicated things really are.**

Agree Strongly ☐ ☐ ☐ ☐ ☐ ☐ ☐ Disagree Strongly

**110. A person who leads an even, regular life in which few surprises or unexpected happenings arise, really has a lot to be grateful for.**

Agree Strongly ☐ ☐ ☐ ☐ ☐ ☐ ☐ Disagree Strongly

**111. Many of our most important decisions are based upon insufficient information.**

Agree Strongly ☐ ☐ ☐ ☐ ☐ ☐ ☐ Disagree Strongly

**112. I like parties where I know most of the people more than ones where all or most of the people are complete strangers.**

Agree Strongly ☐ ☐ ☐ ☐ ☐ ☐ ☐ Disagree Strongly

**113. Teachers or supervisors who hand out vague assignments give a chance for one to show initiative and originality.**

Agree Strongly ☐ ☐ ☐ ☐ ☐ ☐ ☐ Disagree Strongly

**114. The sooner we all acquire similar values and ideals the better.**

Agree Strongly ☐ ☐ ☐ ☐ ☐ ☐ ☐ Disagree Strongly

**115. A good teacher is one who makes you wonder about your way of looking at things.**

Agree Strongly ☐ ☐ ☐ ☐ ☐ ☐ ☐ Disagree Strongly

**116. I often act impulsively when something is bothering me.**

Agree Strongly ☐ ☐ ☐ ☐ ☐ ☐ ☐ Disagree Strongly

**117. I am able to laugh at myself pretty easily.**

Agree Strongly ☐ ☐ ☐ ☐ ☐ ☐ ☐ Disagree Strongly

**118. When I have to face a difficult situation I try to imagine what it will be like and plan ways to cope with it.**

Agree Strongly ☐ ☐ ☐ ☐ ☐ ☐ ☐ Disagree Strongly

**119. I'm often told that I don't show my feelings.**

Agree Strongly ☐ ☐ ☐ ☐ ☐ ☐ ☐ Disagree Strongly

**120. People say I tend to ignore unpleasant facts as if they didn't exist.**

Agree Strongly ☐ ☐ ☐ ☐ ☐ ☐ ☐ Disagree Strongly

**121. I have special talents that allow me to go through life with no problems.**

Agree Strongly ☐ ☐ ☐ ☐ ☐ ☐ ☐ Disagree Strongly

**122. I am sure I get a raw deal from life.**

Agree Strongly ☐ ☐ ☐ ☐ ☐ ☐ ☐ Disagree Strongly

**123. I get openly aggressive when I feel hurt.**

Agree Strongly ☐ ☐ ☐ ☐ ☐ ☐ ☐ Disagree Strongly

**124. I'm usually able to see the funny side of an otherwise painful predicament.**

Agree Strongly ☐ ☐ ☐ ☐ ☐ ☐ ☐ Disagree Strongly

**125. If I can predict that I'm going to be sad ahead of time, I can cope better.**

Agree Strongly ☐ ☐ ☐ ☐ ☐ ☐ ☐ Disagree Strongly

**126. Often I find that I don't feel anything when the situation would seem to warrant strong emotions.**

Agree Strongly ☐ ☐ ☐ ☐ ☐ ☐ ☐ Disagree Strongly

**127. I fear nothing.**

Agree Strongly ☐ ☐ ☐ ☐ ☐ ☐ ☐ Disagree Strongly

**128. I ignore danger as if I were Superman.**

Agree Strongly ☐ ☐ ☐ ☐ ☐ ☐ ☐ Disagree Strongly

**129. People tend to mistreat me.**

Agree Strongly ☐ ☐ ☐ ☐ ☐ ☐ ☐ Disagree Strongly

Think about the past month. For Questions 130 to 155, please indicate how well the statement describes your behavior or intention. Please use the following response scale:
VW = This describes me very well
MW = This describes me moderately well
L = This describes me a little
NAA = This does not describe me at all

**130. I can bounce back after feeling disappointed**

VW☐ MW☐ L☐ NAA☐

**131. I can accomplish what I need to if I put my mind to it**

VW☐ MW☐ L☐ NAA☐

**132. Obstacles or problems in my life have resulted in unexpected changes for the better**

VW☐ MW☐ L☐ NAA☐

**133. I find it easy to wait patiently when I need to**

VW☐ MW☐ L☐ NAA☐

**134. There is always more than one right answer**

VW☐ MW☐ L☐ NAA☐

**135. I know how to satisfy all parts of myself**

VW☐ MW☐ L☐ NAA☐

**136. I am not one to procrastinate**

VW☐ MW☐ L☐ NAA☐

**137. I am afraid to try something again when I have failed at it before**

VW☐ MW☐ L☐ NAA☐

**138. I decide certain problems are not worth worrying about**

VW☐ MW☐ L☐ NAA☐

**139. I relax myself when tension builds up**

VW☐ MW☐ L☐ NAA☐

**140. I can see the humorous side of situations**

VW☐ MW☐ L☐ NAA☐

**141. I often put things aside for a while to get a perspective on them**

VW☐ MW☐ L☐ NAA☐

**142. When I encounter a problem, I focus on what I can do to solve it**

VW☐ MW☐ L☐ NAA☐

**143. I can disagree effectively to bring about change**

VW☐ MW☐ L☐ NAA☐

**144. I would not express my feelings if I believed they would cause a disagreement**

VW☐ MW☐ L☐ NAA☐

**145. When it comes right down to it, I can only trust myself to get things done**

VW☐ MW☐ L☐ NAA☐

**146. I remain calm even in situations where others get angry**

VW☐ MW☐ L☐ NAA☐

**147. It is better not to stir up problems if you can avoid doing so**

VW☐ MW☐ L☐ NAA☐

**148. I have a hard time getting consensus from my work team**

VW☐ MW☐ L☐ NAA☐

**149. I solicit feedback from my peers on my performance**

VW☐ MW☐ L☐ NAA☐

**150. I am good at organizing and motivating groups of people**

VW☐ MW☐ L☐ NAA☐

**151. I enjoy the challenge of facing and solving problems at work**

VW☐ MW☐ L☐ NAA☐

**152. I listen to criticism with an open mind and accept it when it is justified**

VW☐ MW☐ L☐ NAA☐

**153. I let things build up to a crisis point before talking about it**

VW☐ MW☐ L☐ NAA☐

**154. When I make a critical comment I focus on the behavior and not the person**

VW☐ MW☐ L☐ NAA☐

**155. I avoid confrontations**

VW☐ MW☐ L☐ NAA☐

**156. Mark the words below that you most frequently associate with a change.**

| | | |
|---|---|---|
| ☐ Adjust | ☐ Alter | ☐ Ambiguity |
| ☐ Anxiety | ☐ Better | ☐ Challenging |
| ☐ Chance | ☐ Concern | ☐ Death |
| ☐ Deteriorate | ☐ Different | ☐ Disruption |
| ☐ Exciting | ☐ Fear | ☐ Fun |
| ☐ Grow | ☐ Improve | ☐ Learn |
| ☐ Modify | ☐ New | ☐ Opportunity |
| ☐ Rebirth | ☐ Replace | ☐ Revise |
| ☐ Stress | ☐ Transfer | ☐ Transition |
| ☐ Uncertainty | ☐ Upheaval | ☐ Vary |

For Questions 157 to 179, two statements are given. Please indicate which statement you prefer in each pair.

**157. ☐ Many of the unhappy things in people's lives are partly due to bad luck.**
**☐ People's misfortunes result from the mistakes they make.**

**158. ☐ One of the major reasons why we have wars is because people don't take enough interest in politics.**
**☐ There will always be wars, no matter how hard people try to prevent them.**

**159. ☐ In the long run people get the respect they deserve in this world.**
**☐ Unfortunately, an individual's worth often passes unrecognized no matter how hard he tries.**

**160. ☐ The idea that teachers are unfair to students is nonsense.**
**☐ Most students don't realize the extent to which their grades are influenced by accidental happenings.**

**161. ☐ Without the right breaks one cannot be an effective leader.**
**☐ Capable people who fail to become leaders have not taken advantage of their opportunities.**

**162. ☐ No matter how hard you try some people just don't like you.**
**☐ People who can't get others to like them don't understand how to get along with others.**

**163. ☐ I have often found that what is going to happen will happen.**
**☐ Trusting to fate has never turned out as well for me as making a decision to take a definite action.**

**164. ☐ In the case of the well prepared student there is rarely if ever such a thing as an unfair test.**
**☐ Many times exam questions tend to be so unrelated to course work that studying is really useless.**

**165. ☐ Becoming a success is a matter of hard work, luck has little or nothing to do with it.**
**☐ Getting a good job depends mainly on being in the right place at the right time.**

**166. ☐ The average citizen can have an influence in government decisions.**
**☐ This world is run by the few people in power, and there is not much the little guy can do about it.**

**167. ☐ When I make plans, I am almost certain that I can make them work.**
**☐ It is not always wise to plan too far ahead because many things turn out to be a matter of good or bad fortune anyhow.**

**168. ☐ In my case getting what I want has little or nothing to do with luck.**
**☐ Many times we might just as well decide what to do by flipping a coin.**

**169. ☐ Who gets to be the boss often depends on who was lucky enough to be in the right place first.**
**☐ Getting people to do the right thing depends upon ability, luck has little or nothing to do with it.**

**170. ☐ As far as world affairs are concerned, most of us are the victims of forces we can neither understand, nor control.**
**☐ By taking an active part in political and social affairs the people can control world events.**

**171. ☐ Most people don't realize the extent to which their lives are controlled by accidental happenings.**
**☐ There really is no such thing as "luck."**

**172. ☐ It is hard to know whether or not a person really likes you.**
**☐ How many friends you have depends on how nice a person you are.**

**173. ☐ In the long run the bad things that happen to us are balanced by the good ones.**
**☐ Most misfortunes are the result of lack of ability, ignorance, laziness, or all three.**

**174. ☐ With enough effort we can wipe out political corruption.**
**☐ It is difficult for people to have much control over the things politicians do in office.**

**175. ☐ Sometimes I can't understand how teachers arrive at the grades they give.**
**☐ There is a direct connection between how hard I study and the grades I get.**

176. ☐ **Many times I feel that I have little influence over the things that happen to me.**
☐ **It is impossible for me to believe that chance or luck plays an important role in my life.**

177. ☐ **People are lonely because they don't try to be friendly.**
☐ **There's not much use in trying too hard to please people, if they like you, they like you.**

178. ☐ **What happens to me is my own doing.**
☐ **Sometimes I feel that I don't have enough control over the direction my life is taking.**

179. ☐ **Most of the time I can't understand why politicians behave the way they do.**
☐ **In the long run the people are responsible for bad government on a national as well as on a local level.**

To what extent do you agree or disagree with the statements for Questions 180 to 199? Please use the following response scale:
AS = Agree strongly
A = Agree
N = Neither agree nor disagree
D = Disagree
DS = Disagree strongly

180. **To be happy, I must maintain the approval of all the persons I consider significant.**
AS☐ A☐ N☐ D☐ DS☐

181. **To be a worthwhile person, I must be thoroughly competent in everything I do.**
AS☐ A☐ N☐ D☐ DS☐

182. **Individuals who take unfair advantage of me should be punished.**
AS☐ A☐ N☐ D☐ DS☐

183. **It is terrible when things do not go the way I would like.**
AS☐ A☐ N☐ D☐ DS☐

184. **My negative emotions are the result of external pressures.**
AS☐ A☐ N☐ D☐ DS☐

185. **If there is a risk that something bad will happen, it makes sense to be upset.**
AS☐ A☐ N☐ D☐ DS☐

186. **It is better to ignore personal problems than to try to solve them.**
AS☐ A☐ N☐ D☐ DS☐

187. **Many events from my past so strongly influence me that it is impossible to change.**
AS☐ A☐ N☐ D☐ DS☐

188. **I dislike having any uncertainty about my future.**
AS☐ A☐ N☐ D☐ DS☐

189. **Life should be easier than it is.**
AS☐ A☐ N☐ D☐ DS☐

190. **To be happy I must be loved by the persons who are important to me.**
AS☐ A☐ N☐ D☐ DS☐

191. **I must keep achieving in order to be satisfied with myself.**
AS☐ A☐ N☐ D☐ DS☐

192. **Most people who have been unfair to me are generally bad individuals.**
AS☐ A☐ N☐ D☐ DS☐

193. **It is awful when something I want to happen does not occur.**
AS☐ A☐ N☐ D☐ DS☐

194. **I cannot help how I feel when everything is going wrong.**
AS☐ A☐ N☐ D☐ DS☐

195. **When it looks as if something might be wrong, it is reasonable to be quite concerned.**
AS☐ A☐ N☐ D☐ DS☐

196. **It makes more sense to wait than to try to improve a bad life situation.**
AS☐ A☐ N☐ D☐ DS☐

197. **Some of my ways of acting are so ingrained that I could never change them.**
AS☐ A☐ N☐ D☐ DS☐

198. **I hate it when I cannot eliminate an uncertainty.**
AS☐ A☐ N☐ D☐ DS☐

199. **Things should turn out better than they usually do.**
AS☐ A☐ N☐ D☐ DS☐

To what extent do you agree or disagree with the statements for Questions 200 to 207? Please use the following response scale:
AS = agree strongly
A = agree somewhat
U = undecided
D = disagree somewhat
DS = disagree strongly

**200. If I could do as I pleased, I would change the kind of work I do every few months.**

AS☐ A☐ U☐ D☐ DS☐

**201. One can never feel at ease on a job where the ways of doing things are always being changed.**

AS☐ A☐ U☐ D☐ DS☐

**202. The trouble with most jobs is that you just get used to doing things in one way and then they want you to do them differently.**

AS☐ A☐ U☐ D☐ DS☐

**203. I would prefer to stay with a job that I know I can handle than to change to one where most things would be new to me.**

AS☐ A☐ U☐ D☐ DS☐

**204. The trouble with many people is that when they find a job they can do well, they don't stick with it.**

AS☐ A☐ U☐ D☐ DS☐

**205. I like a job where I know that I will be doing my work about the same way from one week to the next.**

AS☐ A☐ U☐ D☐ DS☐

**206. When I get used to doing things in one way it is disturbing to have to change to a new method.**

AS☐ A☐ U☐ D☐ DS☐

**207. It would take a sizeable raise in pay to get me to voluntarily transfer to another job.**

AS☐ A☐ U☐ D☐ DS☐

**208. The job that you would consider ideal for you would be one where the way you do your work:**

Is always the same ☐ ☐ ☐ ☐ ☐ Changes a great deal

## Section 2: Your Company and Change

To what extent do you agree or disagree with the statements for Questions 209 to 268? Please use the following response scale:
AS = agree strongly
A = agree somewhat
U = undecided
D = disagree somewhat
DS = disagree strongly

**209.** [redacted]

AS☐ A☐ U☐ D☐ DS☐

**210.** [redacted]

AS☐ A☐ U☐ D☐ DS☐

**211.** [redacted]

AS☐ A☐ U☐ D☐ DS☐

**212.** [redacted]

AS☐ A☐ U☐ D☐ DS☐

**213.** [redacted]

AS☐ A☐ U☐ D☐ DS☐

**214.** [redacted]

AS☐ A☐ U☐ D☐ DS☐

**215.** [redacted]

AS☐ A☐ U☐ D☐ DS☐

**216.** [redacted]

AS☐ A☐ U☐ D☐ DS☐

**217.** [redacted]

AS☐ A☐ U☐ D☐ DS☐

**218.** [redacted]

AS☐ A☐ U☐ D☐ DS☐

**219.** [redacted]

AS☐ A☐ U☐ D☐ DS☐

**220.** [redacted]

AS☐ A☐ U☐ D☐ DS☐

**221.** [redacted]

AS☐ A☐ U☐ D☐ DS☐

**222.** [redacted]

AS☐ A☐ U☐ D☐ DS☐

**223.** [redacted]

AS☐ A☐ U☐ D☐ DS☐

**224.** [redacted]

AS☐ A☐ U☐ D☐ DS☐

**225.** [redacted]

AS☐ A☐ U☐ D☐ DS☐

**226.** [redacted]

AS☐ A☐ U☐ D☐ DS☐

**227.** [redacted]

AS☐ A☐ U☐ D☐ DS☐

**228.** [redacted]

AS☐ A☐ U☐ D☐ DS☐

**229.** [redacted]

AS☐ A☐ U☐ D☐ DS☐

**230.** [redacted]

AS☐ A☐ U☐ D☐ DS☐

**231.** [redacted]

AS☐ A☐ U☐ D☐ DS☐

**232.** [redacted]

AS☐ A☐ U☐ D☐ DS☐

**233.** [redacted]

AS☐ A☐ U☐ D☐ DS☐

**234.** [redacted]

AS☐ A☐ U☐ D☐ DS☐

**235.** [redacted]

AS☐ A☐ U☐ D☐ DS☐

**236.** [redacted]

AS☐ A☐ U☐ D☐ DS☐

**237.** [redacted]

AS☐ A☐ U☐ D☐ DS☐

**238.** [redacted]

AS☐ A☐ U☐ D☐ DS☐

**239.** [redacted]

AS☐ A☐ U☐ D☐ DS☐

**240.** [redacted]

AS☐ A☐ U☐ D☐ DS☐

**241.** [redacted]

AS☐ A☐ U☐ D☐ DS☐

**242.** [redacted]

AS☐ A☐ U☐ D☐ DS☐

**243.** [redacted]

AS☐ A☐ U☐ D☐ DS☐

**244.** [redacted]

AS☐ A☐ U☐ D☐ DS☐

**245.** [redacted]

AS☐ A☐ U☐ D☐ DS☐

**246.** [redacted]

AS☐ A☐ U☐ D☐ DS☐

**247.** [redacted]

AS☐ A☐ U☐ D☐ DS☐

**248.** [redacted]

AS☐ A☐ U☐ D☐ DS☐

249. [redacted]

AS☐ A☐ U☐ D☐ DS☐

250. [redacted]

AS☐ A☐ U☐ D☐ DS☐

251. [redacted]

AS☐ A☐ U☐ D☐ DS☐

252. [redacted]

AS☐ A☐ U☐ D☐ DS☐

253. [redacted]

AS☐ A☐ U☐ D☐ DS☐

254. [redacted]

AS☐ A☐ U☐ D☐ DS☐

255. [redacted]

AS☐ A☐ U☐ D☐ DS☐

256. [redacted]

AS☐ A☐ U☐ D☐ DS☐

257. [redacted]

AS☐ A☐ U☐ D☐ DS☐

258. [redacted]

AS☐ A☐ U☐ D☐ DS☐

259. [redacted]

AS☐ A☐ U☐ D☐ DS☐

260. [redacted]

AS☐ A☐ U☐ D☐ DS☐

261. [redacted]

AS☐ A☐ U☐ D☐ DS☐

262. [redacted]

AS☐ A☐ U☐ D☐ DS☐

263. [redacted]

AS☐ A☐ U☐ D☐ DS☐

264. [redacted]

AS☐ A☐ U☐ D☐ DS☐

265. [redacted]

AS☐ A☐ U☐ D☐ DS☐

266. [redacted]

AS☐ A☐ U☐ D☐ DS☐

267. [redacted]

AS☐ A☐ U☐ D☐ DS☐

268. [redacted]

AS☐ A☐ U☐ D☐ DS☐

To what extent do you feel that the statements for Questions 269 to 274 are true or not?

**269. People throughout my organization share values or visions.**

True ☐ ☐ ☐ ☐ ☐ ☐ ☐ Not True

**270. My organization has a good track record in implementing change smoothly.**

True ☐ ☐ ☐ ☐ ☐ ☐ ☐ Not True

**271. There is a lot of cooperation and trust throughout my organization (as opposed to animosity).**

True ☐ ☐ ☐ ☐ ☐ ☐ ☐ Not True

**272. My organization's culture supports risk taking (as opposed to being highly bureaucratic and rule bound).**

True ☐ ☐ ☐ ☐ ☐ ☐ ☐ Not True

**273. People are able to handle change (as opposed to being worn out from recent, unsettling changes).**

True ☐ ☐ ☐ ☐ ☐ ☐ ☐ Not True

**274. My organization rewards people who take part in change efforts (as opposed to subtly punishing those who take the time off other work to get involved).**

True ☐ ☐ ☐ ☐ ☐ ☐ ☐ Not True

## Section 3: Technological Changes Occurring Within Your Company

**275. Over the past year, have any technological changes happened in your company?** Some examples of technological change include using computers for tasks that previously did not use them, introducing new computer software or programs, and changes in existing computer systems. Please include changes currently in progress.

☐ No
☐ Yes..... Please describe the changes below. Try to be as specific as you can.

_____
_____
_____
_____
_____
_____
_____

**276. Are you aware of any technological changes planned for the next year?**

☐ No
☐ Yes..... Please describe the changes below. Try to be as specific as you can.

_____
_____
_____
_____
_____
_____
_____

If you answered **No** to both Question 275 and Question 276, please skip to Question 334, page 15.
If you answered **Yes** to either question, please continue with Question 277.

**277. Of all the changes that you described, which one do you feel affected (or will affect) you the most?**

_____
_____
_____

Please answer Questions 278 to 333 based on the technological change that you indicated in Question 277.

**278. Do you think the change has affected (or will affect) the way you interact with others?**

A great deal ☐ ☐ ☐ ☐ ☐ ☐ Not at all | Don't know ☐

**279. How do you feel about this?**

Like it very much ☐ ☐ ☐ ☐ ☐ ☐ Dislike it very much

**280. Have you been (or will you be) involved in the decision to make the change?**

A great deal ☐ ☐ ☐ ☐ ☐ ☐ Not at all | Don't know ☐

**281. How do you feel about this?**

Like it very much ☐ ☐ ☐ ☐ ☐ ☐ Dislike it very much

**282. Have you received (or will you receive) training to prepare for the change?**

A great deal ☐ ☐ ☐ ☐ ☐ ☐ Not at all | Don't know ☐

**283. How do you feel about this?**

Like it very much ☐ ☐ ☐ ☐ ☐ ☐ Dislike it very much

**284. Have adequate resources been available (or will they be available) to you during the change?**

A great deal ☐ ☐ ☐ ☐ ☐ ☐ Not at all | Don't know ☐

**285. How do you feel about this?**

Like it very much ☐ ☐ ☐ ☐ ☐ ☐ Dislike it very much

**286. Were you (or will you be) given any rewards for using the new technology?**

A great deal ☐ ☐ ☐ ☐ ☐ ☐ Not at all | Don't know ☐

**287. How do you feel about this?**

Like it very much ☐ ☐ ☐ ☐ ☐ ☐ Dislike it very much

**288. Were there (or will there be) any punishments for <u>not</u> using the new technology?**

A great deal ☐ ☐ ☐ ☐ ☐ ☐ Not at all | ☐ Don't know

**289. How do you feel about this?**

Like it very much ☐ ☐ ☐ ☐ ☐ ☐ Dislike it very much

**290. How motivated were you (or are you) to use the new technology?**

A great deal ☐ ☐ ☐ ☐ ☐ ☐ Not at all

**291. Do you think you resisted (or will resist) the technological change at all?**

A great deal ☐ ☐ ☐ ☐ ☐ ☐ Not at all

To what extent do you agree or disagree with the statements for Questions 292 to 331? Please use the following response scale:
AS = agree strongly
A = agree somewhat
U = undecided
D = disagree somewhat
DS = disagree strongly

**292.** [redacted]
AS☐ A☐ U☐ D☐ DS☐

**293.** [redacted]
AS☐ A☐ U☐ D☐ DS☐

**294.** [redacted]
AS☐ A☐ U☐ D☐ DS☐

**295.** [redacted]
AS☐ A☐ U☐ D☐ DS☐

**296.** [redacted]
AS☐ A☐ U☐ D☐ DS☐

**297.** [redacted]
AS☐ A☐ U☐ D☐ DS☐

**298.** [redacted]
AS☐ A☐ U☐ D☐ DS☐

**299.** [redacted]
AS☐ A☐ U☐ D☐ DS☐

**300.** [redacted]
AS☐ A☐ U☐ D☐ DS☐

**301.** [redacted]
AS☐ A☐ U☐ D☐ DS☐

**302.** [redacted]
AS☐ A☐ U☐ D☐ DS☐

**303.** [redacted]
AS☐ A☐ U☐ D☐ DS☐

**304.** [redacted]
AS☐ A☐ U☐ D☐ DS☐

**305.** [redacted]
AS☐ A☐ U☐ D☐ DS☐

**306.** [redacted]
AS☐ A☐ U☐ D☐ DS☐

**307.** [redacted]
AS☐ A☐ U☐ D☐ DS☐

**308.** [redacted]
AS☐ A☐ U☐ D☐ DS☐

**309.** [redacted]
AS☐ A☐ U☐ D☐ DS☐

**310.** [redacted]
AS☐ A☐ U☐ D☐ DS☐

**311.** [redacted]
AS☐ A☐ U☐ D☐ DS☐

**312.** [redacted]
AS☐ A☐ U☐ D☐ DS☐

**313.** [redacted]
AS☐ A☐ U☐ D☐ DS☐

**314.** [redacted]

AS☐ A☐ U☐ D☐ DS☐

**315.** [redacted]

AS☐ A☐ U☐ D☐ DS☐

**316.** [redacted]

AS☐ A☐ U☐ D☐ DS☐

**317.** [redacted]

AS☐ A☐ U☐ D☐ DS☐

**318.** [redacted]

AS☐ A☐ U☐ D☐ DS☐

**319.** [redacted]

AS☐ A☐ U☐ D☐ DS☐

**320.** [redacted]

AS☐ A☐ U☐ D☐ DS☐

**321.** [redacted]

AS☐ A☐ U☐ D☐ DS☐

**322.** [redacted]

AS☐ A☐ U☐ D☐ DS☐

**323.** [redacted]

AS☐ A☐ U☐ D☐ DS☐

**324.** [redacted]

AS☐ A☐ U☐ D☐ DS☐

**325.** [redacted]

AS☐ A☐ U☐ D☐ DS☐

**326.** [redacted]

AS☐ A☐ U☐ D☐ DS☐

**327.** [redacted]

AS☐ A☐ U☐ D☐ DS☐

**328.** [redacted]

AS☐ A☐ U☐ D☐ DS☐

**329.** [redacted]

AS☐ A☐ U☐ D☐ DS☐

**330.** [redacted]

AS☐ A☐ U☐ D☐ DS☐

**331.** [redacted]

AS☐ A☐ U☐ D☐ DS☐

To what extent do you feel that the statements for Questions 332 to 333 are true or not?

**332. People will be able to maintain respect and status when the change is implemented (as opposed to losing these as a result of the change).**

True ☐ ☐ ☐ ☐ ☐ ☐ ☐ Not True

**333. The change will be mild (and not cause a major disruption of the status quo).**

True ☐ ☐ ☐ ☐ ☐ ☐ ☐ Not True

## Section 4: Your Attitudes Towards Technology

To what extent do you agree or disagree with the statements for Questions 334 to 392? Please use the following response scale:
AS = agree strongly
A = agree somewhat
U = undecided
D = disagree somewhat
DS = disagree strongly
Answer quickly with your first reaction to each statement and use the "undecided" choice as little as possible.

**334. Having a computer available to me would improve my productivity.**

AS☐ A☐ U☐ D☐ DS☐

**335. If I had to use a computer for some reason, it would probably save me some time and work.**

AS☐ A☐ U☐ D☐ DS☐

**336. If I used a computer, I could get a better picture of the facts and figures.**

AS☐ A☐ U☐ D☐ DS☐

**337. Having a computer available to me would improve my general satisfaction.**

AS☐ A☐ U☐ D☐ DS☐

**338. Having to use a computer could make my life less enjoyable.**

AS☐ A☐ U☐ D☐ DS☐

339. **Having a computer available to me could make things easier for me.**
AS☐ A☐ U☐ D☐ DS☐

340. **I feel very negative about computers in general.**
AS☐ A☐ U☐ D☐ DS☐

341. **Having a computer available to me could make things more fun for me.**
AS☐ A☐ U☐ D☐ DS☐

342. **If I had a computer at my disposal, I would try to get rid of it.**
AS☐ A☐ U☐ D☐ DS☐

343. **I look forward to a time when computers are more widely used.**
AS☐ A☐ U☐ D☐ DS☐

344. **I doubt if I would ever use computers very much.**
AS☐ A☐ U☐ D☐ DS☐

345. **I avoid using computers whenever I can.**
AS☐ A☐ U☐ D☐ DS☐

346. **I enjoy using computers.**
AS☐ A☐ U☐ D☐ DS☐

347. **I feel that there are too many computers around now.**
AS☐ A☐ U☐ D☐ DS☐

348. **Computers are probably going to be an important part of my life.**
AS☐ A☐ U☐ D☐ DS☐

349. **A computer could make learning fun.**
AS☐ A☐ U☐ D☐ DS☐

350. **If I were to use a computer, I could get a lot of satisfaction from it.**
AS☐ A☐ U☐ D☐ DS☐

351. **If I had to use a computer, it would probably be more trouble than it's worth.**
AS☐ A☐ U☐ D☐ DS☐

352. **I am usually uncomfortable when I have to use a computer.**
AS☐ A☐ U☐ D☐ DS☐

353. **I sometimes get nervous just thinking about computers.**
AS☐ A☐ U☐ D☐ DS☐

354. **I will probably never learn to use a computer.**
AS☐ A☐ U☐ D☐ DS☐

355. **Computers are too complicated to be of much use to me.**
AS☐ A☐ U☐ D☐ DS☐

356. **If I had to use a computer all the time, I would probably be very unhappy.**
AS☐ A☐ U☐ D☐ DS☐

357. **I sometimes feel intimidated when I have to use a computer.**
AS☐ A☐ U☐ D☐ DS☐

358. **I sometimes feel that computers are smarter than I am.**
AS☐ A☐ U☐ D☐ DS☐

359. **I can think of many ways that I could use a computer.**
AS☐ A☐ U☐ D☐ DS☐

360. **I feel insecure about my ability to interpret a computer printout.**
AS☐ A☐ U☐ D☐ DS☐

361. **I look forward to using a computer on my job.**
AS☐ A☐ U☐ D☐ DS☐

362. **The challenge of learning about computers is exciting.**
AS☐ A☐ U☐ D☐ DS☐

363. **I am confident that I can learn computer skills.**
AS☐ A☐ U☐ D☐ DS☐

364. **Anyone can learn to use a computer if they are patient and motivated.**
AS☐ A☐ U☐ D☐ DS☐

365. **Learning to operate computers is like learning any new skill – the more you practice, the better you become.**
AS☐ A☐ U☐ D☐ DS☐

366. **I am afraid that if I begin to use computers I will become dependent upon them and lose some of my reasoning skills.**
AS☐ A☐ U☐ D☐ DS☐

367. **I am sure that with time and practice I will be as comfortable working with computers as I am in working with a typewriter.**
AS☐ A☐ U☐ D☐ DS☐

368. I feel that I will be able to keep up with the advances happening in the computer field.

AS☐ A☐ U☐ D☐ DS☐

369. I dislike working with machines that are smarter than I am.

AS☐ A☐ U☐ D☐ DS☐

370. I feel apprehensive about using computers.

AS☐ A☐ U☐ D☐ DS☐

371. I have difficulty in understanding the technical aspects of computers.

AS☐ A☐ U☐ D☐ DS☐

372. It scares me to think that I could cause the computer to destroy a large amount of information by hitting the wrong key.

AS☐ A☐ U☐ D☐ DS☐

373. I hesitate to use a computer for fear of making mistakes that I cannot correct.

AS☐ A☐ U☐ D☐ DS☐

374. You have to be a genius to understand all the special keys contained on most computers.

AS☐ A☐ U☐ D☐ DS☐

375. If given the opportunity, I would like to learn about and use computers.

AS☐ A☐ U☐ D☐ DS☐

376. I have avoided computers because they are unfamiliar and somewhat intimidating to me.

AS☐ A☐ U☐ D☐ DS☐

377. I feel computers are necessary tools in both educational and work settings.

AS☐ A☐ U☐ D☐ DS☐

378. Computers are threatening.

AS☐ A☐ U☐ D☐ DS☐

379. Computers are unfriendly.

AS☐ A☐ U☐ D☐ DS☐

380. Every home should have a computer.

AS☐ A☐ U☐ D☐ DS☐

381. It's easier to answer truthfully when a question is asked by a computer.

AS☐ A☐ U☐ D☐ DS☐

382. It is easy to learn to operate a computer.

AS☐ A☐ U☐ D☐ DS☐

383. Computers are stupid.

AS☐ A☐ U☐ D☐ DS☐

384. Using a computer is more trouble than it's worth.

AS☐ A☐ U☐ D☐ DS☐

385. Computers are complicated to use.

AS☐ A☐ U☐ D☐ DS☐

386. Computers are frightening.

AS☐ A☐ U☐ D☐ DS☐

387. Computer games are exciting.

AS☐ A☐ U☐ D☐ DS☐

388. Computers make things easy to learn.

AS☐ A☐ U☐ D☐ DS☐

389. Computers take over from people.

AS☐ A☐ U☐ D☐ DS☐

390. There is not a lot of use for computers.

AS☐ A☐ U☐ D☐ DS☐

391. Computers control people.

AS☐ A☐ U☐ D☐ DS☐

392. Computers are fun.

AS☐ A☐ U☐ D☐ DS☐

393. What are your general comments on the impact of computers on technological change?

_____

_____

_____

_____

_____

_____

_____

## Section 5: Your Computer Experience

**394. How would you rate your ability in typing?**

- ☐ Absolute zero
- ☐ Minimal
- ☐ Good
- ☐ Very good
- ☐ Excellent

**395. Do you own a personal computer?**

- ☐ No
- ☐ Yes

**396. Do you use a computer at work?**

- ☐ Never
- ☐ Rarely
- ☐ Sometimes
- ☐ Often
- ☐ I use one for a majority of my work

**397. About how many hours per day (at home or at work) do you spend using a computer…**

To play games?....._____ hours per day
For email?....._____ hours per day
To access the Internet?....._____ hours per day
For word-processing?....._____ hours per day
For data analysis?....._____ hours per day
For drawing or drafting?..._____ hours per day
To write programs?....._____ hours per day
For other uses not listed?.._____ hours per day

**398. How would you rate your knowledge of computers?**

- ☐ Absolute zero
- ☐ Minimal
- ☐ Good
- ☐ Very good
- ☐ Extensive

**399. Have you ever taken a course in computer programming?**

- ☐ No
- ☐ Yes

**400. Have you ever taken an academic or job-training course in word processing?**

- ☐ No
- ☐ Yes

**401. Have you ever taken a test or exam where you were required to type responses using a computer?**

- ☐ No
- ☐ Yes

**402. Have you ever used computers that were linked to other computers?**

- ☐ No
- ☐ Yes
- ☐ I don't know

To what extent do you agree or disagree with the statements for Questions 403 - 414? Please use the following response scale:
AS = Agree strongly
A = Agree
N = Neither agree nor disagree
D = Disagree
DS = Disagree strongly

**403. I frequently read computer magazines or other sources of information that describe new computer technology.**

AS☐ A☐ N☐ D☐ DS☐

**404. I know how to recover deleted or "lost data" on a computer or PC.**

AS☐ A☐ N☐ D☐ DS☐

**405. I know what a LAN is.**

AS☐ A☐ N☐ D☐ DS☐

**406. I know what an operating system is.**

AS☐ A☐ N☐ D☐ DS☐

**407. I know how to write computer programs.**

AS☐ A☐ N☐ D☐ DS☐

**408. I know how to install software on a personal computer.**

AS☐ A☐ N☐ D☐ DS☐

**409. I know what email is.**

AS☐ A☐ N☐ D☐ DS☐

**410. I know what a database is.**

AS☐ A☐ N☐ D☐ DS☐

**411. I know what the Internet is.**

AS☐ A☐ N☐ D☐ DS☐

**412. I am computer literate.**

AS☐ A☐ N☐ D☐ DS☐

**413. I regularly use a PC for word processing.**

AS☐ A☐ N☐ D☐ DS☐

**414. I am good at using computers.**

AS☐ A☐ N☐ D☐ DS☐

To what extent do you agree or disagree with the statements for Questions 415 - 441? Please use the following response scale:
AS = Agree strongly
A = Agree somewhat
D = Disagree somewhat
DS = Disagree strongly

**415. Computers do not scare me at all.**

AS☐ A☐ D☐ DS☐

**416. I would like working with computers.**

AS☐ A☐ D☐ DS☐

**417. Working with a computer would make me very nervous.**

AS☐ A☐ D☐ DS☐

**418. I have had many negative experiences working with computers.**

AS☐ A☐ D☐ DS☐

**419. I do not feel threatened when others talk about computers.**

AS☐ A☐ D☐ DS☐

**420. It wouldn't bother me at all to take computer courses.**

AS☐ A☐ D☐ DS☐

**421. I'm no good with computers.**

AS☐ A☐ D☐ DS☐

**422. The challenge of solving problems with computers does not appeal to me.**

AS☐ A☐ D☐ DS☐

**423. Computers make me feel uncomfortable.**

AS☐ A☐ D☐ DS☐

**424. Generally I would feel OK about trying a new problem on the computer.**

AS☐ A☐ D☐ DS☐

**425. I would feel at ease in a computer class.**

AS☐ A☐ D☐ DS☐

**426. I think working with computers would be enjoyable and stimulating.**

AS☐ A☐ D☐ DS☐

**427. I don't think I would enjoy doing advanced computer work.**

AS☐ A☐ D☐ DS☐

**428. Figuring out computer problems does not appeal to me.**

AS☐ A☐ D☐ DS☐

**429. I get a sinking feeling when I think of trying to use a computer.**

AS☐ A☐ D☐ DS☐

**430. I am sure I could do work with computers.**

AS☐ A☐ D☐ DS☐

**431. I would feel comfortable working with a computer.**

AS☐ A☐ D☐ DS☐

**432. I'm not the type to do well with computers.**

AS☐ A☐ D☐ DS☐

**433. I don't understand how some people can spend so much time working with computers and seem to enjoy it.**

AS☐ A☐ D☐ DS☐

**434. Once I start to work with a computer, I would find it hard to stop.**

AS☐ A☐ D☐ DS☐

**435. I think using a computer would be very hard for me.**

AS☐ A☐ D☐ DS☐

**436. I will do as little work with computers as possible.**

AS☐ A☐ D☐ DS☐

**437. Computers make me feel uneasy and confused.**

AS☐ A☐ D☐ DS☐

**438. If a problem is left unsolved in a computer class, I would continue to think about it afterward.**

AS☐ A☐ D☐ DS☐

**439. I do not enjoy talking with others about computers.**

AS☐ A☐ D☐ DS☐

**440. I do not think I could handle a computer course.**

AS☐ A☐ D☐ DS☐

**441. I have a lot of self-confidence when it comes to working with computers.**

AS☐ A☐ D☐ DS☐

**442. I have had many positive experiences working with computers.**

AS☐ A☐ D☐ DS☐

For Questions 443 - 446, please indicate your confidence in your ability to learn the skills below.
Use the following response scale:
0 = I have Low confidence in my ability to learn this skill
10 = I have High confidence in my ability to learn this skill

**443. A new computer by reading a user's manual**

0 1 2 3 4 5 6 7 8 9 10

**444. A new computer by taking a class on it**

0 1 2 3 4 5 6 7 8 9 10

**445. A new computer program by reading a user's manual**

0 1 2 3 4 5 6 7 8 9 10

**446. A new computer program by taking a class on it**

0 1 2 3 4 5 6 7 8 9 10

## Section 6: Your Personality

For Questions 447 to 516, two choices are given. Please indicate which choice you prefer in each pair.

**447.** [redacted]

**448.** [redacted]

**449.** [redacted]

**450.** [redacted]

**451.** [redacted]

**452.** [redacted]

**453.** [redacted]

**454.** [redacted]

**455.** [redacted]

**456.** [redacted]

**457.** [redacted]

**458.** [redacted]

**459.** [redacted]

**460.** [redacted]

**461.** [redacted]

**462.** [redacted]

**463.** [redacted]

**464.** [redacted]

**465.** [redacted]

**466.** [redacted]

467. [redacted]

468. [redacted]

469. [redacted]

470. [redacted]

471. [redacted]

472. [redacted]

473. [redacted]

474. [redacted]

475. [redacted]

476. [redacted]

477. [redacted]

478. [redacted]

479. [redacted]

480. [redacted]

481. [redacted]

482. [redacted]

483. [redacted]

484. [redacted]

485. [redacted]

486. [redacted]

487. [redacted]

488. [redacted]

489. [redacted]

490. [redacted]

491. [redacted]

492. [redacted]

493. [redacted]

494. [redacted]

495. [redacted]

496. [redacted]

497. [redacted]

498. [redacted]

499. [redacted]

500. [redacted]

501. [redacted]

502. [redacted]

503. [redacted]

504. [redacted]

505. [redacted]

506. [redacted]

507. [redacted]

508. [redacted]

509. [redacted]

510. [redacted]

511. [redacted]

512. [redacted]

513. [redacted]

514. [redacted]

515. [redacted]

516. [redacted]

Think about the past month. For Questions 517 to 529, please indicate how well the statement describes your behavior or intention. Please use the following response scale:
VW = This describes me very well
MW = This describes me moderately well
L = This describes me a little
NAA = This does not describe me at all

**517. I can make things happen**

VW☐ MW☐ L☐ NAA☐

**518. Fate plays a strong role in my life**

VW☐ MW☐ L☐ NAA☐

**519. I find it useless to fight the established hierarchy at my company**

VW☐ MW☐ L☐ NAA☐

**520. Circumstances are beyond my control**

VW☐ MW☐ L☐ NAA☐

**521. I need recognition from others to make my life worthwhile**

VW☐ MW☐ L☐ NAA☐

**522. I am easy to like**

VW☐ MW☐ L☐ NAA☐

**523. I have a hard time accepting compliments**

VW☐ MW☐ L☐ NAA☐

**524. I have the ability to get what I want**

VW☐ MW☐ L☐ NAA☐

**525. I feel in control in my life**

VW☐ MW☐ L☐ NAA☐

**526. If I reflect on my life, I might find that I am basically unhappy**

VW☐ MW☐ L☐ NAA☐

**527. I feel frightened and out of control when things change rapidly**

VW☐ MW☐ L☐ NAA☐

**528. I enjoy taking charge of things**

VW☐ MW☐ L☐ NAA☐

**529. I know what I want and I go after it**

VW☐ MW☐ L☐ NAA☐

## Section 7: Your Job

**530. What is your job title?**

_____

**531. What are the primary responsibilities of your job?**

_____

_____

_____

**532. When did you start working at this position?**

_____ month _____ year

**533. When did you start working for this company?**

_____ month _____ year

**534. How are you paid for your work?**

☐ I am paid by the hour
☐ I am paid a salary

**535. How are you employed?**

☐ Full-time, year round
☐ Full-time, seasonal
☐ Part-time, year round
☐ Part-time, seasonal

**536. From the selections below, choose the profession that most closely identifies your job and that of your immediate supervisor:**

| | You | Your Immediate Supervisor |
|---|---|---|
| Architect | ☐ | ☐ |
| Engineer | ☐ | ☐ |
| Contractor | ☐ | ☐ |
| Construction Manager | ☐ | ☐ |
| Administrator | ☐ | ☐ |
| Management | ☐ | ☐ |
| Computer/IT Specialist | ☐ | ☐ |

**537. When did you start working in the profession you identified above?**

_____ month _____ year

**538. From the selections below, which level best identifies your position in your company?**

☐ I am the only person in this company
☐ Executive (CEO, CFO, etc.)
☐ Management (project mangers, superintendents, etc.)
☐ Professional staff (architects, engineers, designers, etc.)
☐ Technical staff (drafters, inspectors, etc.)
☐ Construction labor (carpenters, masons, roofers, etc.)
☐ Administrative staff

**539. Are you responsible for supervising other employees?**

☐ No
☐ Yes .....How many?_____ employees supervised

**540. Do you have the power to hire or fire employees?**

☐ I only have the power to hire new employees
☐ I only have the power to fire existing employees
☐ I have the power to both hire and fire employees
☐ I do not have the power to hire or fire employees

**541. Do you have the power to reward or punish employees?**

- ☐ I only have the power to reward employees
- ☐ I only have the power to punish employees
- ☐ I have the power to both reward and punish employees
- ☐ I do not have the power to reward or punish employees

**542. What do you *hope* to be doing five years from now?**

_____

_____

_____

**543. What do you *really expect* to be doing five years from now?**

_____

_____

_____

**544. Are you the main wage earner in your household?**

- ☐ No
- ☐ Yes

**545. Could your household live adequately if you were not working?**

- ☐ No
- ☐ Yes

## Section 8: Your Company

**546. How many people does your company employ *at this location*?**

- ☐ 5 employees or less
- ☐ 6 - 20 employees
- ☐ 21 - 50 employees
- ☐ 51 - 200 employees
- ☐ 201 - 1000 employees
- ☐ 1001 or more employees

**547. How many people does your company employ *at all locations combined*?**

- ☐ 5 employees or less
- ☐ 6 - 20 employees
- ☐ 21 - 50 employees
- ☐ 51 - 200 employees
- ☐ 201 - 1000 employees
- ☐ 1001 or more employees

**548. What industry does your company work in *at this location*? Check all that apply.**

- ☐ Architecture
- ☐ Engineering
- ☐ General Building Construction (manufacturing, industrial, commercial, institutional)
- ☐ Residential Building Construction (single and multifamily housing)
- ☐ Heavy Construction (highways, streets, bridges, tunnels, utilities)
- ☐ Construction Management

**549. What industry does your company work in *at all locations combined*? Check all that apply.**

- ☐ Architecture
- ☐ Engineering
- ☐ General Building Construction (manufacturing, industrial, commercial, institutional)
- ☐ Residential Building Construction (single and multifamily housing)
- ☐ Heavy Construction (highways, streets, bridges, tunnels, utilities)
- ☐ Construction Management

## Section 9: Yourself

**550. What is your age?**

_____ years

**551. What is your gender?**

- ☐ Female
- ☐ Male

**552. What is the highest level of education you have completed?**

- ☐ Did not complete 8th grade
- ☐ Did not complete high school
- ☐ Did not complete high school, but received a GED
- ☐ High school diploma
- ☐ Some college
- ☐ Associate's degree
  In what? _____
- ☐ Bachelor's degree
  In what? _____
- ☐ Some graduate school
  In what? _____
- ☐ Master's degree or higher
  In what? _____

**553. Are you a member of a union?**

- ☐ No
- ☐ Yes ..... Which one?_____

**554. Do you have a professional license or registration?**

- ☐ No
- ☐ Yes ..... Which one?_____

Thank you for taking the time to complete this questionnaire. Your assistance in providing this information is very much appreciated.

If there are any comments you might have about the survey or any items that may not have been addressed to your satisfaction, please do so in the space provided below. Thanks again for your help!

Please return your completed questionnaire in the envelope provided to:

Kirsten A. Davis
Construction Engineering and Management Program
Via Dept. of Civil and Environmental Engineering
Virginia Polytechnic Institute and State University
200 Patton Hall
Blacksburg, VA 24061-0105 USA

# Appendix E. Analysis of Phase I Data

## *E.1 Variable Names, Types, Normality, Item Numbers*

| Variable Name | Full Name | Variable Type | Normal? | Question Numbers in Phase I Survey |
|---|---|---|---|---|
| ADDEFM | Adaptive Defense Mechanisms | continuous | | Q117-Q118, Q124-Q125 |
| AGE | Age | continuous | | Q550 |
| ATTCOM | Attitudes to Computers | continuous | normal | Q378-Q392 |
| CAIN | Computer Anxiety Index (CAIN) | continuous | | Q334-Q359 |
| CARS | Computer Anxiety Rating Scale (CARS) | continuous | | Q360-Q377 |
| CAS | Computer Attitude Scale (CAS) | continuous | | Q415-Q417, Q419-Q441 |
| CHGSCL | The Change Scale | continuous | normal | Q200-Q208 |
| CLASSQ | Classification questions | continuous | | Q394-Q395 |
| COMPCO | Computer Confidence | continuous | | Q443-Q446 |
| COMPEX | Computer Experience | continuous | normal | Q397 |
| COMPUN | Computer Understanding and Experience Scale | continuous | | Q396, Q398-Q414 |
| COMSIZ | Company size | ordinal | | Q547 |
| COSECA | company industry sector: architecture | nominal | | Q549 |
| COSECE | company industry sector: engineering | nominal | | Q549 |
| COSECG | company industry sector: general building construction | nominal | | Q549 |
| COSECH | company industry sector: heavy construction | nominal | | Q549 |
| COSECM | company industry sector: construction management | nominal | | Q549 |
| COSECR | company industry sector: residential building construction | nominal | | Q549 |
| COSHIM | The Change Opinion Survey: handled improperly | continuous | normal | Q296, Q304, Q312, Q320, Q328 |
| COSHTM | The Change Opinion Survey: hard to meet needs | continuous | | Q293, Q301, Q309, Q317, Q325 |
| COSIWV | The Change Opinion Survey: inconsistent with values | continuous | | Q298, Q306, Q314, Q322, Q330 |
| COSNDS | The Change Opinion Survey: needs already met | continuous | | Q292, Q300, Q308, Q316, Q324 |
| COSRCT | The Change Opinion Survey: responsible can't be trusted | continuous | | Q299, Q307, Q315, Q323, Q331 |
| COSROB | The Change Opinion Survey: risks outweigh benefits | continuous | | Q294, Q302, Q310, Q318, Q326 |
| COSUNN | The Change Opinion Survey: unnecessary | continuous | | Q295, Q303, Q311, Q319, Q327 |
| COSURV | The Change Opinion Survey (complete) | continuous | | Q292-Q331 |
| COSWFL | The Change Opinion Survey: will fail | continuous | | Q297, Q305, Q313, Q321, Q329 |
| CSINDX | Change Seeker Index | continuous | normal | Q8-Q98 |
| DECISN | Decision-maker? | continuous | | Q280-Q281 |
| DISINN | Disposition to Innovation | continuous | | Q7, Q99 |
| EDUCAT | Education level | ordinal | | Q552 |
| EIQCOD | EIQ:Constructive Discontent | continuous | normal | Q143-Q155 |
| EIQPOW | EIQ: Personal Power | continuous | normal | Q517-Q529 |
| EIQRES | EIQ:Resilience | continuous | | Q130-Q142 |
| GENDER | Gender | nominal | | Q551 |
| INEXCO | Internal vs. External Control | continuous | normal | Q157-Q179 |
| INTAMB | Intolerance of Ambiguity | continuous | | Q100-Q115 |
| IPOWCO | Interpersonal power: coercive | continuous | | Q540, Q541 |

| Variable Name | Full Name | Variable Type | Normal? | Question Numbers in Phase I Survey |
|---|---|---|---|---|
| IPOWEX | Interpersonal power: expert | continuous | | Q533, Q537, Q552 |
| IPOWLG | Interpersonal power: legitimate | continuous | | Q539, Q540 |
| IPOWRE | Interpersonal power: reward | continuous | | Q541 |
| IRBSCL | Irrational Belief Scale | continuous | normal | Q180-Q199 |
| JOBIN2 | Job investment (mine) | continuous | | Q532-Q535, Q537 |
| JOBINV | Job Investment | ordinal | | Q542-Q545 |
| KTSEI | The Keirsey Temperament Sorter II (E/I) | nominal | | Q447, Q454, Q461, Q468, Q475, Q482, Q489, Q496, Q503, Q510 |
| KTSJP | The Keirsey Temperament Sorter II (J/P) | nominal | | Q452-Q453, Q459-Q460, Q466-Q467, Q473-Q474, Q480-Q481, Q487-Q488, Q494-Q495, Q501-Q502, Q508-Q509, Q515-Q516 |
| KTSSN | The Keirsey Temperament Sorter II (S/N) | nominal | | Q448-Q449, Q455-Q456, Q462-Q463, Q469-Q470, Q476-Q477, Q483-Q484, Q490-Q491, Q497-Q498, Q504-Q505, Q511-Q512 |
| KTSTF | The Keirsey Temperament Sorter II (T/F) | nominal | | Q450-Q451, Q457-Q458, Q464-Q465, Q471-Q472, Q478-Q479, Q485-Q486, Q492-Q493, Q499-Q500, Q506-Q507, Q513-Q514 |
| LEVORG | Level in organization | ordinal | | Q538-Q541 |
| LICENS | Professional license/ registration? | nominal | | Q554 |
| MADEFM | Maladaptive Defense Mechanisms | continuous | normal | Q116, Q119-Q123, Q126-Q129 |
| MOTIVA | Motivation? | continuous | | Q290-Q291 |
| NEGPRE | Negative previous experiences | ordinal | | Q418 |
| OFFSIZ | Office size | ordinal | | Q546 |
| OFSECA | office industry sector: architecture | nominal | | Q548 |
| OFSECE | office industry sector: engineering | nominal | | Q548 |
| OFSECG | office industry sector: general building construction | nominal | | Q548 |
| OFSECH | office industry sector: heavy construction | nominal | | Q548 |
| OFSECM | office industry sector: construction management | nominal | | Q548 |
| OFSECR | office industry sector: residential building construction | nominal | | Q548 |
| PERFUT | Future Year | nominal | | Q276 |
| PERPAS | Past Year | nominal | | Q275 |
| PNACCP | Psychological Need Fulfillment Inventory: Acceptance | continuous | normal | Q211, Q215, Q219, Q223, Q227, Q231, Q235, Q239, Q243, Q247, Q251, Q255, Q259, Q263, Q267 |
| PNMAST | Psychological Need Fulfillment Inventory: Mastery | continuous | normal | Q209, Q213, Q217, Q221, Q225, Q229, Q233, Q237, Q241, Q245, Q249, Q253, Q257, Q261, Q265 |
| PNMEAN | Psychological Need Fulfillment Inventory: Meaning/Purpose | continuous | normal | Q212, Q216, Q220, Q224, Q228, Q232, Q236, Q240, Q244, Q248, Q252, Q256, Q260, Q264, Q268 |
| PNRESP | Psychological Need Fulfillment Inventory: Respect | continuous | normal | Q210, Q214, Q218, Q222, Q226, Q230, Q234, Q238, Q242, Q246, Q250, Q254, Q258, Q262, Q266 |
| POSPRE | Positive previous experiences | ordinal | | Q442 |

| Variable Name | Full Name | Variable Type | Normal? | Question Numbers in Phase I Survey |
|---|---|---|---|---|
| PRIGID | Personal Rigidity | continuous | | Q1-Q6 |
| PUNISH | Punishments? | continuous | | Q288-Q289 |
| RESRCS | Resources available? | continuous | | Q284-Q285 |
| REWARD | Rewards? | continuous | normal | Q286-Q287 |
| RTCINV | Reaction-to-Change Inventory | continuous | | Q156 |
| SUPCHG | Support for Change | continuous | normal | Q269-Q274, Q332-Q333 |
| TRAING | Training? | continuous | normal | Q282-Q283 |
| TRTECH | Tasks requiring tech. | continuous | normal | Q278-Q279 |
| UNION | Member of union? | nominal | | Q553 |

## *E.2 Summary of Raw Data Set*

The questionnaire has been reproduced with a tally of the responses for each question from the participants of Phase I. Each question indicates how many people marked each choice. Duplicate responses (see section 4.3.1.1) are not included in this tally. Free-response questions (those that did not involve a multiple choice answer) are noted with a ✱✱ and are summarized in this section immediately following the questionnaire.

Copyright permission was not granted for reproduction of some survey questions. These questions were blacked out. The reader is directed to the original source for question wordings.

<u>Blacked out Questions</u>

Questions 6, 8-98: The Change Seeker Index (CSI) (Garlington and Shimota 1964)

Questions 209-268: Psychological Need Fulfillment Inventory (Hultman 1998)

Questions 292-331: The Change Opinion Survey (Hultman 1998)

Questions 447-516: The Keirsey Temperament Sorter II (Keirsey 1998)

# Understanding Technological Change: A Research Study

## Section 1: Your Attitudes Towards Change

For Questions 1 to 99, please indicate whether you agree or disagree with each statement.

1. **I must admit that it makes me angry when other people interfere with my daily activity.**

   15 Agree
   35 Disagree

2. **I find that a well-ordered mode of life with regular hours is congenial to my temperament.**

   32 Agree
   18 Disagree

3. **It bothers me when something unexpected interrupts my daily routine.**

   12 Agree
   38 Disagree

4. **I don't like to undertake any project unless I have a pretty good idea as to how it will turn out.**

   17 Agree
   33 Disagree

5. **I find it hard to set aside a task that I have undertaken, even for a short time.**

   16 Agree
   34 Disagree

6. [redacted]

   26 Agree
   24 Disagree

7. **I wait until products are well established before I considering purchasing them.**

   29 Agree
   21 Disagree

8. [redacted]

   25 Agree
   25 Disagree

9. [redacted]

   17 Agree
   33 Disagree

10. [redacted]

    14 Agree
    36 Disagree

11. [redacted]

    34 Agree
    16 Disagree

12. [redacted]

    36 Agree
    13 Disagree

13. [redacted]

    47 Agree
    3 Disagree

14. [redacted]

    42 Agree
    7 Disagree

15. [redacted]

    21 Agree
    29 Disagree

16. [redacted]

    23 Agree
    26 Disagree

17. [redacted]

    39 Agree
    11 Disagree

18. [redacted]

    32 Agree
    18 Disagree

19. [redacted]

    39 Agree
    11 Disagree

**20.** [redacted]

15 Agree
35 Disagree

**21.** [redacted]

44 Agree
6 Disagree

**22.** [redacted]

18 Agree
32 Disagree

**23.** [redacted]

27 Agree
23 Disagree

**24.** [redacted]

12 Agree
38 Disagree

**25.** [redacted]

20 Agree
30 Disagree

**26.** [redacted]

39 Agree
11 Disagree

**27.** [redacted]

17 Agree
33 Disagree

**28.** [redacted]

36 Agree
14 Disagree

**29.** [redacted]

12 Agree
38 Disagree

**30.** [redacted]

23 Agree
27 Disagree

**31.** [redacted]

37 Agree
13 Disagree

**32.** [redacted]

10 Agree
40 Disagree

**33.** [redacted]

32 Agree
18 Disagree

**34.** [redacted]

7 Agree
43 Disagree

**35.** [redacted]

14 Agree
36 Disagree

**36.** [redacted]

4 Agree
46 Disagree

**37.** [redacted]

16 Agree
34 Disagree

**38.** [redacted]

22 Agree
28 Disagree

**39.** [redacted]

19 Agree
31 Disagree

**40.** [redacted]

15 Agree
35 Disagree

**41.** [redacted]

40 Agree
10 Disagree

**42.** [redacted]

4 Agree
46 Disagree

**43.** [redacted]

14 Agree
36 Disagree

**44.** [redacted]

7 Agree
43 Disagree

**45.** [redacted]

16 Agree
34 Disagree

**46.** [redacted]

47 Agree
3 Disagree

**47.** [redacted]

16 Agree
34 Disagree

**48.** [redacted]

46 Agree
4 Disagree

**49.** [redacted]

23 Agree
27 Disagree

**50.** [redacted]

6 Agree
44 Disagree

**51.** [redacted]

23 Agree
27 Disagree

**52.** [redacted]

42 Agree
8 Disagree

**53.** [redacted]

42 Agree
8 Disagree

**54.** [redacted]

19 Agree
31 Disagree

**55.** [redacted]

31 Agree
19 Disagree

**56.** [redacted]

12 Agree
38 Disagree

**57.** [redacted]

20 Agree
30 Disagree

**58.** [redacted]

15 Agree
35 Disagree

**59.** [redacted]

25 Agree
25 Disagree

**60.** [redacted]

23 Agree
27 Disagree

**61.** [redacted]

30 Agree
19 Disagree

**62.** [redacted]

34 Agree
16 Disagree

**63.** [redacted]

30 Agree
20 Disagree

**64.** [redacted]

40 Agree
10 Disagree

**65.** [redacted]

5 Agree
45 Disagree

**66.** [redacted]

22 Agree
28 Disagree

**67.** [redacted]

44 Agree
6 Disagree

**68.** [redacted]

31 Agree
19 Disagree

**69.** [redacted]

4 Agree
46 Disagree

**70.** [redacted]

19 Agree
30 Disagree

**71.** [redacted]

31 Agree
19 Disagree

**72.** [redacted]

27 Agree
23 Disagree

**73.** [redacted]

14 Agree
36 Disagree

**74.** [redacted]

47 Agree
3 Disagree

**75.** [redacted]

25 Agree
25 Disagree

**76.** [redacted]

48 Agree
2 Disagree

**77.** [redacted]

9 Agree
41 Disagree

**78.** [redacted]

22 Agree
28 Disagree

**79.** [redacted]

11 Agree
39 Disagree

**80.** [redacted]

35 Agree
15 Disagree

**81.** [redacted]

25 Agree
25 Disagree

**82.** [redacted]

26 Agree
24 Disagree

**83.** [redacted]

22 Agree
27 Disagree

**84.** [redacted]

25 Agree
25 Disagree

**85.** [redacted]

4 Agree
46 Disagree

**86.** [redacted]

12 Agree
38 Disagree

**87.** [redacted]

5 Agree
45 Disagree

**88.** [redacted]

9 Agree
41 Disagree

**89.** [redacted]

39 Agree
11 Disagree

**90.** [redacted]

35 Agree
15 Disagree

**91.** [redacted]

31 Agree
19 Disagree

**92.** [redacted]

33 Agree
17 Disagree

**93.** [redacted]

34 Agree
16 Disagree

**94.** [redacted]

31 Agree
19 Disagree

**95.** [redacted]

39 Agree
11 Disagree

**96.** [redacted]

31 Agree
19 Disagree

**97.** [redacted]

27 Agree
23 Disagree

**98.** [redacted]

19 Agree
30 Disagree

**99. I am likely to rush out and buy the latest new products as soon as they are available.**

3 Agree
47 Disagree

To what extent do you agree or disagree with the statements for Questions 100 to 129?

**100. An expert who doesn't come up with a definite answer probably doesn't know too much.**

| Agree Strongly | | | | | | Disagree Strongly |
|---|---|---|---|---|---|---|
| 4 | 6 | 9 | 9 | 7 | 8 | 6 |

**101. People who fit their lives to a schedule probably miss most of the joy of living.**

| Agree Strongly | | | | | | Disagree Strongly |
|---|---|---|---|---|---|---|
| 2 | 10 | 12 | 4 | 10 | 9 | 2 |

**102. There is really no such thing as a problem that can't be solved.**

| Agree Strongly | | | | | | Disagree Strongly |
|---|---|---|---|---|---|---|
| 16 | 7 | 9 | 6 | 2 | 5 | 4 |

**103. I would like to live in a foreign country for a while.**

| Agree Strongly | | | | | | Disagree Strongly |
|---|---|---|---|---|---|---|
| 8 | 3 | 7 | 5 | 5 | 10 | 11 |

**104. A good job is one where what is to be done and how it is to be done are always clear.**

| Agree Strongly | | | | | | Disagree Strongly |
|---|---|---|---|---|---|---|
| 5 | 8 | 3 | 11 | 6 | 11 | 5 |

**105. It is more fun to tackle a complicated problem than to solve a simple one.**

| Agree Strongly | | | | | | Disagree Strongly |
|---|---|---|---|---|---|---|
| 17 | 16 | 5 | 7 | 1 | 2 | 1 |

**106. In the long run it is possible to get more done by tackling small, simple problems rather than large and complicated ones.**

| Agree Strongly | | | | | | Disagree Strongly |
|---|---|---|---|---|---|---|
| 5 | 5 | 11 | 10 | 10 | 2 | 6 |

**107. Often the most interesting and stimulating people are those who don't mind being different and original.**

| Agree Strongly | | | | | | Disagree Strongly |
|---|---|---|---|---|---|---|
| 19 | 15 | 6 | 6 | 0 | 2 | 1 |

**108. What we are used to is always preferable to what is unfamiliar.**

| Agree Strongly | | | | | | Disagree Strongly |
|---|---|---|---|---|---|---|
| 4 | 7 | 8 | 7 | 6 | 9 | 8 |

**109. People who insist upon a yes or no answer just don't know how complicated things really are.**

| Agree Strongly | | | | | | Disagree Strongly |
|---|---|---|---|---|---|---|
| 6 | 10 | 10 | 9 | 6 | 5 | 3 |

**110. A person who leads an even, regular life in which few surprises or unexpected happenings arise, really has a lot to be grateful for.**

| Agree Strongly | | | | | | Disagree Strongly |
|---|---|---|---|---|---|---|
| 2 | 4 | 15 | 10 | 8 | 4 | 6 |

**111. Many of our most important decisions are based upon insufficient information.**

| Agree Strongly | | | | | | Disagree Strongly |
|---|---|---|---|---|---|---|
| 4 | 11 | 14 | 9 | 3 | 4 | 4 |

**112. I like parties where I know most of the people more than ones where all or most of the people are complete strangers.**

| Agree Strongly | | | | | | Disagree Strongly |
|---|---|---|---|---|---|---|
| 14 | 16 | 5 | 4 | 4 | 4 | 2 |

**113. Teachers or supervisors who hand out vague assignments give a chance for one to show initiative and originality.**

| Agree Strongly | | | | | | Disagree Strongly |
|---|---|---|---|---|---|---|
| 7 | 10 | 9 | 8 | 6 | 5 | 4 |

**114. The sooner we all acquire similar values and ideals the better.**

| Agree Strongly | | | | | | Disagree Strongly |
|---|---|---|---|---|---|---|
| 0 | 2 | 8 | 8 | 6 | 11 | 14 |

**115. A good teacher is one who makes you wonder about your way of looking at things.**

| Agree Strongly | | | | | | Disagree Strongly |
|---|---|---|---|---|---|---|
| 22 | 15 | 4 | 2 | 1 | 2 | 3 |

**116. I often act impulsively when something is bothering me.**

| Agree Strongly | | | | | | Disagree Strongly |
|---|---|---|---|---|---|---|
| 3 | 5 | 10 | 5 | 5 | 18 | 3 |

**117. I am able to laugh at myself pretty easily.**

| Agree Strongly | | | | | | Disagree Strongly |
|---|---|---|---|---|---|---|
| 18 | 19 | 4 | 5 | 1 | 2 | 0 |

**118. When I have to face a difficult situation I try to imagine what it will be like and plan ways to cope with it.**

| Agree Strongly | | | | | | Disagree Strongly |
|---|---|---|---|---|---|---|
| 14 | 17 | 10 | 4 | 3 | 1 | 0 |

**119. I'm often told that I don't show my feelings.**

| Agree Strongly | | | | | | Disagree Strongly |
|---|---|---|---|---|---|---|
| 6 | 13 | 5 | 4 | 6 | 8 | 7 |

**120. People say I tend to ignore unpleasant facts as if they didn't exist.**

| Agree Strongly | | | | | | Disagree Strongly |
|---|---|---|---|---|---|---|
| 3 | 4 | 6 | 6 | 8 | 16 | 6 |

**121. I have special talents that allow me to go through life with no problems.**

| Agree Strongly | | | | | | Disagree Strongly |
|---|---|---|---|---|---|---|
| 4 | 3 | 7 | 5 | 5 | 9 | 16 |

**122. I am sure I get a raw deal from life.**

| Agree Strongly | | | | | | Disagree Strongly |
|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 3 | 7 | 12 | 27 |

**123. I get openly aggressive when I feel hurt.**

| Agree Strongly | | | | | | Disagree Strongly |
|---|---|---|---|---|---|---|
| 5 | 2 | 5 | 6 | 6 | 18 | 7 |

**124. I'm usually able to see the funny side of an otherwise painful predicament.**

| Agree Strongly | | | | | | Disagree Strongly |
|---|---|---|---|---|---|---|
| 5 | 15 | 16 | 8 | 4 | 1 | 0 |

**125. If I can predict that I'm going to be sad ahead of time, I can cope better.**

| Agree Strongly | | | | | | Disagree Strongly |
|---|---|---|---|---|---|---|
| 4 | 7 | 7 | 14 | 2 | 8 | 7 |

**126. Often I find that I don't feel anything when the situation would seem to warrant strong emotions.**

| Agree Strongly | | | | | | Disagree Strongly |
|---|---|---|---|---|---|---|
| 5 | 5 | 14 | 6 | 4 | 10 | 5 |

**127. I fear nothing.**

| Agree Strongly | | | | | | Disagree Strongly |
|---|---|---|---|---|---|---|
| 3 | 5 | 2 | 2 | 5 | 7 | 25 |

**128. I ignore danger as if I were Superman.**

| Agree Strongly | | | | | | Disagree Strongly |
|---|---|---|---|---|---|---|
| 0 | 2 | 7 | 2 | 5 | 9 | 24 |

**129. People tend to mistreat me.**

| Agree Strongly | | | | | | Disagree Strongly |
|---|---|---|---|---|---|---|
| 0 | 2 | 0 | 3 | 2 | 22 | 19 |

Think about the past month. For Questions 130 to 155, please indicate how well the statement describes your behavior or intention. Please use the following response scale:
VW = This describes me very well
MW = This describes me moderately well
L = This describes me a little
NAA = This does not describe me at all

**130. I can bounce back after feeling disappointed**

VW 24 MW 20 L 4 NAA 1

**131. I can accomplish what I need to if I put my mind to it**

VW 35 MW 14 L 0 NAA 0

**132. Obstacles or problems in my life have resulted in unexpected changes for the better**

VW 11 MW 26 L 11 NAA 1

**133. I find it easy to wait patiently when I need to**

VW 16 MW 18 L 11 NAA 4

**134. There is always more than one right answer**

VW 14 MW 22 L 10 NAA 3

**135. I know how to satisfy all parts of myself**

VW 4 MW 27 L 14 NAA 4

**136. I am not one to procrastinate**

VW 7 MW 10 L 20 NAA 12

**137. I am afraid to try something again when I have failed at it before**

VW 5 MW 4 L 23 NAA 17

**138. I decide certain problems are not worth worrying about**

VW 14 MW 20 L 12 NAA 3

**139. I relax myself when tension builds up**

VW 6 MW 24 L 14 NAA 5

**140. I can see the humorous side of situations**

VW 23 MW 23 L 3 NAA 0

**141. I often put things aside for a while to get a perspective on them**

VW 7 MW 33 L 9 NAA 0

**142. When I encounter a problem, I focus on what I can do to solve it**

VW 27 MW 20 L 2 NAA 0

**143. I can disagree effectively to bring about change**

VW 7 MW 25 L 17 NAA 0

**144. I would not express my feelings if I believed they would cause a disagreement**

VW 3 MW 16 L 15 NAA 14

**145. When it comes right down to it, I can only trust myself to get things done**

VW 7 MW 9 L 24 NAA 9

**146. I remain calm even in situations where others get angry**

VW 15 MW 19 L 13 NAA 2

**147. It is better not to stir up problems if you can avoid doing so**

VW 12 MW 24 L 10 NAA 3

**148. I have a hard time getting consensus from my work team**

VW 2 MW 2 L 21 NAA 24

**149. I solicit feedback from my peers on my performance**

VW 6 MW 21 L 16 NAA 6

**150. I am good at organizing and motivating groups of people**

VW 8 MW 28 L 11 NAA 2

**151. I enjoy the challenge of facing and solving problems at work**

VW 22 MW 26 L 1 NAA 0

**152. I listen to criticism with an open mind and accept it when it is justified**

VW 13 MW 31 L 4 NAA 1

**153. I let things build up to a crisis point before talking about it**

VW 2 MW 10 L 22 NAA 15

**154. When I make a critical comment I focus on the behavior and not the person**

VW 6 MW 28 L 11 NAA 4

**155. I avoid confrontations**

VW 9 MW 21 L 12 NAA 7

**156. Mark the words below that you most frequently associate with a change.**

| | | | | | |
|---|---|---|---|---|---|
| 37 | Adjust | 22 | Alter | 5 | Ambiguity |
| 7 | Anxiety | 14 | Better | 25 | Challenging |
| 15 | Chance | 4 | Concern | 5 | Death |
| 3 | Deteriorate | 25 | Different | 6 | Disruption |
| 17 | Exciting | 3 | Fear | 11 | Fun |
| 23 | Grow | 21 | Improve | 27 | Learn |
| 24 | Modify | 26 | New | 30 | Opportunity |
| 6 | Rebirth | 12 | Replace | 18 | Revise |
| 6 | Stress | 5 | Transfer | 24 | Transition |
| 19 | Uncertainty | 4 | Upheaval | 12 | Vary |

For Questions 157 to 179, two statements are given. Please indicate which statement you prefer in each pair.

**157.** 19 **Many of the unhappy things in people's lives are partly due to bad luck.**
29 **People's misfortunes result from the mistakes they make.**

**158.** 5 **One of the major reasons why we have wars is because people don't take enough interest in politics.**
44 **There will always be wars, no matter how hard people try to prevent them.**

**159.** 22 **In the long run people get the respect they deserve in this world.**
26 **Unfortunately, an individual's worth often passes unrecognized no matter how hard he tries.**

**160.** 30 **The idea that teachers are unfair to students is nonsense.**
18 **Most students don't realize the extent to which their grades are influenced by accidental happenings.**

**161.** 8 **Without the right breaks one cannot be an effective leader.**
39 **Capable people who fail to become leaders have not taken advantage of their opportunities.**

**162.** 37 **No matter how hard you try some people just don't like you.**
12 **People who can't get others to like them don't understand how to get along with others.**

**163.** 26 **I have often found that what is going to happen will happen.**
22 **Trusting to fate has never turned out as well for me as making a decision to take a definite action.**

**164.** 43 **In the case of the well prepared student there is rarely if ever such a thing as an unfair test.**
6 **Many times exam questions tend to be so unrelated to course work that studying is really useless.**

**165.** 32 **Becoming a success is a matter of hard work, luck has little or nothing to do with it.**
16 **Getting a good job depends mainly on being in the right place at the right time.**

**166.** 34 **The average citizen can have an influence in government decisions.**
15 **This world is run by the few people in power, and there is not much the little guy can do about it.**

**167.** 39 **When I make plans, I am almost certain that I can make them work.**
10 **It is not always wise to plan too far ahead because many things turn out to be a matter of good or bad fortune anyhow.**

**168.** 43 **In my case getting what I want has little or nothing to do with luck.**
6 **Many times we might just as well decide what to do by flipping a coin.**

**169.** 8 **Who gets to be the boss often depends on who was lucky enough to be in the right place first.**
41 **Getting people to do the right thing depends upon ability, luck has little or nothing to do with it.**

**170.** 26 **As far as world affairs are concerned, most of us are the victims of forces we can neither understand, nor control.**
22 **By taking an active part in political and social affairs the people can control world events.**

**171.** 27 **Most people don't realize the extent to which their lives are controlled by accidental happenings.**
22 **There really is no such thing as "luck."**

**172.** 29 **It is hard to know whether or not a person really likes you.**
19 **How many friends you have depends on how nice a person you are.**

**173.** 29 **In the long run the bad things that happen to us are balanced by the good ones.**
17 **Most misfortunes are the result of lack of ability, ignorance, laziness, or all three.**

**174.** 15 **With enough effort we can wipe out political corruption.**
32 **It is difficult for people to have much control over the things politicians do in office.**

**175.** 7 **Sometimes I can't understand how teachers arrive at the grades they give.**
42 **There is a direct connection between how hard I study and the grades I get.**

**176.** 21 **Many times I feel that I have little influence over the things that happen to me.**
26 **It is impossible for me to believe that chance or luck plays an important role in my life.**

**177.** 22 **People are lonely because they don't try to be friendly.**
25 **There's not much use in trying too hard to please people, if they like you, they like you.**

**178.** 42 **What happens to me is my own doing.**
6 **Sometimes I feel that I don't have enough control over the direction my life is taking.**

**179.** 18 **Most of the time I can't understand why politicians behave the way they do.**
30 **In the long run the people are responsible for bad government on a national as well as on a local level.**

To what extent do you agree or disagree with the statements for Questions 180 to 199? Please use the following response scale:
AS = Agree strongly
A = Agree
N = Neither agree nor disagree
D = Disagree
DS = Disagree strongly

**180. To be happy, I must maintain the approval of all the persons I consider significant.**
AS 3 A 14 N 7 D 15 DS 10

**181. To be a worthwhile person, I must be thoroughly competent in everything I do.**
AS 6 A 10 N 11 D 16 DS 6

**182. Individuals who take unfair advantage of me should be punished.**
AS 7 A 16 N 16 D 8 DS 2

**183. It is terrible when things do not go the way I would like.**
AS 2 A 7 N 14 D 22 DS 4

**184. My negative emotions are the result of external pressures.**
AS 2 A 13 N 12 D 17 DS 5

**185. If there is a risk that something bad will happen, it makes sense to be upset.**
AS 1 A 9 N 11 D 21 DS 7

**186. It is better to ignore personal problems than to try to solve them.**
AS 0 A 0 N 3 D 21 DS 25

**187. Many events from my past so strongly influence me that it is impossible to change.**
AS 0 A 5 N 6 D 28 DS 10

**188. I dislike having any uncertainty about my future.**
AS 4 A 17 N 10 D 9 DS 9

**189. Life should be easier than it is.**
AS 0 A 16 N 15 D 14 DS 4

**190. To be happy I must be loved by the persons who are important to me.**
AS 10 A 18 N 11 D 7 DS 3

**191. I must keep achieving in order to be satisfied with myself.**
AS 11 A 24 N 7 D 6 DS 1

**192. Most people who have been unfair to me are generally bad individuals.**
AS 2 A 7 N 18 D 21 DS 1

**193. It is awful when something I want to happen does not occur.**
AS 1 A 10 N 9 D 27 DS 2

**194. I cannot help how I feel when everything is going wrong.**
AS 5 A 20 N 6 D 16 DS 2

**195. When it looks as if something might be wrong, it is reasonable to be quite concerned.**
AS 4 A 34 N 5 D 6 DS 0

**196. It makes more sense to wait than to try to improve a bad life situation.**
AS 1 A 2 N 3 D 24 DS 19

**197. Some of my ways of acting are so ingrained that I could never change them.**
AS 0 A 7 N 13 D 21 DS 8

**198. I hate it when I cannot eliminate an uncertainty.**
AS 1 A 18 N 11 D 16 DS 3

**199. Things should turn out better than they usually do.**
AS 0 A 8 N 17 D 22 DS 2

To what extent do you agree or disagree with the statements for Questions 200 to 207? Please use the following response scale:
AS = agree strongly
A = agree somewhat
U = undecided
D = disagree somewhat
DS = disagree strongly

**200. If I could do as I pleased, I would change the kind of work I do every few months.**

AS 0 A 16 U 3 D 20 DS 10

**201. One can never feel at ease on a job where the ways of doing things are always being changed.**

AS 3 A 13 U 3 D 27 DS 3

**202. The trouble with most jobs is that you just get used to doing things in one way and then they want you to do them differently.**

AS 1 A 9 U 6 D 27 DS 6

**203. I would prefer to stay with a job that I know I can handle than to change to one where most things would be new to me.**

AS 0 A 15 U 5 D 24 DS 5

**204. The trouble with many people is that when they find a job they can do well, they don't stick with it.**

AS 1 A 7 U 14 D 22 DS 5

**205. I like a job where I know that I will be doing my work about the same way from one week to the next.**

AS 1 A 15 U 15 D 12 DS 6

**206. When I get used to doing things in one way it is disturbing to have to change to a new method.**

AS 1 A 10 U 8 D 26 DS 4

**207. It would take a sizeable raise in pay to get me to voluntarily transfer to another job.**

AS 2 A 18 U 9 D 17 DS 3

**208. The job that you would consider ideal for you would be one where the way you do your work:**

| Is always the same | | | | Changes a great deal |
|---|---|---|---|---|
| 0 | 5 | 25 | 14 | 5 |

## Section 2: Your Company and Change

To what extent do you agree or disagree with the statements for Questions 209 to 268? Please use the following response scale:
AS = agree strongly
A = agree somewhat
U = undecided
D = disagree somewhat
DS = disagree strongly

**209.**

AS 1 A 12 U 11 D 21 DS 4

**210.**

AS 0 A 12 U 10 D 22 DS 5

**211.**

AS 2 A 19 U 6 D 15 DS 7

**212.**

AS 1 A 18 U 10 D 14 DS 6

**213.**

AS 2 A 6 U 4 D 27 DS 10

**214.**

AS 4 A 12 U 7 D 18 DS 8

**215.**

AS 1 A 6 U 7 D 20 DS 15

**216.**

AS 1 A 16 U 13 D 15 DS 4

**217.**

AS 1 A 4 U 4 D 30 DS 10

**218.**

AS 1 A 4 U 5 D 22 DS 17

**219.**

AS 1 A 10 U 6 D 20 DS 12

**220.**
AS 0 A 7 U 3 D 22 DS 17

**221.**
AS 2 A 9 U 7 D 24 DS 7

**222.**
AS 1 A 8 U 8 D 25 DS 7

**223.**
AS 2 A 2 U 4 D 21 DS 20

**224.**
AS 3 A 2 U 3 D 21 DS 20

**225.**
AS 0 A 2 U 5 D 28 DS 14

**226.**
AS 0 A 8 U 6 D 21 DS 14

**227.**
AS 2 A 11 U 3 D 21 DS 12

**228.**
AS 5 A 12 U 9 D 17 DS 6

**229.**
AS 3 A 11 U 9 D 23 DS 3

**230.**
AS 1 A 6 U 5 D 23 DS 14

**231.**
AS 3 A 19 U 4 D 19 DS 4

**232.**
AS 1 A 16 U 7 D 20 DS 5

**233.**
AS 1 A 7 U 6 D 27 DS 8

**234.**
AS 1 A 7 U 9 D 23 DS 9

**235.**
AS 1 A 18 U 7 D 18 DS 5

**236.**
AS 0 A 13 U 7 D 22 DS 7

**237.**
AS 0 A 5 U 14 D 26 DS 4

**238.**
AS 1 A 10 U 10 D 21 DS 7

**239.**
AS 1 A 4 U 7 D 31 DS 6

**240.**
AS 2 A 10 U 4 D 26 DS 7

**241.**
AS 1 A 11 U 5 D 18 DS 13

**242.**
AS 0 A 7 U 14 D 19 DS 9

**243.**
AS 2 A 16 U 6 D 13 DS 11

**244.**
AS 1 A 5 U 8 D 26 DS 9

**245.**
AS 1 A 18 U 4 D 18 DS 8

**246.**
AS 1 A 8 U 5 D 23 DS 12

**247.**
AS 0 A 8 U 7 D 22 DS 11

**248.**
AS 1 A 5 U 5 D 27 DS 11

**249.** [redacted]

AS 1 A 17 U 4 D 19 DS 8

**250.** [redacted]

AS 0 A 6 U 8 D 23 DS 12

**251.** [redacted]

AS 1 A 11 U 11 D 18 DS 8

**252.** [redacted]

AS 0 A 13 U 7 D 24 DS 5

**253.** [redacted]

AS 2 A 9 U 7 D 29 DS 2

**254.** [redacted]

AS 2 A 16 U 8 D 15 DS 8

**255.** [redacted]

AS 0 A 2 U 7 D 31 DS 9

**256.** [redacted]

AS 0 A 4 U 7 D 28 DS 10

**257.** [redacted]

AS 0 A 9 U 4 D 30 DS 6

**258.** [redacted]

AS 1 A 7 U 16 D 16 DS 9

**259.** [redacted]

AS 0 A 7 U 2 D 31 DS 9

**260.** [redacted]

AS 2 A 18 U 7 D 18 DS 4

**261.** [redacted]

AS 1 A 11 U 5 D 26 DS 6

**262.** [redacted]

AS 1 A 7 U 9 D 23 DS 9

**263.** [redacted]

AS 2 A 4 U 3 D 28 DS 12

**264.** [redacted]

AS 1 A 9 U 7 D 26 DS 6

**265.** [redacted]

AS 1 A 8 U 9 D 22 DS 9

**266.** [redacted]

AS 1 A 4 U 10 D 26 DS 8

**267.** [redacted]

AS 2 A 9 U 11 D 17 DS 10

**268.** [redacted]

AS 0 A 10 U 6 D 25 DS 8

To what extent do you feel that the statements for Questions 269 to 274 are true or not?

**269. People throughout my organization share values or visions.**

| True | | | | | | Not True |
|---|---|---|---|---|---|---|
| 8 | 14 | 15 | 6 | 4 | 1 | 1 |

**270. My organization has a good track record in implementing change smoothly.**

| True | | | | | | Not True |
|---|---|---|---|---|---|---|
| 5 | 13 | 17 | 8 | 4 | 2 | 0 |

**271. There is a lot of cooperation and trust throughout my organization (as opposed to animosity).**

| True | | | | | | Not True |
|---|---|---|---|---|---|---|
| 11 | 11 | 12 | 10 | 3 | 1 | 1 |

**272. My organization's culture supports risk taking (as opposed to being highly bureaucratic and rule bound).**

| True | | | | | | Not True |
|---|---|---|---|---|---|---|
| 7 | 11 | 10 | 6 | 5 | 4 | 5 |

**273. People are able to handle change (as opposed to being worn out from recent, unsettling changes).**

| True | | | | | | Not True |
|---|---|---|---|---|---|---|
| 7 | 12 | 13 | 10 | 6 | 1 | 0 |

**274. My organization rewards people who take part in change efforts (as opposed to subtly punishing those who take the time off other work to get involved).**

| True | | | | | | Not True |
|---|---|---|---|---|---|---|
| 4 | 16 | 14 | 9 | 4 | 2 | 0 |

## Section 3: Technological Changes Occurring Within Your Company

**275. Over the past year, have any technological changes happened in your company?** Some examples of technological change include using computers for tasks that previously did not use them, introducing new computer software or programs, and changes in existing computer systems. Please include changes currently in progress.

12 No
36 Yes..... Please describe the changes below. Try to be as specific as you can.

**

**276. Are you aware of any technological changes planned for the next year?**

30 No
18 Yes..... Please describe the changes below. Try to be as specific as you can.

**

If you answered **No** to both Question 275 and Question 276, please skip to Question 334, page 15.
If you answered **Yes** to either question, please continue with Question 277.

**277. Of all the changes that you described, which one do you feel affected (or will affect) you the most?**

**

Please answer Questions 278 to 333 based on the technological change that you indicated in Question 277.

**278. Do you think the change has affected (or will affect) the way you interact with others?**

| A great deal | | | | | Not at all | Don't know |
|---|---|---|---|---|---|---|
| 1 | 6 | 4 | 4 | 8 | 14 | 1 |

**279. How do you feel about this?**

| Like it very much | | | | | Dislike it very much |
|---|---|---|---|---|---|
| 13 | 9 | 7 | 4 | 2 | 0 |

**280. Have you been (or will you be) involved in the decision to make the change?**

| A great deal | | | | | Not at all | Don't know |
|---|---|---|---|---|---|---|
| 9 | 4 | 9 | 2 | 2 | 11 | 1 |

**281. How do you feel about this?**

| Like it very much | | | | | Dislike it very much |
|---|---|---|---|---|---|
| 11 | 6 | 14 | 5 | 0 | 0 |

**282. Have you received (or will you receive) training to prepare for the change?**

| A great deal | | | | | Not at all | Don't know |
|---|---|---|---|---|---|---|
| 4 | 5 | 6 | 6 | 4 | 9 | 3 |

**283. How do you feel about this?**

| Like it very much | | | | | Dislike it very much |
|---|---|---|---|---|---|
| 6 | 5 | 15 | 4 | 4 | 2 |

**284. Have adequate resources been available (or will they be available) to you during the change?**

| A great deal | | | | | Not at all | Don't know |
|---|---|---|---|---|---|---|
| 4 | 15 | 7 | 4 | 4 | 0 | 3 |

**285. How do you feel about this?**

| Like it very much | | | | | Dislike it very much |
|---|---|---|---|---|---|
| 5 | 12 | 10 | 3 | 2 | 3 |

**286. Were you (or will you be) given any rewards for using the new technology?**

| A great deal | | | | | Not at all | Don't know |
|---|---|---|---|---|---|---|
| 2 | 2 | 4 | 7 | 2 | 15 | 5 |

**287. How do you feel about this?**

| Like it very much | | | | | Dislike it very much |
|---|---|---|---|---|---|
| 5 | 3 | 13 | 9 | 2 | 3 |

**288. Were there (or will there be) any punishments for <u>not</u> using the new technology?**

| A great deal | | | | | Not at all | Don't know |
|---|---|---|---|---|---|---|
| 4 | 2 | 0 | 5 | 8 | 14 | 4 |

**289. How do you feel about this?**

| Like it very much | | | | | Dislike it very much |
|---|---|---|---|---|---|
| 11 | 7 | 6 | 9 | 1 | 0 |

**290. How motivated were you (or are you) to use the new technology?**

| A great deal | | | | | Not at all |
|---|---|---|---|---|---|
| 18 | 11 | 4 | 2 | 0 | 2 |

**291. Do you think you resisted (or will resist) the technological change at all?**

| A great deal | | | | | Not at all |
|---|---|---|---|---|---|
| 0 | 1 | 3 | 3 | 6 | 24 |

To what extent do you agree or disagree with the statements for Questions 292 to 331? Please use the following response scale:
AS = agree strongly
A = agree somewhat
U = undecided
D = disagree somewhat
DS = disagree strongly

**292.** [redacted]
AS 0 A 2 U 2 D 14 DS 20

**293.** [redacted]
AS 0 A 6 U 2 D 16 DS 14

**294.** [redacted]
AS 3 A 3 U 3 D 16 DS 13

**295.** [redacted]
AS 0 A 10 U 1 D 14 DS 13

**296.** [redacted]
AS 3 A 11 U 5 D 12 DS 7

**297.** [redacted]
AS 0 A 1 U 1 D 16 DS 20

**298.** [redacted]
AS 1 A 3 U 2 D 18 DS 14

**299.** [redacted]
AS 1 A 2 U 2 D 15 DS 18

**300.** [redacted]
AS 0 A 5 U 3 D 12 DS 18

**301.** [redacted]
AS 1 A 2 U 3 D 10 DS 22

**302.** [redacted]
AS 1 A 0 U 1 D 13 DS 23

**303.** [redacted]
AS 0 A 4 U 1 D 15 DS 18

**304.** [redacted]
AS 1 A 2 U 1 D 16 DS 18

**305.** [redacted]
AS 0 A 2 U 2 D 18 DS 16

**306.** [redacted]
AS 1 A 0 U 2 D 14 DS 21

**307.** [redacted]
AS 1 A 0 U 2 D 18 DS 17

**308.** [redacted]
AS 1 A 2 U 6 D 16 DS 13

**309.** [redacted]
AS 0 A 1 U 0 D 19 DS 18

**310.** [redacted]
AS 0 A 0 U 1 D 15 DS 22

**311.** [redacted]
AS 1 A 5 U 9 D 14 DS 9

**312.** [redacted]
AS 1 A 9 U 1 D 16 DS 11

**313.** [redacted]
AS 1 A 1 U 5 D 18 DS 13

**314.** [redacted]

AS 2 A 2 U 2 D 19 DS 13

**315.** [redacted]

AS 0 A 2 U 1 D 15 DS 20

**316.** [redacted]

AS 0 A 3 U 3 D 17 DS 15

**317.** [redacted]

AS 1 A 8 U 4 D 11 DS 14

**318.** [redacted]

AS 1 A 0 U 2 D 16 DS 19

**319.** [redacted]

AS 0 A 1 U 3 D 14 DS 20

**320.** [redacted]

AS 1 A 0 U 7 D 18 DS 12

**321.** [redacted]

AS 0 A 3 U 5 D 15 DS 15

**322.** [redacted]

AS 2 A 1 U 4 D 15 DS 16

**323.** [redacted]

AS 0 A 2 U 2 D 14 DS 20

**324.** [redacted]

AS 0 A 7 U 3 D 17 DS 11

**325.** [redacted]

AS 0 A 8 U 6 D 12 DS 12

**326.** [redacted]

AS 0 A 1 U 3 D 16 DS 18

**327.** [redacted]

AS 0 A 8 U 4 D 12 DS 14

**328.** [redacted]

AS 0 A 1 U 2 D 21 DS 14

**329.** [redacted]

AS 0 A 3 U 2 D 15 DS 18

**330.** [redacted]

AS 0 A 4 U 1 D 18 DS 15

**331.** [redacted]

AS 0 A 0 U 4 D 12 DS 22

To what extent do you feel that the statements for Questions 332 to 333 are true or not?

**332. People will be able to maintain respect and status when the change is implemented (as opposed to losing these as a result of the change).**

| True | | | | | | Not True |
|---|---|---|---|---|---|---|
| 23 | 10 | 1 | 2 | 1 | 0 | 1 |

**333. The change will be mild (and not cause a major disruption of the status quo).**

| True | | | | | | Not True |
|---|---|---|---|---|---|---|
| 19 | 12 | 1 | 4 | 1 | 0 | 1 |

## Section 4: Your Attitudes Towards Technology

To what extent do you agree or disagree with the statements for Questions 334 to 392? Please use the following response scale:
AS = agree strongly
A = agree somewhat
U = undecided
D = disagree somewhat
DS = disagree strongly
Answer quickly with your first reaction to each statement and use the "undecided" choice as little as possible.

**334. Having a computer available to me would improve my productivity.**

AS 30 A 10 U 4 D 5 DS 0

**335. If I had to use a computer for some reason, it would probably save me some time and work.**

AS 28 A 15 U 4 D 2 DS 0

**336. If I used a computer, I could get a better picture of the facts and figures.**

AS 25 A 20 U 1 D 3 DS 0

**337. Having a computer available to me would improve my general satisfaction.**

AS 24 A 19 U 5 D 1 DS 0

**338. Having to use a computer could make my life less enjoyable.**

AS 1 A 1 U 4 D 22 DS 21

**339. Having a computer available to me could make things easier for me.**

AS 26 A 18 U 4 D 1 DS 0

**340. I feel very negative about computers in general.**

AS 0 A 2 U 3 D 15 DS 29

**341. Having a computer available to me could make things more fun for me.**

AS 16 A 21 U 7 D 5 DS 0

**342. If I had a computer at my disposal, I would try to get rid of it.**

AS 0 A 0 U 2 D 12 DS 35

**343. I look forward to a time when computers are more widely used.**

AS 11 A 19 U 11 D 7 DS 1

**344. I doubt if I would ever use computers very much.**

AS 0 A 2 U 1 D 13 DS 33

**345. I avoid using computers whenever I can.**

AS 0 A 2 U 2 D 18 DS 27

**346. I enjoy using computers.**

AS 21 A 21 U 6 D 1 DS 0

**347. I feel that there are too many computers around now.**

AS 0 A 8 U 4 D 20 DS 17

**348. Computers are probably going to be an important part of my life.**

AS 25 A 20 U 1 D 3 DS 0

**349. A computer could make learning fun.**

AS 20 A 26 U 2 D 1 DS 0

**350. If I were to use a computer, I could get a lot of satisfaction from it.**

AS 19 A 18 U 8 D 4 DS 0

**351. If I had to use a computer, it would probably be more trouble than it's worth.**

AS 0 A 2 U 4 D 23 DS 20

**352. I am usually uncomfortable when I have to use a computer.**

AS 2 A 1 U 6 D 14 DS 26

**353. I sometimes get nervous just thinking about computers.**

AS 0 A 1 U 3 D 15 DS 30

**354. I will probably never learn to use a computer.**

AS 0 A 2 U 0 D 11 DS 36

**355. Computers are too complicated to be of much use to me.**

AS 0 A 2 U 0 D 10 DS 37

**356. If I had to use a computer all the time, I would probably be very unhappy.**

AS 3 A 7 U 3 D 15 DS 21

**357. I sometimes feel intimidated when I have to use a computer.**

AS 0 A 6 U 5 D 14 DS 24

**358. I sometimes feel that computers are smarter than I am.**

AS 0 A 13 U 10 D 8 DS 18

**359. I can think of many ways that I could use a computer.**

AS 19 A 28 U 1 D 1 DS 0

**360. I feel insecure about my ability to interpret a computer printout.**

AS 0 A 5 U 5 D 17 DS 22

**361. I look forward to using a computer on my job.**

AS 17 A 24 U 4 D 4 DS 0

**362. The challenge of learning about computers is exciting.**

AS 16 A 23 U 7 D 3 DS 0

**363. I am confident that I can learn computer skills.**

AS 23 A 25 U 1 D 0 DS 0

**364. Anyone can learn to use a computer if they are patient and motivated.**

AS 18 A 28 U 3 D 0 DS 0

**365. Learning to operate computers is like learning any new skill – the more you practice, the better you become.**

AS 29 A 19 U 1 D 0 DS 0

**366. I am afraid that if I begin to use computers I will become dependent upon them and lose some of my reasoning skills.**

AS 0 A 6 U 4 D 22 DS 17

**367. I am sure that with time and practice I will be as comfortable working with computers as I am in working with a typewriter.**

AS 22 A 22 U 4 D 0 DS 1

**368. I feel that I will be able to keep up with the advances happening in the computer field.**

AS 13 A 22 U 8 D 6 DS 0

**369. I dislike working with machines that are smarter than I am.**

AS 0 A 1 U 9 D 18 DS 21

**370. I feel apprehensive about using computers.**

AS 0 A 4 U 5 D 20 DS 20

**371. I have difficulty in understanding the technical aspects of computers.**

AS 2 A 19 U 2 D 16 DS 10

**372. It scares me to think that I could cause the computer to destroy a large amount of information by hitting the wrong key.**

AS 1 A 10 U 6 D 19 DS 13

**373. I hesitate to use a computer for fear of making mistakes that I cannot correct.**

AS 0 A 3 U 5 D 21 DS 20

**374. You have to be a genius to understand all the special keys contained on most computers.**

AS 0 A 4 U 4 D 19 DS 22

**375. If given the opportunity, I would like to learn about and use computers.**

AS 20 A 24 U 4 D 1 DS 0

**376. I have avoided computers because they are unfamiliar and somewhat intimidating to me.**

AS 0 A 3 U 3 D 15 DS 28

**377. I feel computers are necessary tools in both educational and work settings.**

AS 24 A 22 U 2 D 0 DS 1

**378. Computers are threatening.**

AS 0 A 0 U 5 D 19 DS 25

**379. Computers are unfriendly.**

AS 0 A 4 U 6 D 17 DS 22

**380. Every home should have a computer.**

AS 16 A 20 U 6 D 4 DS 3

**381. It's easier to answer truthfully when a question is asked by a computer.**

AS 1 A 6 U 19 D 16 DS 7

**382. It is easy to learn to operate a computer.**

AS 11 A 26 U 9 D 3 DS 0

**383. Computers are stupid.**

AS 1 A 2 U 7 D 21 DS 17

**384. Using a computer is more trouble than it's worth.**

AS 0 A 1 U 3 D 21 DS 24

**385. Computers are complicated to use.**

AS 0 A 8 U 3 D 20 DS 18

**386. Computers are frightening.**

AS 0 A 3 U 2 D 18 DS 26

**387. Computer games are exciting.**

AS 9 A 25 U 11 D 2 DS 2

**388. Computers make things easy to learn.**

AS 8 A 27 U 11 D 2 DS 1

**389. Computers take over from people.**

AS 1 A 9 U 6 D 19 DS 14

**390. There is not a lot of use for computers.**

AS 2 A 1 U 1 D 15 DS 30

**391. Computers control people.**

AS 0 A 2 U 6 D 19 DS 22

**392. Computers are fun.**

AS 9 A 31 U 7 D 2 DS 0

**393. What are your general comments on the impact of computers on technological change?**

_____

** _____

_____

_____

_____

_____

_____

## Section 5: Your Computer Experience

**394. How would you rate your ability in typing?**

- [2] Absolute zero
- [8] Minimal
- [22] Good
- [12] Very good
- [5] Excellent

**395. Do you own a personal computer?**

- [5] No
- [44] Yes

**396. Do you use a computer at work?**

- [7] Never
- [3] Rarely
- [4] Sometimes
- [12] Often
- [23] I use one for a majority of my work

**397. About how many hours per day (at home or at work) do you spend using a computer…**

To play games?.....**____ hours per day
For email?.....**____ hours per day
To access the Internet?.....**____ hours per day
For word-processing?.....**____ hours per day
For data analysis?.....**____ hours per day
For drawing or drafting?...**____ hours per day
To write programs?.....**____ hours per day
For other uses not listed?..**____ hours per day

**398. How would you rate your knowledge of computers?**

- [2] Absolute zero
- [11] Minimal
- [20] Good
- [16] Very good
- [0] Extensive

**399. Have you ever taken a course in computer programming?**

- [27] No
- [22] Yes

**400. Have you ever taken an academic or job-training course in word processing?**

- [34] No
- [15] Yes

**401. Have you ever taken a test or exam where you were required to type responses using a computer?**

- [21] No
- [28] Yes

**402. Have you ever used computers that were linked to other computers?**

- [7] No
- [41] Yes
- [1] I don't know

To what extent do you agree or disagree with the statements for Questions 403 - 414? Please use the following response scale:
AS = Agree strongly
A = Agree
N = Neither agree nor disagree
D = Disagree
DS = Disagree strongly

**403. I frequently read computer magazines or other sources of information that describe new computer technology.**

AS [0] A [4] N [9] D [18] DS [18]

**404. I know how to recover deleted or "lost data" on a computer or PC.**

AS [2] A [23] N [6] D [11] DS [7]

**405. I know what a LAN is.**

AS [16] A [16] N [2] D [7] DS [8]

**406. I know what an operating system is.**

AS [14] A [28] N [1] D [4] DS [2]

**407. I know how to write computer programs.**

AS [1] A [8] N [7] D [15] DS [18]

**408. I know how to install software on a personal computer.**

AS [18] A [22] N [2] D [3] DS [4]

**409. I know what email is.**

AS [35] A [12] N [0] D [2] DS [0]

**410. I know what a database is.**

AS [27] A [15] N [3] D [3] DS [1]

**411. I know what the Internet is.**

AS [34] A [13] N [0] D [2] DS [0]

**412. I am computer literate.**

AS [21] A [16] N [7] D [2] DS [3]

**413. I regularly use a PC for word processing.**

AS [22] A [13] N [2] D [8] DS [4]

**414. I am good at using computers.**

AS [15] A [21] N [5] D [5] DS [3]

To what extent do you agree or disagree with the statements for Questions 415 - 441? Please use the following response scale:
AS = Agree strongly
A = Agree somewhat
D = Disagree somewhat
DS = Disagree strongly

**415. Computers do not scare me at all.**

AS 23 A 19 D 6 DS 1

**416. I would like working with computers.**

AS 17 A 23 D 9 DS 0

**417. Working with a computer would make me very nervous.**

AS 0 A 3 D 18 DS 28

**418. I have had many negative experiences working with computers.**

AS 0 A 4 D 23 DS 22

**419. I do not feel threatened when others talk about computers.**

AS 16 A 24 D 7 DS 2

**420. It wouldn't bother me at all to take computer courses.**

AS 14 A 27 D 6 DS 2

**421. I'm no good with computers.**

AS 1 A 3 D 21 DS 24

**422. The challenge of solving problems with computers does not appeal to me.**

AS 0 A 8 D 23 DS 18

**423. Computers make me feel uncomfortable.**

AS 0 A 3 D 23 DS 23

**424. Generally I would feel OK about trying a new problem on the computer.**

AS 13 A 29 D 5 DS 2

**425. I would feel at ease in a computer class.**

AS 14 A 24 D 11 DS 0

**426. I think working with computers would be enjoyable and stimulating.**

AS 10 A 29 D 10 DS 0

**427. I don't think I would enjoy doing advanced computer work.**

AS 1 A 24 D 18 DS 6

**428. Figuring out computer problems does not appeal to me.**

AS 1 A 25 D 18 DS 5

**429. I get a sinking feeling when I think of trying to use a computer.**

AS 0 A 3 D 23 DS 23

**430. I am sure I could do work with computers.**

AS 20 A 28 D 1 DS 0

**431. I would feel comfortable working with a computer.**

AS 20 A 27 D 2 DS 0

**432. I'm not the type to do well with computers.**

AS 0 A 4 D 24 DS 21

**433. I don't understand how some people can spend so much time working with computers and seem to enjoy it.**

AS 1 A 11 D 22 DS 15

**434. Once I start to work with a computer, I would find it hard to stop.**

AS 5 A 16 D 27 DS 1

**435. I think using a computer would be very hard for me.**

AS 2 A 7 D 18 DS 22

**436. I will do as little work with computers as possible.**

AS 1 A 2 D 25 DS 21

**437. Computers make me feel uneasy and confused.**

AS 0 A 4 D 21 DS 24

**438. If a problem is left unsolved in a computer class, I would continue to think about it afterward.**

AS 2 A 31 D 14 DS 2

**439. I do not enjoy talking with others about computers.**

AS 1 A 21 D 18 DS 9

**440. I do not think I could handle a computer course.**

AS 0 A 2 D 26 DS 21

**441. I have a lot of self-confidence when it comes to working with computers.**

AS 10 A 22 D 17 DS 0

**442. I have had many positive experiences working with computers.**

AS 14 A 28 D 6 DS 1

For Questions 443 - 446, please indicate your confidence in your ability to learn the skills below.
Use the following response scale:
0 = I have Low confidence in my ability to learn this skill
10 = I have High confidence in my ability to learn this skill

**443. A new computer by reading a user's manual**

| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 0 | 2 | 2 | 2 | 5 | 4 | 8 | 8 | 6 | 10 |

**444. A new computer by taking a class on it**

| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 1 | 0 | 0 | 1 | 3 | 2 | 6 | 7 | 16 | 13 |

**445. A new computer program by reading a user's manual**

| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0 | 2 | 5 | 1 | 2 | 4 | 10 | 7 | 8 | 9 |

**446. A new computer program by taking a class on it**

| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 1 | 0 | 1 | 0 | 2 | 3 | 4 | 6 | 17 | 15 |

## Section 6: Your Personality

For Questions 447 to 516, two choices are given. Please indicate which choice you prefer in each pair.

**447.** [redacted]
14 [redacted]
34 [redacted]

**448.** [redacted]
37 [redacted]
11 [redacted]

**449.** [redacted]
12 [redacted]
37 [redacted]

**450.** [redacted]
22 [redacted]
27 [redacted]

**451.** [redacted]
25 [redacted]
23 [redacted]

**452.** [redacted]
27 [redacted]
22 [redacted]

**453.** [redacted]
19 [redacted]
29 [redacted]

**454.** [redacted]
28 [redacted]
20 [redacted]

**455.** [redacted]
42 [redacted]
7 [redacted]

**456.** [redacted]
23 [redacted]
25 [redacted]

**457.** [redacted]
28 [redacted]
21 [redacted]

**458.** [redacted]
11 [redacted]
38 [redacted]

**459.** [redacted]
39 [redacted]
10 [redacted]

**460.** [redacted]
40 [redacted]
9 [redacted]

**461.** [redacted]
19 [redacted]
30 [redacted]

**462.** [redacted]
39 [redacted]
10 [redacted]

**463.** [redacted]
36 [redacted]
13 [redacted]

**464.** [redacted]
23 [redacted]
25 [redacted]

**465.** [redacted]
20 [redacted]
29 [redacted]

**466.** [redacted]
36 [redacted]
13 [redacted]

**467.** [redacted]

26
23 [redacted]

**468.** [redacted]

31
17 [redacted]

**469.** [redacted]

27
21 [redacted]

**470.** [redacted]

19
30 [redacted]

**471.** [redacted]

16
33 [redacted]

**472.** [redacted]

29
20 [redacted]

**473.** [redacted]

17
32 [redacted]

**474.** [redacted]

44
4 [redacted]

**475.** [redacted]

18
31 [redacted]

**476.** [redacted]

46
3 [redacted]

**477.** [redacted]

20
28 [redacted]

**478.** [redacted]

10
39 [redacted]

**479.** [redacted]

25
22 [redacted]

**480.** [redacted]

25
24 [redacted]

**481.** [redacted]

35
13 [redacted]

**482.** [redacted]

26
23 [redacted]

**483.** [redacted]

44
5 [redacted]

**484.** [redacted]

28
21 [redacted]

**485.** [redacted]

38
9 [redacted]

**486.** [redacted]

33
15 [redacted]

**487.** [redacted]

39
10 [redacted]

**488.** [redacted]

40
9 [redacted]

**489.** [redacted]

14
35 [redacted]

**490.** [redacted]

26
23 [redacted]

**491.** [redacted]

40
8 [redacted]

**492.** [redacted]

28
20 [redacted]

**493.** [redacted]

18 [redacted]
31 [redacted]

**494.** [redacted]

37 [redacted]
11 [redacted]

**495.** [redacted]

29 [redacted]
20 [redacted]

**496.** [redacted]

39 [redacted]
10 [redacted]

**497.** [redacted]

45 [redacted]
4 [redacted]

**498.** [redacted]

42 [redacted]
7 [redacted]

**499.** [redacted]

20 [redacted]
28 [redacted]

**500.** [redacted]

28 [redacted]
21 [redacted]

**501.** [redacted]

40 [redacted]
8 [redacted]

**502.** [redacted]

20 [redacted]
28 [redacted]

**503.** [redacted]

13 [redacted]
35 [redacted]

**504.** [redacted]

38 [redacted]
10 [redacted]

**505.** [redacted]

45 [redacted]
3 [redacted]

**506.** [redacted]

7 [redacted]
42 [redacted]

**507.** [redacted]

40 [redacted]
9 [redacted]

**508.** [redacted]

29 [redacted]
20 [redacted]

**509.** [redacted]

34 [redacted]
15 [redacted]

**510.** [redacted]

35 [redacted]
14 [redacted]

**511.** [redacted]

39 [redacted]
10 [redacted]

**512.** [redacted]

19 [redacted]
30 [redacted]

**513.** [redacted]

33 [redacted]
15 [redacted]

**514.** [redacted]

34 [redacted]
15 [redacted]

**515.** [redacted]

25 [redacted]
24 [redacted]

**516.** [redacted]

36 [redacted]
13 [redacted]

Think about the past month. For Questions 517 to 529, please indicate how well the statement describes your behavior or intention. Please use the following response scale:
VW = This describes me very well
MW = This describes me moderately well
L = This describes me a little
NAA = This does not describe me at all

**517. I can make things happen**

VW 13 MW 30 L 5 NAA 0

**518. Fate plays a strong role in my life**

VW [2] MW [18] L [18] NAA [11]

**519. I find it useless to fight the established hierarchy at my company**

VW [1] MW [12] L [21] NAA [15]

**520. Circumstances are beyond my control**

VW [2] MW [9] L [19] NAA [18]

**521. I need recognition from others to make my life worthwhile**

VW [1] MW [11] L [24] NAA [13]

**522. I am easy to like**

VW [10] MW [34] L [5] NAA [0]

**523. I have a hard time accepting compliments**

VW [2] MW [18] L [19] NAA [10]

**524. I have the ability to get what I want**

VW [10] MW [27] L [11] NAA [1]

**525. I feel in control in my life**

VW [8] MW [32] L [8] NAA [1]

**526. If I reflect on my life, I might find that I am basically unhappy**

VW [0] MW [4] L [14] NAA [31]

**527. I feel frightened and out of control when things change rapidly**

VW [0] MW [10] L [16] NAA [23]

**528. I enjoy taking charge of things**

VW [12] MW [25] L [12] NAA [0]

**529. I know what I want and I go after it**

VW [10] MW [28] L [10] NAA [1]

## Section 7: Your Job

**530. What is your job title?**

**_____

**531. What are the primary responsibilities of your job?**

**_____

_____

_____

**532. When did you start working at this position?**

**____ month **____ year

**533. When did you start working for this company?**

**____ month **____ year

**534. How are you paid for your work?**

[23] I am paid by the hour
[25] I am paid a salary

**535. How are you employed?**

[42] Full-time, year round
[3] Full-time, seasonal
[3] Part-time, year round
[0] Part-time, seasonal

**536. From the selections below, choose the profession that most closely identifies your job and that of your immediate supervisor:**

| | You | Your Immediate Supervisor |
|---|---|---|
| Architect | 4 | 4 |
| Engineer | 14 | 10 |
| Contractor | 15 | 13 |
| Construction Manager | 4 | 7 |
| Administrator | 6 | 1 |
| Management | 5 | 8 |
| Computer/IT Specialist | 1 | 2 |

**537. When did you start working in the profession you identified above?**

**____ month **____ year

**538. From the selections below, which level best identifies your position in your company?**

[0] I am the only person in this company
[5] Executive (CEO, CFO, etc.)
[21] Management (project mangers, superintendents, etc.)
[10] Professional staff (architects, engineers, designers, etc.)
[3] Technical staff (drafters, inspectors, etc.)
[4] Construction labor (carpenters, masons, roofers, etc.)
[6] Administrative staff

**539. Are you responsible for supervising other employees?**

[16] No
[33] Yes..... How many?**____ employees supervised

**540. Do you have the power to hire or fire employees?**

[4] I only have the power to hire new employees
[2] I only have the power to fire existing employees
[16] I have the power to both hire and fire employees
[27] I do not have the power to hire or fire employees

**541. Do you have the power to reward or punish employees?**

- [5] I only have the power to reward employees
- [2] I only have the power to punish employees
- [21] I have the power to both reward and punish employees
- [20] I do not have the power to reward or punish employees

**542. What do you *hope* to be doing five years from now?**

** _____

_____

_____

**543. What do you *really expect* to be doing five years from now?**

** _____

_____

_____

**544. Are you the main wage earner in your household?**

- [11] No
- [37] Yes

**545. Could your household live adequately if you were not working?**

- [44] No
- [4] Yes

## Section 8: Your Company

**546. How many people does your company employ *at this location*?**

- [9] 5 employees or less
- [15] 6 - 20 employees
- [9] 21 - 50 employees
- [9] 51 - 200 employees
- [5] 201 - 1000 employees
- [0] 1001 or more employees

**547. How many people does your company employ *at all locations combined*?**

- [2] 5 employees or less
- [10] 6 - 20 employees
- [5] 21 - 50 employees
- [9] 51 - 200 employees
- [16] 201 - 1000 employees
- [5] 1001 or more employees

**548. What industry does your company work in *at this location*? Check all that apply.**

- [11] Architecture
- [16] Engineering
- [21] General Building Construction (manufacturing, industrial, commercial, institutional)
- [15] Residential Building Construction (single and multifamily housing)
- [9] Heavy Construction (highways, streets, bridges, tunnels, utilities)
- [2] Construction Management

**549. What industry does your company work in *at all locations combined*? Check all that apply.**

- [11] Architecture
- [20] Engineering
- [24] General Building Construction (manufacturing, industrial, commercial, institutional)
- [19] Residential Building Construction (single and multifamily housing)
- [11] Heavy Construction (highways, streets, bridges, tunnels, utilities)
- [13] Construction Management

## Section 9: Yourself

**550. What is your age?**

** ____ years

**551. What is your gender?**

- [12] Female
- [36] Male

**552. What is the highest level of education you have completed?**

- [0] Did not complete 8th grade
- [0] Did not complete high school
- [0] Did not complete high school, but received a GED
- [3] High school diploma
- [13] Some college
- [4] Associate's degree
  In what? ** _____
- [22] Bachelor's degree
  In what? ** _____
- [3] Some graduate school
  In what? ** _____
- [3] Master's degree or higher
  In what? ** _____

**553. Are you a member of a union?**

- [47] No
- [1] Yes..... Which one? ** _____

**554. Do you have a professional license or registration?**

- [29] No
- [19] Yes..... Which one? ** _____

**Summary of Free-Response Questions** (noted with a ** on reproduced survey)

**Question 275:** Over the past year, have any technological changes happened in your company? (Note that not all responses match with the definition of technology from section 1.5.1. Additionally, some respondents provided responses that did not appear to relate to any sort of technology change. These responses are omitted from this summary.)

- Addition of GPS systems to earth moving equipment
- CAD charts
- Changed to new design software
- Computers for bidding, scheduling
- Database applications, client networking – netmeetings
- Firm is in process of going to AutoCAD 2002
- Implementing new computer software, network/pc upgrades
- Many new software packages used
- Networked office computers, user of laser leveling systems, internet purchasing
- New software, improved computers
- Paint spraying technology, email use for payroll
- Software program for invoices
- Software updates
- Software upgrades, new contact information program
- Sonar depth instruments installed on machines
- Switching from Microstation to AutoCAD drafting programs
- The change from P3 to P3e, upgrading our cost system (Trueline)
- The use of computer programs to handle invoicing and customer record keeping
- The use of GPS for surveying and some heavy equipment, such as dozers and graders.
- Updates in computer software
- Updates in scheduling software (P3) and correspondence software (expedition). Also, utilization of GPS by survey crews and placement of sensors on equipment.
- Upgrade from the AutoCAD Land Development 2000 to the 2000i edition
- Upgrade to windows 2000 network, evaluate new software to improve drainage design and estimating
- Upgrades in software for accounting and design programs
- Upgrades to cad programs
- Use of new software to enhance and/or improve quality of work
- Using laser levels & transits as opposed to manual ones
- Using MSProject to schedule all jobs, developing custom estimating software, using PDA's as transition tool from office to field, developing web site as sales and client communications tool
- We are evaluating the various hydraulic modeling software packages. Everyone has their own favorite and we're trying to develop a company standard.
- Work on an intranet and common systems between companies

**Question 276:** Are you aware of any technological changes planned for the next year? (Note that not all responses match with the definition of technology from section 1.5.1. Additionally, some respondents provided responses that did not appear to relate to any sort of technology change. These responses are omitted from this summary.)

- Automatic payment/direct deposit
- Continuation of the above
- Continued work on common systems
- Expanded branch office connections
- Expansion of GPS systems on heavy equipment to track location of piece and also production, etc., maybe eliminate operators
- Implementing use of digital cameras for planning and documentation purposes
- Maybe office computers networked, estimating software
- More use of jobsite computer equipment
- New computers, new software
- New computer work station, upgrades to several computers, possible new plotter, better internet access
- New marketing program, new accounting program to web based system
- New software
- Our goal is to continually seek and implement effective technological improvements
- There are always changes. The specifics are unsure
- Update computers
- Updates
- Upgrade to Office 2000

**Question 277:** Of all the changes that you described, which one do you feel affected (or will affect) you the most? (Note that not all responses match with the definition of technology from section 1.5.1. Additionally, some respondents provided responses that did not appear to relate to any sort of technology change. These responses are omitted from this summary.)

- Addition of GPS systems to earth moving equipment
- AutoCad 2002
- Bidding
- CAD
- Charts
- Computer use
- Database applications
- Digital cameras
- GPS on equipment will greatly change the work environment
- If the new company standard for hydraulic modeling is not the package I use, then I'll have to learn new software.
- Implementing new estimating software since I purchase all materials (pricing, etc)

- Many new software packages used
- Network computers
- New accounting program
- New computers
- New email system
- New software
- New software for drainage design
- Software changes
- Software updates
- Sonar equipment
- The customized software and the use of the internet
- The use of the internet, especially when there is a website
- Upgrade from the AutoCad Land Development 2000 to the 2000i edition
- Upgrade to my computer
- Use of jobsite computers - I have no training on use
- Using laser levels & transits as opposed to manual ones

**Question 393:** What are your general comments on the impact of computers on technological change?

- Absolutely necessary - valuable tool in applications
- As a tool, computers help the industry; yet, most design and craft related areas suffer from the lack of hand-mind coordination it takes in drawing by hand or building models - when CAD is the only method used.
- Can't imagine how much more difficult my job would be without them, am still thinking of ways to use this technology in our business
- Computers are a necessary part of technological change in many industries. They can help with organization of information and communication of ideas.
- Computers are a necessary tool and continually promote technological change
- Computers are a necessary tool in the construction industry. Computers = speed!!
- Computers are a necessity to keep up with the faced [sic = fast] paced lifestyle of the industry
- Computers are an integral tool for accommodating change for the level
- Computers are good - however, let's not rely completely on them. Computers break down too! Have a backup plan or strategy in place.
- Computers are great for helping solve problems, allowing one to see a finished product before it is started, as well as many other things. There is a disadvantage, however, where people do not learn to solve the problems on their own so they never know if the computer is functioning properly and giving a correct answer.
- Computers are, in general, quite beneficial for most situations. I have been using computers since I was 5 or 6 years old and I've always liked them.
- Computers are the catalysts for modern technological change
- Computers have added efficiency. Computers do not replace the need for logical and independent thought processing by the user.

- Computers have advanced technology and productivity considerably, however people are becoming very dependent
- Computers have become indispensable for technological change
- Computers have changed the world incredibly. They will continue this change.
- Computers have evolved society to the next level as much as the industrial revolution
- Computers have progressively made work more precise, efficient, and easier.
- Essential and extremely useful
- Everyone in my organization uses a computer on a daily basis and I don't see how we could operate without them. They will only become more important in the future.
- Faster analogy of facts, figures
- Good
- I think it is a big advantage to be able to compile and store information
- I think they are amazing.
- Makes my life much easier and my performance more efficient
- Nearly every person at our office uses a computer daily - more and more businesses will have to abandon "old ways" & use computers just to survive.
- Outstanding
- People will have to learn to live with computers in their daily lives because the future will be centered around their use.
- Technological change has increased dramatically after the computer was invented and used daily.
- The use of computers accelerate the development and adoption of other technologies. The technological benefits of computer use include increased productivity, efficiency, and accuracy.
- There should be a distinction between computers and software. Constant upgrade requirements (software and hardware) become a racket.
- They give you too much info!
- They have increased productivity, creativity, presentation skill, and professional quality.
- They increase personal productivity
- They should with proper training make paperwork easier to go from point A to point B therefore cutting down on travel time for delivery of documents
- They've increased the rate of technological change in a plethora of fields
- Things are changing too fast and the average person can't keep up
- Timesaving
- You can learn more about the world and about the field that you are in. You can learn more about technological and updates.

**Question 397:** About how many hours per day (at home or at work) do you spend using a computer…

| | Hours per day | | | | |
|---|---|---|---|---|---|
| | **0** | **>0 and ≤2** | **>2 and ≤4** | **>4 and ≤6** | **>6 and ≤8** |
| To play games? | 33 | 15 | 0 | 0 | 0 |
| For email? | 7 | 41 | 1 | 0 | 0 |
| To access the Internet? | 5 | 42 | 2 | 0 | 0 |
| For word-processing? | 15 | 23 | 8 | 3 | 0 |
| For data analysis? | 21 | 22 | 5 | 0 | 0 |
| To write programs? | 32 | 8 | 2 | 4 | 2 |
| For drawing or drafting? | 49 | 0 | 0 | 0 | 0 |
| For other uses not listed? | 35 | 12 | 1 | 0 | 1 |

**Question 530:** What is your job title?

- Accounting manager
- Admin & project management assistant
- Administrative manager
- Architect
- Assistant project manager
- Associate
- Carpenter/laborer
- Ceramic tile manager
- Construction superintendent
- Controller
- Designer (x2)
- Drafter (x2)
- Electrical foreman
- Electrical supervisor
- Engineer (x2)
- Engineering manager
- Estimator/management
- Manager
- Office manager
- Office manager, purchasing
- Owner
- Owner, president
- President
- Project engineer (x4)
- Project engineer/ production

- Project manager (x5)
- Project superintendent (x2)
- Rodbuster
- Secretary
- Senior engineer (x2)
- Superintendent
- Supervisor
- Vice president
- Vice president, structural engineer

**Question 531:** What are the primary responsibilities of your job?

- Assist PE
- Bidding, scheduling, cost control
- Bookkeeping, payroll, all accounting, purchase materials, get estimates from subs, draw up all legal contracts, etc.
- Budgeting, scheduling, job coordination
- Build per plans & specs, coordinate all phases of construction
- CAD design – civil
- Communicate with owner, schedule activities, purchase/schedule materials, manage equipment and labor
- Coordinate sales, orders, and job schedules
- Cost, schedule, submittals, safety, deliveries
- Database entry updates, contract bidding process, receptionist
- Design and model roadways and utilities, drafting
- Design of structures, marketing, public relations
- Designing and drawing house & apartment plans, working with contractors on building the aforementioned
- Designing water & sewer systems, coordinating schedule with client and other engineers, drafters
- Digital mapping, editing drawings
- Drafting, meeting with clients, reviewing shop drawings, attending on-site meetings with contractors, designing details of buildings
- Drafting, preparing environmental reports
- Field engineering work - inspection of any structural members, re-steel, steel, concrete
- Financial management and reporting
- From an estimate to final completion
- General ledger, internal controls, staff management, project reports, financial reports
- Keep employees at work and working, keep tools & materials on the job, take care of paperwork, work on whatever projects need my help
- Manage construction project
- New client contact (sales), scheduling, design
- Orientation of new employees, manage administration of day to day, all bookkeeping
- Organize, plan, finance, manage, hire, fire, sell, produce, control profit margin

- Oversee all aspects of the business
- Oversee engineering design projects, proposals and marketing for projects
- Owner of 7 person architecture firm
- Personnel, drawings, work in place, subs,
- Please the client, meet scope, schedule and budget
- Project engineer/ manager
- Project management
- Project management, customer estimates
- Project management, marketing, supervisor
- Public relations, correspondence, customer representative, management assistant
- Review and control finances, look for new work, participate in organizations both charitable and non
- Schedule work, organize crews, evaluate personnel
- Scheduling, managing employees/sub contractors, quality control, managing new technologies
- Supervising trades, coordinating and getting work done
- To see and get the work done at a reasonable time
- Truss design
- Tying rebar in footings, slabs, and walls
- Wiring of large buildings
- Writing change orders, writing letters, ordering materials, billing, invoices

**Question 532:** When did you start working at this position?

| Jan 1970 – Dec 1974 | Jan 1975 – Dec 1979 | Jan 1980 – Dec 1984 | Jan 1985 – Dec 1989 | Jan 1990 – Dec 1994 | Jan 1995 – Dec 1999 | Jan 2000 – Dec 2002 |
|---|---|---|---|---|---|---|
| 1 | 2 | 4 | 5 | 6 | 11 | 20 |

**Question 533:** When did you start working for this company?

| Jan 1970 – Dec 1974 | Jan 1975 – Dec 1979 | Jan 1980 – Dec 1984 | Jan 1985 – Dec 1989 | Jan 1990 – Dec 1994 | Jan 1995 – Dec 1999 | Jan 2000 – Dec 2002 |
|---|---|---|---|---|---|---|
| 1 | 0 | 3 | 5 | 11 | 11 | 18 |

**Question 537:** When did you start working in the profession you identified above?

| Jan 1955 – Dec 1974 | Jan 1975 – Dec 1979 | Jan 1980 – Dec 1984 | Jan 1985 – Dec 1989 | Jan 1990 – Dec 1994 | Jan 1995 – Dec 1999 | Jan 2000 – Dec 2002 |
|---|---|---|---|---|---|---|
| 5 | 3 | 6 | 5 | 7 | 14 | 8 |

**Question 539:** How many employees supervised?

| 0 supervised | 1-2 supervised | 3-5 supervised | 6-9 supervised | 10-15 supervised | 16 or more supervised | Number supervised varies |
|---|---|---|---|---|---|---|
| 16 | 7 | 9 | 5 | 3 | 5 | 2 |

**Question 542:** What do you *hope* to be doing five years from now?

- At the present time I am satisfied with my present situation but am not unwilling to accept new responsibilities
- Be a project engineer or manager on a bridge job over water
- Be part of management
- Become a master in this company
- Construction, carpentry
- Continue to work on growing our business, doing volunteer work for the community and be an advocate for our industry
- Design/build construction contracts
- Designing buildings
- Don't know (x2)
- Either working in missions or as a travel agent
- Engineering manager/dept manager
- Financial and portfolio management
- Financially independent and retired
- Go to grad school, graduate & find a job with an architect
- I am already changing duties to become the human resources manager/safety officer
- I expect to be a professor of cultural studies and of dance
- I hope to own a construction company
- I want to be a civil engineer
- In charge of the design of roadway projects
- Living in luxury
- Living somewhere completely different, maybe working in the same industry
- More marketing
- Own business
- Own my own consulting firm
- Pastoring a church
- PE for a company
- Project manager
- Responsibly bringing in sufficient work that pushes the envelope of energy efficient sustainable buildings
- Retire (x3)
- Running a profitable greenhouse/ nursery business from my home
- Running company focusing on sustainable design, re-use of older buildings, etc.
- Running the organization

- Same job (x2)
- Same thing (x2)
- Same thing, bigger projects, more staff
- Same - with more control of my work
- Taking a larger management role in this business with employees directly under me
- Teaching at a University
- To continue to enjoy my work
- Working at a different company and having a job I look forward to each day
- Working for myself in the same profession as a custom homes contractor
- Working in similar position or upper management w/ a company doing 4x or better the volume

**Question 543:** What do you *really expect* to be doing five years from now?

- Construction, carpentry
- Don't know/have no idea (x2)
- Doing the same as I've been doing the last 25 years
- Engineering manager
- Financially independent and retired
- Hopefully, exactly what I wrote above
- I want to be a civil engineer
- No changes
- Not much different than now
- Nothing specific - but something challenging
- Own business
- Own my own consulting firm
- Own work – writing
- Pastoring a church
- Probably the same thing I'm doing now (maybe with a greenhouse on the side)
- Project manager
- Project manager or superintendent of a heavy civil project
- Project management
- Project management - design projects
- Retired (x2)
- Running a painting corporation
- Running the organization
- Same job (x5)
- Same as above (x14)
- Teaching at a University
- Working and going to graduate school
- Working towards above goal
- Working like now

**Question 550**: What is your age?

| 20-24 years | 25-29 years | 30-34 years | 35-39 years | 40-44 years | 45-49 years | 50-54 years | 55-59 years | 60-64 years | 65-69 years |
|---|---|---|---|---|---|---|---|---|---|
| 11 | 7 | 7 | 5 | 8 | 2 | 4 | 1 | 1 | 2 |

**Question 552:** What is the highest level of education you have completed?

Associate's degree, in what?

- Admin tech
- Applied science
- Civil
- Civil engineering technician
- Engineering

Bachelor's degree, in what?

- Agricultural engineering
- Architectural engineering
- Architecture (x2)
- Architecture and civil engineering
- Biological systems engineering
- Building construction (x2)
- Business-accounting
- Business economics
- Business management (x3)
- Civil engineering (x8)
- Math/accounting
- Math
- Spanish, minor biology, minor architecture

Some graduate school, in what?

- Acoustics
- Education
- Engineering

Master's degree or higher, in what?

- Architecture, divinity
- Civil Engineering
- Public administration

**Question 553:** Are you a member of a union?

- Operating engineers

**Question 554:** Do you have a professional license or registration?

- Architect (x2)
- Certified design accountant
- Class A contractor (x2)
- Contractor (x2)
- CPA
- Electrical
- Electrical journeyman
- EIT (x3)
- HVAC Card to buy refrig.
- PE (x5)

## *E.3 Correlation Table*

| | ATTCOM | CHGSCL | COMPEX | COSHIM | CSINDX | EIQCOD | EIQPOW | INEXCO | IRBSCL |
|---|---|---|---|---|---|---|---|---|---|
| ATTCOM | 1.00 | | | | | | | | |
| CHGSCL | -0.38 | 1.00 | | | | | | | |
| COMPEX | -0.33 | 0.25 | 1.00 | | | | | | |
| COSHIM | 0.29 | -0.22 | 0.14 | 1.00 | | | | | |
| CSINDX | -0.21 | 0.44 | 0.14 | 0.17 | 1.00 | | | | |
| EIQCOD | -0.21 | 0.42 | 0.10 | -0.32 | 0.21 | 1.00 | | | |
| EIQPOW | -0.40 | 0.37 | -0.11 | -0.38 | 0.16 | 0.55 | 1.00 | | |
| INEXCO | 0.20 | -0.11 | 0.19 | 0.31 | 0.21 | -0.14 | -0.44 | 1.00 | |
| IRBSCL | 0.10 | -0.38 | 0.01 | 0.30 | -0.06 | -0.21 | -0.22 | 0.12 | 1.00 |
| MADEFM | 0.05 | -0.23 | -0.10 | 0.37 | 0.20 | -0.24 | -0.07 | 0.07 | 0.51 |
| PNACCP | -0.03 | 0.12 | -0.03 | -0.32 | -0.31 | 0.21 | 0.33 | -0.22 | -0.21 |
| PNMAST | 0.02 | 0.08 | -0.18 | -0.27 | -0.35 | 0.15 | 0.33 | -0.25 | -0.13 |
| PNMEAN | -0.02 | 0.11 | -0.10 | -0.33 | -0.30 | 0.12 | 0.33 | -0.21 | -0.07 |
| PNRESP | 0.00 | 0.08 | 0.03 | -0.39 | -0.34 | 0.12 | 0.27 | -0.23 | -0.25 |
| REWARD | 0.03 | -0.03 | 0.04 | -0.32 | -0.12 | 0.13 | 0.01 | 0.02 | 0.25 |
| SUPCHG | 0.05 | -0.11 | -0.14 | -0.15 | -0.19 | -0.07 | 0.22 | -0.12 | 0.19 |
| TRAING | 0.11 | -0.03 | -0.07 | -0.35 | -0.04 | 0.28 | 0.00 | 0.09 | 0.13 |
| TRTECH | 0.07 | -0.06 | 0.02 | -0.16 | -0.13 | -0.04 | -0.25 | 0.05 | 0.26 |
| ADDEFM | 0.32 | -0.40 | -0.08 | 0.09 | -0.23 | -0.17 | -0.36 | 0.09 | -0.20 |
| CAIN | 0.76 | -0.37 | -0.50 | 0.36 | -0.10 | -0.08 | -0.40 | 0.24 | 0.05 |
| CARS | 0.80 | -0.35 | -0.56 | 0.37 | -0.13 | -0.27 | -0.53 | 0.20 | 0.13 |
| CAS | -0.77 | 0.48 | 0.48 | -0.35 | 0.26 | 0.21 | 0.37 | -0.11 | -0.12 |
| CLASSQ | -0.44 | 0.31 | 0.58 | -0.16 | 0.18 | 0.35 | 0.16 | -0.02 | 0.07 |
| COMPCO | -0.46 | 0.36 | 0.33 | -0.25 | 0.20 | 0.38 | 0.42 | -0.11 | -0.14 |
| COMPUN | -0.36 | 0.36 | 0.57 | 0.10 | 0.36 | 0.35 | 0.22 | 0.08 | -0.01 |
| COSHTM | 0.12 | -0.40 | 0.07 | 0.57 | -0.18 | -0.22 | -0.41 | 0.07 | 0.57 |
| COSIWV | 0.23 | 0.27 | -0.06 | 0.87 | 0.01 | -0.28 | -0.35 | 0.13 | 0.29 |
| COSNDS | 0.04 | -0.18 | 0.09 | 0.64 | 0.21 | -0.22 | -0.28 | -0.02 | 0.53 |
| COSRCT | 0.22 | -0.27 | 0.02 | 0.62 | 0.07 | -0.21 | -0.35 | 0.00 | 0.44 |
| COSROB | 0.18 | -0.40 | 0.15 | 0.53 | -0.16 | -0.25 | -0.40 | -0.04 | 0.42 |
| COSUNN | 0.14 | -0.42 | 0.01 | 0.59 | 0.03 | -0.12 | -0.29 | -0.03 | 0.37 |
| COSURV | 0.19 | -0.40 | 0.04 | 0.81 | 0.03 | 0.25 | -0.42 | 0.07 | 0.51 |
| COSWFL | 0.26 | -0.33 | -0.10 | 0.69 | -0.07 | -0.28 | -0.43 | 0.07 | 0.41 |
| DECISN | 0.05 | 0.09 | -0.09 | -0.55 | 0.02 | 0.27 | 0.12 | -0.11 | 0.08 |
| DISINN | -0.05 | 0.02 | -0.12 | -0.03 | 0.19 | 0.16 | 0.10 | 0.05 | -0.02 |
| EIQRES | -0.15 | 0.36 | -0.02 | -0.22 | 0.14 | 0.58 | 0.54 | -0.32 | -0.06 |
| INTAMB | 0.25 | -0.50 | -0.30 | 0.24 | -0.43 | -0.08 | -0.12 | 0.03 | 0.37 |
| IPOWCO | 0.06 | 0.04 | -0.36 | -0.33 | 0.02 | 0.10 | 0.31 | -0.27 | 0.12 |
| IPOWEX | 0.01 | -0.27 | -0.23 | -0.17 | -0.48 | -0.21 | -0.11 | -0.24 | 0.15 |
| IPOWLG | 0.14 | -0.10 | -0.37 | -0.09 | 0.11 | 0.09 | 0.18 | -0.16 | 0.23 |
| IPOWRE | 0.16 | 0.07 | -0.31 | -0.22 | 0.09 | 0.06 | 0.23 | -0.27 | 0.05 |
| JOBIN2 | 0.00 | -0.27 | -0.27 | -0.13 | -0.44 | -0.15 | -0.05 | -0.21 | 0.19 |
| MOTIVA | -0.02 | 0.20 | -0.18 | -0.41 | -0.20 | 0.26 | 0.20 | 0.00 | -0.08 |
| PRIGID | 0.33 | -0.48 | -0.41 | 0.33 | -0.37 | -0.41 | -0.34 | -0.10 | 0.38 |
| PUNISH | -0.12 | 0.09 | 0.21 | -0.21 | 0.01 | -0.01 | -0.03 | 0.16 | 0.11 |
| RESRCS | 0.05 | 0.03 | -0.22 | -0.26 | -0.10 | 0.22 | 0.17 | 0.01 | -0.01 |
| RTCINV | -0.10 | -0.03 | -0.04 | -0.03 | -0.14 | 0.12 | 0.06 | -0.16 | -0.09 |
| JOBINV | 0.04 | -0.12 | 0.07 | 0.18 | 0.06 | -0.03 | -0.21 | -0.05 | 0.47 |

| | ATTCOM | CHGSCL | COMPEX | COSHIM | CSINDX | EIQCOD | EIQPOW | INEXCO | IRBSCL |
|---|---|---|---|---|---|---|---|---|---|
| LEVORG | 0.09 | -0.09 | -0.39 | -0.22 | 0.04 | 0.09 | 0.32 | -0.24 | 0.11 |
| NEGPRE | 0.65 | -0.20 | -0.19 | 0.42 | 0.02 | -0.22 | -0.42 | 0.20 | 0.14 |
| POSPRE | -0.54 | 0.41 | 0.36 | -0.21 | 0.21 | 0.07 | 0.28 | -0.03 | -0.06 |
| KTSEI | 0.14 | 0.20 | 0.22 | 0.05 | 0.17 | 0.17 | 0.24 | 0.32 | 0.20 |
| KTSJP | 0.14 | 0.20 | 0.20 | 0.33 | 0.35 | 0.14 | 0.05 | 0.33 | 0.32 |
| KTSSN | 0.07 | 0.28 | 0.03 | 0.14 | 0.49 | 0.17 | 0.08 | 0.08 | 0.22 |
| KTSTF | 0.30 | 0.39 | 0.30 | 0.14 | 0.24 | 0.14 | 0.26 | 0.08 | 0.28 |
| LICENS | 0.14 | 0.10 | 0.07 | 0.04 | 0.06 | 0.08 | 0.10 | 0.10 | 0.28 |
| PERFUT | 0.08 | 0.20 | 0.10 | 0.24 | 0.04 | 0.14 | 0.03 | 0.14 | 0.14 |
| PERPAS | 0.36 | 0.01 | 0.08 | 0.22 | 0.17 | 0.14 | 0.03 | 0.04 | 0.14 |
| UNION | 0.24 | 0.24 | 0.14 | 0.00 | 0.28 | 0.32 | 0.17 | 0.01 | 0.06 |

| | MADEFM | PNACCP | PNMAST | PNMEAN | PNRESP | REWARD | SUPCHG | TRAING | TRTECH |
|---|---|---|---|---|---|---|---|---|---|
| MADEFM | 1.00 | | | | | | | | |
| PNACCP | -0.16 | 1.00 | | | | | | | |
| PNMAST | -0.13 | 0.88 | 1.00 | | | | | | |
| PNMEAN | -0.18 | 0.90 | 0.92 | 1.00 | | | | | |
| PNRESP | -0.23 | 0.91 | 0.83 | 0.85 | 1.00 | | | | |
| REWARD | -0.21 | -0.23 | -0.23 | -0.04 | -0.26 | 1.00 | | | |
| SUPCHG | 0.10 | 0.48 | 0.62 | 0.63 | 0.54 | 0.04 | 1.00 | | |
| TRAING | 0.04 | -0.27 | -0.16 | -0.11 | -0.19 | 0.34 | 0.20 | 1.00 | |
| TRTECH | 0.05 | -0.19 | -0.27 | -0.27 | -0.22 | 0.16 | -0.19 | 0.32 | 1.00 |
| ADDEFM | -0.17 | -0.08 | 0.06 | 0.01 | 0.05 | -0.14 | -0.02 | 0.01 | -0.32 |
| CAIN | 0.00 | -0.09 | 0.01 | -0.11 | -0.02 | -0.02 | -0.11 | 0.13 | -0.08 |
| CARS | 0.05 | -0.13 | -0.03 | -0.06 | -0.09 | -0.03 | -0.06 | 0.11 | -0.04 |
| CAS | -0.02 | -0.09 | -0.15 | -0.15 | -0.10 | -0.04 | -0.03 | -0.04 | 0.02 |
| CLASSQ | -0.11 | 0.03 | -0.09 | -0.05 | 0.08 | -0.17 | 0.00 | 0.09 | 0.08 |
| COMPCO | 0.09 | 0.15 | 0.02 | -0.03 | 0.09 | -0.03 | -0.01 | -0.01 | 0.11 |
| COMPUN | 0.06 | -0.12 | -0.22 | -0.25 | -0.13 | -0.16 | -0.16 | -0.10 | 0.12 |
| COSHTM | 0.26 | -0.15 | -0.09 | -0.06 | -0.10 | -0.04 | 0.20 | 0.05 | 0.11 |
| COSIWV | 0.45 | -0.31 | -0.23 | -0.30 | -0.29 | -0.34 | -0.11 | -0.15 | -0.22 |
| COSNDS | 0.70 | -0.34 | -0.35 | -0.39 | -0.30 | -0.31 | -0.15 | -0.08 | -0.08 |
| COSRCT | 0.46 | -0.23 | -0.19 | -0.27 | -0.12 | -0.34 | -0.09 | 0.01 | -0.05 |
| COSROB | 0.21 | -0.13 | -0.12 | -0.16 | -0.03 | -0.09 | 0.00 | -0.03 | -0.13 |
| COSUNN | 0.51 | -0.30 | -0.25 | -0.29 | -0.20 | -0.28 | 0.09 | 0.01 | -0.14 |
| COSURV | 0.50 | -0.27 | -0.20 | -0.26 | -0.21 | -0.33 | 0.00 | -0.09 | -0.11 |
| COSWFL | 0.43 | -0.25 | -0.18 | -0.27 | -0.16 | -0.21 | -0.03 | 0.02 | -0.07 |
| DECISN | 0.03 | 0.05 | -0.07 | -0.03 | 0.16 | 0.17 | 0.06 | 0.45 | 0.21 |
| DISINN | 0.06 | 0.10 | 0.02 | 0.02 | 0.13 | -0.08 | -0.02 | 0.00 | -0.24 |
| EIQRES | 0.00 | 0.25 | 0.20 | 0.09 | 0.17 | -0.18 | 0.14 | 0.08 | 0.25 |
| INTAMB | 0.19 | 0.06 | 0.18 | 0.13 | 0.07 | -0.06 | 0.17 | 0.09 | -0.31 |
| IPOWCO | 0.17 | 0.11 | 0.13 | 0.21 | 0.09 | 0.29 | 0.26 | 0.28 | 0.13 |
| IPOWEX | -0.15 | 0.19 | 0.29 | 0.27 | 0.21 | 0.13 | 0.19 | 0.06 | 0.01 |
| IPOWLG | 0.27 | -0.10 | -0.05 | -0.01 | -0.10 | 0.12 | 0.12 | 0.25 | 0.21 |
| IPOWRE | 0.15 | -0.01 | 0.04 | 0.09 | -0.02 | 0.36 | 0.17 | 0.26 | 0.08 |
| JOBIN2 | -0.05 | 0.22 | 0.32 | 0.31 | 0.24 | 0.15 | 0.22 | 0.12 | -0.07 |
| MOTIVA | -0.34 | 0.02 | 0.02 | -0.04 | -0.06 | 0.31 | 0.04 | 0.43 | 0.49 |
| PRIGID | 0.20 | -0.24 | -0.02 | -0.08 | -0.17 | 0.01 | 0.12 | 0.03 | 0.01 |
| PUNISH | -0.15 | -0.18 | -0.16 | -0.10 | -0.19 | 0.55 | 0.12 | 0.19 | 0.20 |
| RESRCS | -0.09 | -0.07 | 0.03 | 0.05 | -0.05 | 0.33 | 0.23 | 0.72 | 0.26 |
| RTCINV | -0.31 | 0.07 | -0.03 | 0.00 | 0.14 | 0.01 | 0.07 | -0.16 | 0.09 |
| JOBINV | 0.28 | -0.28 | -0.18 | -0.28 | -0.14 | -0.17 | 0.10 | 0.09 | 0.29 |
| LEVORG | 0.22 | 0.03 | 0.07 | 0.15 | 0.04 | 0.19 | 0.25 | 0.27 | 0.17 |
| NEGPRE | 0.16 | -0.22 | -0.10 | -0.09 | -0.10 | -0.15 | 0.03 | 0.26 | 0.03 |
| POSPRE | 0.05 | -0.18 | -0.18 | -0.13 | -0.19 | 0.09 | -0.01 | 0.06 | 0.06 |
| KTSEI | 0.06 | 0.22 | 0.17 | 0.14 | 0.17 | 0.30 | 0.14 | 0.22 | 0.10 |
| KTSJP | 0.10 | 0.17 | 0.28 | 0.33 | 0.20 | 0.22 | 0.22 | 0.17 | 0.28 |
| KTSSN | 0.02 | 0.14 | 0.14 | 0.20 | 0.17 | 0.08 | 0.03 | 0.03 | 0.28 |

| | MADEFM | PNACCP | PNMAST | PNMEAN | PNRESP | REWARD | SUPCHG | TRAING | TRTECH |
|---|---|---|---|---|---|---|---|---|---|
| KTSTF | 0.20 | 0.24 | 0.17 | 0.22 | 0.17 | 0.46 | 0.22 | 0.22 | 0.10 |
| LICENS | 0.20 | 0.22 | 0.17 | 0.10 | 0.17 | 0.32 | 0.00 | 0.24 | 0.09 |
| PERFUT | 0.22 | 0.17 | 0.10 | 0.07 | 0.14 | 0.47 | 0.14 | 0.47 | 0.39 |
| PERPAS | 0.07 | 0.20 | 0.10 | 0.14 | 0.14 | 0.10 | 0.14 | 0.10 | 0.24 |
| UNION | 0.05 | 0.24 | 0.05 | 0.22 | 0.14 | 0.00 | 0.17 | 0.00 | 0.00 |

| | ADDEFM | CAIN | CARS | CAS | CLASSQ | COMPCO | COMPUN | COSHTM | COSIWV |
|---|---|---|---|---|---|---|---|---|---|
| ADDEFM | 1.00 | | | | | | | | |
| CAIN | 0.25 | 1.00 | | | | | | | |
| CARS | 0.31 | 0.85 | 1.00 | | | | | | |
| CAS | -0.24 | -0.75 | -0.84 | 1.00 | | | | | |
| CLASSQ | -0.21 | -0.35 | -0.43 | 0.41 | 1.00 | | | | |
| COMPCO | -0.39 | -0.49 | -0.64 | 0.58 | 0.31 | 1.00 | | | |
| COMPUN | -0.31 | -0.31 | -0.50 | 0.54 | 0.55 | 0.56 | 1.00 | | |
| COSHTM | -0.12 | 0.17 | 0.22 | -0.31 | -0.12 | -0.26 | -0.06 | 1.00 | |
| COSIWV | -0.02 | 0.41 | 0.39 | -0.38 | -0.21 | -0.24 | 0.01 | 0.65 | 1.00 |
| COSNDS | -0.20 | 0.15 | 0.17 | -0.18 | 0.02 | -0.05 | 0.24 | 0.66 | 0.77 |
| COSRCT | -0.05 | 0.40 | 0.36 | -0.40 | 0.03 | -0.23 | 0.07 | 0.70 | 0.75 |
| COSROB | 0.11 | 0.28 | 0.22 | -0.31 | -0.05 | -0.17 | -0.11 | 0.63 | 0.68 |
| COSUNN | 0.15 | 0.27 | 0.26 | -0.25 | -0.08 | -0.27 | -0.05 | 0.61 | 0.72 |
| COSURV | -0.02 | 0.34 | 0.33 | -0.36 | -0.10 | -0.25 | 0.02 | 0.84 | 0.90 |
| COSWFL | -0.05 | 0.43 | 0.41 | -0.41 | -0.20 | -0.31 | -0.06 | 0.72 | 0.82 |
| DECISN | -0.19 | 0.00 | 0.08 | -0.01 | 0.13 | -0.03 | -0.05 | -0.08 | -0.32 |
| DISINN | -0.04 | 0.09 | 0.11 | -0.06 | -0.08 | -0.13 | -0.21 | 0.09 | -0.02 |
| EIQRES | -0.41 | -0.18 | -0.24 | 0.19 | 0.17 | 0.50 | 0.13 | -0.15 | -0.23 |
| INTAMB | 0.22 | 0.37 | 0.43 | -0.39 | -0.24 | -0.25 | -0.29 | 0.32 | 0.40 |
| IPOWCO | -0.26 | -0.05 | 0.01 | -0.04 | -0.28 | -0.07 | -0.27 | 0.03 | -0.14 |
| IPOWEX | 0.27 | 0.02 | 0.14 | -0.18 | -0.28 | -0.49 | -0.58 | 0.22 | -0.14 |
| IPOWLG | -0.25 | 0.04 | 0.10 | -0.14 | -0.29 | -0.14 | -0.22 | 0.06 | 0.05 |
| IPOWRE | -0.20 | 0.06 | 0.10 | -0.07 | -0.28 | -0.11 | -0.22 | 0.03 | -0.06 |
| JOBIN2 | 0.28 | 0.03 | 0.16 | -0.21 | -0.27 | -0.47 | -0.63 | 0.23 | -0.11 |
| MOTIVA | -0.21 | 0.01 | -0.05 | 0.10 | 0.12 | 0.20 | -0.02 | -0.11 | -0.37 |
| PRIGID | 0.14 | 0.46 | 0.54 | -0.39 | -0.46 | -0.48 | -0.43 | 0.51 | 0.46 |
| PUNISH | -0.05 | -0.14 | -0.08 | 0.16 | 0.11 | 0.23 | 0.11 | -0.14 | -0.36 |
| RESRCS | 0.01 | 0.12 | 0.07 | -0.07 | -0.04 | 0.18 | -0.14 | -0.03 | -0.17 |
| RTCINV | -0.06 | 0.07 | -0.02 | -0.02 | -0.03 | -0.24 | -0.06 | 0.13 | 0.01 |
| JOBINV | -0.13 | 0.06 | -0.01 | 0.12 | 0.14 | -0.02 | 0.25 | 0.39 | 0.26 |
| LEVORG | -0.23 | -0.02 | 0.03 | -0.09 | -0.32 | -0.04 | -0.23 | 0.08 | -0.04 |
| NEGPRE | 0.11 | 0.54 | 0.64 | -0.58 | -0.20 | -0.37 | -0.12 | 0.27 | 0.50 |
| POSPRE | -0.14 | -0.67 | -0.67 | 0.75 | 0.28 | 0.38 | 0.41 | 0.14 | -0.22 |
| KTSEI | NS | NS | NS | NS | NS | NS | NS | NS | NS |
| KTSJP | NS | NS | NS | NS | NS | NS | NS | NS | NS |
| KTSSN | NS | NS | NS | S: 0.0423 | NS | NS | S: 0.0422 | S: 0.018 | NS |
| KTSTF | NS | S: 0.0176 | NS | NS | NS | NS | NS | NS | NS |
| LICENS | NS | NS | NS | NS | NS | NS | NS | NS | NS |
| PERFUT | NS | NS | NS | NS | NS | NS | NS | NS | NS |
| PERPAS | NS | NS | NS | NS | NS | NS | NS | NS | NS |
| UNION | NS | NS | NS | NS | NS | NS | NS | - | - |

| | COSNDS | COSRCT | COSROB | COSUNN | COSURV | COSWFL | DECISN | DISINN | EIQRES |
|---|---|---|---|---|---|---|---|---|---|
| COSNDS | 1.00 | | | | | | | | |
| COSRCT | 0.82 | 1.00 | | | | | | | |
| COSROB | 0.66 | 0.69 | 1.00 | | | | | | |
| COSUNN | 0.56 | 0.62 | 0.56 | 1.00 | | | | | |
| COSURV | 0.85 | 0.88 | 0.78 | 0.79 | 1.00 | | | | |
| COSWFL | 0.78 | 0.82 | 0.70 | 0.60 | 0.88 | 1.00 | | | |
| DECISN | -0.02 | -0.07 | -0.20 | -0.18 | -0.23 | -0.03 | 1.00 | | |
| DISINN | 0.07 | 0.14 | 0.03 | 0.08 | 0.09 | 0.19 | 0.32 | 1.00 | |
| EIQRES | -0.15 | -0.11 | -0.33 | -0.07 | -0.19 | -0.31 | 0.28 | 0.15 | 1.00 |
| INTAMB | 0.18 | 0.26 | 0.38 | 0.44 | 0.36 | 0.31 | 0.08 | 0.06 | -0.08 |
| IPOWCO | 0.03 | 0.09 | -0.11 | -0.08 | -0.08 | 0.03 | 0.39 | 0.21 | 0.29 |
| IPOWEX | -0.10 | 0.00 | 0.14 | 0.01 | 0.01 | 0.04 | 0.12 | 0.19 | -0.13 |
| IPOWLG | 0.12 | 0.14 | -0.07 | 0.10 | 0.06 | 0.15 | 0.34 | 0.21 | 0.25 |
| IPOWRE | 0.08 | 0.15 | -0.03 | -0.01 | -0.02 | 0.08 | 0.25 | 0.13 | 0.17 |
| JOBIN2 | -0.08 | 0.03 | 0.15 | 0.02 | 0.03 | 0.06 | 0.14 | 0.25 | -0.05 |
| MOTIVA | -0.43 | -0.34 | -0.21 | -0.36 | -0.37 | -0.29 | 0.37 | -0.16 | 0.38 |
| PRIGID | 0.29 | 0.36 | 0.26 | 0.36 | 0.46 | 0.48 | -0.07 | -0.03 | -0.22 |
| PUNISH | -0.33 | -0.39 | -0.08 | -0.36 | -0.34 | -0.29 | 0.03 | -0.11 | -0.09 |
| RESRCS | -0.24 | -0.16 | -0.03 | -0.12 | -0.18 | -0.17 | 0.21 | -0.15 | 0.22 |
| RTCINV | -0.03 | -0.03 | 0.05 | 0.06 | 0.04 | 0.07 | 0.16 | 0.01 | 0.10 |
| JOBINV | 0.40 | 0.47 | 0.24 | 0.37 | 0.40 | 0.36 | 0.05 | -0.02 | 0.15 |
| LEVORG | 0.08 | 0.11 | -0.14 | 0.02 | 0.00 | 0.10 | 0.37 | 0.21 | 0.25 |
| NEGPRE | 0.26 | 0.40 | 0.23 | 0.38 | 0.42 | 0.52 | 0.03 | -0.15 | -0.27 |
| POSPRE | -0.01 | -0.15 | -0.21 | -0.12 | -0.18 | -0.14 | -0.01 | -0.08 | -0.01 |
| KTSEI | NS | NS | NS | NS | NS | NS | NS | NS | NS |
| KTSJP | NS | NS | NS | NS | NS | NS | NS | S: 0.0350 | NS |
| KTSSN | NS | S: 0.0222 | S: 0.0049 | S: 0.0498 | S: 0.0411 | NS | NS | NS | NS |
| KTSTF | NS | NS | NS | NS | NS | NS | NS | NS | NS |
| LICENS | NS | NS | NS | NS | NS | NS | NS | NS | NS |
| PERFUT | NS | NS | NS | NS | NS | NS | NS | NS | NS |
| PERPAS | NS | NS | NS | NS | NS | NS | NS | NS | NS |
| UNION | - | - | - | - | - | - | - | - | - |

| | INTAMB | IPOWCO | IPOWEX | IPOWLG | IPOWRE | JOBIN2 | MOTIVA | PRIGID | PUNISH |
|---|---|---|---|---|---|---|---|---|---|
| INTAMB | 1.00 | | | | | | | | |
| IPOWCO | 0.04 | 1.00 | | | | | | | |
| IPOWEX | 0.29 | 0.29 | 1.00 | | | | | | |
| IPOWLG | 0.16 | -0.77 | 0.14 | 1.00 | | | | | |
| IPOWRE | 0.00 | 0.94 | 0.25 | 0.70 | 1.00 | | | | |
| JOBIN2 | 0.38 | 0.34 | 0.97 | 0.18 | 0.27 | 1.00 | | | |
| MOTIVA | -0.01 | 0.09 | 0.01 | -0.01 | 0.06 | 0.01 | 1.00 | | |
| PRIGID | 0.40 | 0.16 | 0.40 | 0.24 | 0.20 | 0.33 | -0.04 | 1.00 | |
| PUNISH | -0.04 | -0.19 | -0.15 | -0.28 | -0.20 | -0.10 | 0.45 | -0.20 | 1.00 |
| RESRCS | 0.24 | 0.28 | 0.04 | 0.30 | 0.25 | 0.11 | 0.59 | 0.06 | 0.36 |
| RTCINV | -0.06 | -0.01 | 0.19 | -0.08 | -0.09 | 0.18 | 0.09 | -0.03 | 0.08 |
| JOBINV | 0.11 | 0.20 | -0.02 | 0.26 | 0.18 | -0.02 | -0.02 | 0.36 | -0.06 |
| LEVORG | -0.23 | 0.90 | 0.17 | 0.82 | 0.81 | 0.21 | 0.02 | 0.24 | -0.19 |
| NEGPRE | 0.11 | -0.05 | -0.11 | 0.14 | 0.03 | -0.12 | -0.09 | 0.31 | -0.04 |
| POSPRE | -0.14 | 0.19 | -0.15 | 0.10 | 0.21 | -0.17 | -0.02 | -0.34 | 0.06 |
| KTSEI | NS | NS | NS | NS | NS | NS | NS | NS | NS |
| KTSJP | NS | NS | NS | NS | NS | NS | NS | NS | NS |
| KTSSN | S: 0.0028 | NS | S: 0.0181 | NS | NS | S:0.0101 | NS | NS | NS |
| KTSTF | S: 0.0439 | NS | NS | NS | NS | NS | NS | S: 0.0142 | NS |
| LICENS | NS | S: 0.0368 | NS | NS | S: 0.0390 | NS | NS | NS | NS |
| PERFUT | NS | NS | NS | NS | NS | NS | S: 0.0019 | NS | NS |
| PERPAS | NS | NS | NS | NS | NS | NS | NS | NS | NS |
| UNION | - | - | - | - | - | - | - | - | - |

| | RESRCS | RTCINV | JOBINV | LEVORG | NEGPRE | POSPRE | KTSEI | KTSJP | KTSSN | KTSTF |
|---|---|---|---|---|---|---|---|---|---|---|
| RESRCS | 1.00 | | | | | | | | | |
| RTCINV | -0.09 | 1.00 | | | | | | | | |
| JOBINV | -0.07 | 0.06 | 1.00 | | | | | | | |
| LEVORG | 0.30 | -0.05 | 0.21 | 1.00 | | | | | | |
| NEGPRE | 0.11 | -0.12 | 0.16 | 0.10 | 1.00 | | | | | |
| POSPRE | -0.12 | -0.21 | 0.12 | 0.16 | -0.31 | 1.00 | | | | |
| KTSEI | NS | NS | NS | NS | NS | NS | 1.00 | | | |
| KTSJP | NS | NS | NS | NS | NS | NS | - | 1.00 | | |
| KTSSN | NS | NS | NS | NS | NS | NS | - | - | 1.00 | |
| KTSTF | NS | NS | NS | NS | NS | NS | - | - | - | 1.00 |
| LICENS | NS | NS | NS | S: 0.0055 | NS | NS | - | - | NS | - |
| PERFUT | NS | NS | NS | NS | NS | NS | - | - | NS | - |
| PERPAS | NS | NS | S: 0.0410 | NS | S: 0.0497 | NS | - | - | NS | NS |
| UNION | - | - | - | - | - | - | - | - | - | - |

| | LICENS | PERFUT | PERPAS | UNION |
|---|---|---|---|---|
| LICENS | 1.00 | | | |
| PERFUT | NS | 1.00 | | |
| PERPAS | NS | NS | 1.00 | |
| UNION | - | - | - | 1.00 |

## *E.4 Factor Analysis - Components*

The FACTOR Procedure
Initial Factor Method: Principal Factors

Prior Communality Estimates: SMC

| CAS | ATTCOM | CAIN | CARS | NEGPRE | POSPRE |
|---|---|---|---|---|---|
| 0.78276921 | 0.74990665 | 0.77943015 | 0.86849980 | 0.49378795 | 0.58689739 |

Eigenvalues of the Reduced Correlation Matrix: Total = 4.26129115 Average = 0.71021519

| | Eigenvalue | Difference | Proportion | Cumulative |
|---|---|---|---|---|
| 1 | 4.07598712 | 3.69465579 | 0.9565 | 0.9565 |
| 2 | 0.38133133 | 0.33674772 | 0.0895 | 1.0460 |
| 3 | 0.04458361 | 0.06400874 | 0.0105 | 1.0565 |
| 4 | -.01942513 | 0.06811212 | -0.0046 | 1.0519 |
| 5 | -.08753725 | 0.04611127 | -0.0205 | 1.0314 |
| 6 | -.13364852 | | -0.0314 | 1.0000 |

2 factors will be retained by the PROPORTION criterion.

Factor Pattern

| | | Factor1 | Factor2 |
|---|---|---|---|
| CAS | CAS | -0.89303 | 0.15065 |
| ATTCOM | ATTCOM | 0.86754 | 0.17267 |
| CAIN | CAIN | 0.88392 | -0.01385 |
| CARS | CARS | 0.95354 | 0.06120 |
| NEGPRE | NEGPRE | 0.62454 | 0.36735 |
| POSPRE | POSPRE | -0.66726 | 0.43582 |

Variance Explained by Each Factor

| Factor1 | Factor2 |
|---|---|
| 4.0759871 | 0.3813313 |

Final Communality Estimates: Total = 4.457318

| CAS | ATTCOM | CAIN | CARS | NEGPRE | POSPRE |
|---|---|---|---|---|---|
| 0.82020133 | 0.78244643 | 0.78151484 | 0.91298901 | 0.52499235 | 0.63517449 |

The FACTOR Procedure
Initial Factor Method: Principal Factors

Prior Communality Estimates: SMC

| SUPCHG | PNACCP | PNMAST | PNMEAN | PNRESP |
|---|---|---|---|---|
| 0.47515171 | 0.90377663 | 0.86918497 | 0.89367428 | 0.84279879 |

Eigenvalues of the Reduced Correlation Matrix: Total = 3.98458637 Average = 0.79691727

| | Eigenvalue | Difference | Proportion | Cumulative |
|---|---|---|---|---|
| 1 | 3.89938909 | 3.70670207 | 0.9786 | 0.9786 |
| 2 | 0.19268702 | 0.18346764 | 0.0484 | 1.0270 |
| 3 | 0.00921938 | 0.04895990 | 0.0023 | 1.0293 |
| 4 | -.03974052 | 0.03722809 | -0.0100 | 1.0193 |
| 5 | -.07696861 | | -0.0193 | 1.0000 |

2 factors will be retained by the PROPORTION criterion.

Factor Pattern

| | | Factor1 | Factor2 |
|---|---|---|---|
| SUPCHG | SUPCHG | 0.62027 | 0.32317 |
| PNACCP | PNACCP | 0.94060 | -0.23357 |
| PNMAST | PNMAST | 0.94070 | 0.08581 |
| PNMEAN | PNMEAN | 0.95638 | 0.07354 |
| PNRESP | PNRESP | 0.91124 | -0.14465 |

Variance Explained by Each Factor

| Factor1 | Factor2 |
|---|---|
| 3.8993891 | 0.1926870 |

Final Communality Estimates: Total = 4.092076

| SUPCHG | PNACCP | PNMAST | PNMEAN | PNRESP |
|---|---|---|---|---|
| 0.48917105 | 0.93927479 | 0.89228911 | 0.92006405 | 0.85127711 |

The FACTOR Procedure
Initial Factor Method: Principal Factors

Prior Communality Estimates: SMC

| COMPUN | COMPEX | CLASSQ | COMPCO | IPOWEX | JOBIN2 |
|---|---|---|---|---|---|
| 0.69281746 | 0.43267105 | 0.51708822 | 0.44784140 | 0.93128093 | 0.93944161 |

Eigenvalues of the Reduced Correlation Matrix: Total = 3.96114067 Average = 0.66019011

| | Eigenvalue | Difference | Proportion | Cumulative |
|---|---|---|---|---|
| 1 | 2.98054667 | 1.77933596 | 0.7524 | 0.7524 |
| 2 | 1.20121071 | 1.13488039 | 0.3032 | 1.0557 |
| 3 | 0.06633032 | 0.09861395 | 0.0167 | 1.0724 |
| 4 | -.03228363 | 0.07213968 | -0.0082 | 1.0643 |
| 5 | -.10442331 | 0.04581678 | -0.0264 | 1.0379 |
| 6 | -.15024009 | | -0.0379 | 1.0000 |

2 factors will be retained by the PROPORTION criterion.

Factor Pattern

| | | Factor1 | Factor2 |
|---|---|---|---|
| COMPUN | COMPUN | 0.79731 | 0.38301 |
| COMPEX | COMPEX | 0.56944 | 0.36732 |
| CLASSQ | CLASSQ | 0.59038 | 0.48869 |
| COMPCO | COMPCO | 0.65491 | 0.14378 |
| IPOWEX | IPOWEX | -0.74648 | 0.62195 |
| JOBIN2 | JOBIN2 | -0.82817 | 0.52277 |

Variance Explained by Each Factor

| Factor1 | Factor2 |
|---|---|
| 2.9805467 | 1.2012107 |

Final Communality Estimates: Total = 4.181757

| COMPUN | COMPEX | CLASSQ | COMPCO | IPOWEX | JOBIN2 |
|---|---|---|---|---|---|
| 0.78240402 | 0.45918781 | 0.58736731 | 0.44958536 | 0.94405777 | 0.95915511 |

The FACTOR Procedure
Initial Factor Method: Principal Factors

Prior Communality Estimates: SMC

| IRBSCL | MADEFM | COSURV | JOBINV |
|---|---|---|---|
| 0.38719535 | 0.35300250 | 0.32973059 | 0.24496821 |

Eigenvalues of the Reduced Correlation Matrix: Total = 1.31489665 Average = 0.32872416

| | Eigenvalue | Difference | Proportion | Cumulative |
|---|---|---|---|---|
| 1 | 1.66782961 | 1.68120426 | 1.2684 | 1.2684 |
| 2 | -.01337465 | 0.14920174 | -0.0102 | 1.2582 |
| 3 | -.16257639 | 0.01440553 | -0.1236 | 1.1346 |
| 4 | -.17698192 | | -0.1346 | 1.0000 |

1 factor will be retained by the PROPORTION criterion.

Factor Pattern

| | | Factor1 |
|---|---|---|
| IRBSCL | IRBSCL | 0.70507 |
| MADEFM | MADEFM | 0.66998 |
| COSURV | COSURV | 0.64457 |
| JOBINV | JOBINV | 0.55351 |

Variance Explained by Each Factor

| Factor1 |
|---|
| 1.6678296 |

Final Communality Estimates: Total = 1.667830

| IRBSCL | MADEFM | COSURV | JOBINV |
|---|---|---|---|
| 0.49712324 | 0.44886702 | 0.41546507 | 0.30637428 |

The FACTOR Procedure
Initial Factor Method: Principal Factors

Prior Communality Estimates: SMC

| EIQPOW | INEXCO | EIQCOD |
|---|---|---|
| 0.44012424 | 0.20729618 | 0.32068490 |

Eigenvalues of the Reduced Correlation Matrix: Total = 0.96810532 Average = 0.32270177

| | Eigenvalue | Difference | Proportion | Cumulative |
|---|---|---|---|---|
| 1 | 1.13190726 | 1.01433807 | 1.1692 | 1.1692 |
| 2 | 0.11756919 | 0.39894033 | 0.1214 | 1.2906 |
| 3 | -.28137114 | | -0.2906 | 1.0000 |

1 factor will be retained by the PROPORTION criterion.

Factor Pattern

| | | Factor1 |
|---|---|---|
| EIQPOW | EIQPOW | 0.75982 |
| INEXCO | INEXCO | -0.44795 |
| EIQCOD | EIQCOD | 0.59491 |

Variance Explained by Each Factor

| Factor1 |
|---|
| 1.1319073 |

Final Communality Estimates: Total = 1.131907

| EIQPOW | INEXCO | EIQCOD |
|---|---|---|
| 0.57732517 | 0.20066006 | 0.35392203 |

The FACTOR Procedure
Initial Factor Method: Principal Factors

Prior Communality Estimates: SMC

| MOTIVA | PUNISH | RESRCS | TRAING | TRTECH |
|---|---|---|---|---|
| 0.43031022 | 0.24764571 | 0.62220584 | 0.45733804 | 0.20673492 |

Eigenvalues of the Reduced Correlation Matrix: Total = 1.96423473 Average = 0.39284695

| | Eigenvalue | Difference | Proportion | Cumulative |
|---|---|---|---|---|
| 1 | 2.00194324 | 1.75103817 | 1.0192 | 1.0192 |
| 2 | 0.25090506 | 0.15297824 | 0.1277 | 1.1469 |
| 3 | 0.09792683 | 0.22318406 | 0.0499 | 1.1968 |
| 4 | -.12525723 | 0.13602595 | -0.0638 | 1.1330 |
| 5 | -.26128318 | | -0.1330 | 1.0000 |

1 factor will be retained by the PROPORTION criterion.

Factor Pattern

| | | Factor1 |
|---|---|---|
| MOTIVA | MOTIVA | 0.65768 |
| PUNISH | PUNISH | 0.50066 |
| RESRCS | RESRCS | 0.83165 |
| TRAING | TRAING | 0.68327 |
| TRTECH | TRTECH | 0.40029 |

Variance Explained by Each Factor

| Factor1 |
|---|
| 2.0019432 |

Final Communality Estimates: Total = 2.001943

| MOTIVA | PUNISH | RESRCS | TRAING | TRTECH |
|---|---|---|---|---|
| 0.43253685 | 0.25066421 | 0.69164828 | 0.46686155 | 0.16023235 |

## *E.5 Cronbach Coefficient Alpha - CAS*

The CORR Procedure

| 26 Variables: | Q415 | Q416 | Q417 | Q419 | Q420 | Q421 | Q422 | Q423 | Q424 |
|---|---|---|---|---|---|---|---|---|---|
| | Q425 | Q426 | Q427 | Q428 | Q429 | Q430 | Q431 | Q432 | Q433 |
| | Q434 | Q435 | Q436 | Q437 | Q438 | Q439 | Q440 | Q441 | |

Simple Statistics

| Variable | N | Mean | Std Dev | Sum | Minimum | Maximum | Label |
|---|---|---|---|---|---|---|---|
| Q415 | 49 | 3.30612 | 0.76931 | 162.00000 | 1.00000 | 4.00000 | Q415 |
| Q416 | 49 | 3.16327 | 0.71726 | 155.00000 | 2.00000 | 4.00000 | Q416 |
| Q417 | 49 | 3.51020 | 0.61652 | 172.00000 | 2.00000 | 4.00000 | Q417 |
| Q419 | 49 | 3.10204 | 0.79700 | 152.00000 | 1.00000 | 4.00000 | Q419 |
| Q420 | 49 | 3.08163 | 0.75930 | 151.00000 | 1.00000 | 4.00000 | Q420 |
| Q421 | 49 | 3.38776 | 0.70167 | 166.00000 | 1.00000 | 4.00000 | Q421 |
| Q422 | 49 | 3.20408 | 0.70651 | 157.00000 | 2.00000 | 4.00000 | Q422 |
| Q423 | 49 | 3.40816 | 0.60959 | 167.00000 | 2.00000 | 4.00000 | Q423 |
| Q424 | 49 | 3.08163 | 0.73134 | 151.00000 | 1.00000 | 4.00000 | Q424 |
| Q425 | 49 | 3.06122 | 0.71903 | 150.00000 | 2.00000 | 4.00000 | Q425 |
| Q426 | 49 | 3.00000 | 0.64550 | 147.00000 | 2.00000 | 4.00000 | Q426 |
| Q427 | 49 | 2.59184 | 0.73367 | 127.00000 | 1.00000 | 4.00000 | Q427 |
| Q428 | 49 | 2.55102 | 0.70891 | 125.00000 | 1.00000 | 4.00000 | Q428 |
| Q429 | 49 | 3.40816 | 0.60959 | 167.00000 | 2.00000 | 4.00000 | Q429 |
| Q430 | 49 | 3.38776 | 0.53293 | 166.00000 | 2.00000 | 4.00000 | Q430 |
| Q431 | 49 | 3.36735 | 0.56620 | 165.00000 | 2.00000 | 4.00000 | Q431 |
| Q432 | 49 | 3.34694 | 0.63084 | 164.00000 | 2.00000 | 4.00000 | Q432 |
| Q433 | 49 | 3.04082 | 0.78949 | 149.00000 | 1.00000 | 4.00000 | Q433 |
| Q434 | 49 | 2.51020 | 0.71071 | 123.00000 | 1.00000 | 4.00000 | Q434 |
| Q435 | 49 | 3.22449 | 0.84817 | 158.00000 | 1.00000 | 4.00000 | Q435 |
| Q436 | 49 | 3.34694 | 0.66304 | 164.00000 | 1.00000 | 4.00000 | Q436 |
| Q437 | 49 | 3.40816 | 0.64286 | 167.00000 | 2.00000 | 4.00000 | Q437 |
| Q438 | 49 | 2.67347 | 0.62543 | 131.00000 | 1.00000 | 4.00000 | Q438 |
| Q439 | 49 | 2.71429 | 0.79057 | 133.00000 | 1.00000 | 4.00000 | Q439 |
| Q440 | 49 | 3.38776 | 0.57068 | 166.00000 | 2.00000 | 4.00000 | Q440 |
| Q441 | 49 | 2.85714 | 0.73598 | 140.00000 | 2.00000 | 4.00000 | Q441 |

Cronbach Coefficient Alpha

| Variables | Alpha |
|---|---|
| Raw | 0.949373 |
| Standardized | 0.952064 |

Cronbach Coefficient Alpha with Deleted Variable

| | Raw Variables | | Standardized Variables | | |
|---|---|---|---|---|---|
| Deleted Variable | Correlation with Total | Alpha | Correlation with Total | Alpha | Label |
| Q415 | 0.511624 | 0.948921 | 0.510459 | 0.951599 | Q415 |
| Q416 | 0.609945 | 0.947685 | 0.605332 | 0.950618 | Q416 |
| Q417 | 0.701250 | 0.946808 | 0.708582 | 0.949539 | Q417 |
| Q419 | 0.447714 | 0.949795 | 0.455605 | 0.952162 | Q419 |
| Q420 | 0.516091 | 0.948839 | 0.521224 | 0.951489 | Q420 |
| Q421 | 0.800776 | 0.945552 | 0.803286 | 0.948538 | Q421 |
| Q422 | 0.724585 | 0.946399 | 0.718762 | 0.949432 | Q422 |
| Q423 | 0.829730 | 0.945577 | 0.837088 | 0.948178 | Q423 |
| Q424 | 0.700123 | 0.946656 | 0.696896 | 0.949662 | Q424 |
| Q425 | 0.764967 | 0.945921 | 0.767370 | 0.948919 | Q425 |
| Q426 | 0.566961 | 0.948111 | 0.560927 | 0.951079 | Q426 |
| Q427 | 0.490507 | 0.949063 | 0.492230 | 0.951787 | Q427 |
| Q428 | 0.486622 | 0.949042 | 0.481032 | 0.951901 | Q428 |
| Q429 | 0.801797 | 0.945849 | 0.810880 | 0.948457 | Q429 |
| Q430 | 0.794636 | 0.946265 | 0.800384 | 0.948568 | Q430 |
| Q431 | 0.736072 | 0.946632 | 0.744367 | 0.949162 | Q431 |
| Q432 | 0.832253 | 0.945458 | 0.841782 | 0.948128 | Q432 |
| Q433 | 0.701870 | 0.946630 | 0.696350 | 0.949667 | Q433 |
| Q434 | 0.441708 | 0.949539 | 0.433255 | 0.952390 | Q434 |
| Q435 | 0.642933 | 0.947469 | 0.645727 | 0.950197 | Q435 |
| Q436 | 0.655365 | 0.947197 | 0.650683 | 0.950146 | Q436 |
| Q437 | 0.795763 | 0.945785 | 0.806335 | 0.948505 | Q437 |
| Q438 | 0.115258 | 0.952420 | 0.100574 | 0.955719 | Q438 |
| Q439 | 0.516683 | 0.948926 | 0.515475 | 0.951548 | Q439 |
| Q440 | 0.784823 | 0.946173 | 0.794838 | 0.948627 | Q440 |
| Q441 | 0.719027 | 0.946432 | 0.722368 | 0.949394 | Q441 |

## *E.6 Cronbach Coefficient Alpha - IRBSCL*

The CORR Procedure

20 Variables: Q180 Q181 Q182 Q183 Q184 Q185 Q186 Q187 Q188
Q189 Q190 Q191 Q192 Q193 Q194 Q195 Q196 Q197
Q198 Q199

Simple Statistics

| Variable | N | Mean | Std Dev | Sum | Minimum | Maximum | Label |
|---|---|---|---|---|---|---|---|
| Q180 | 49 | 2.69388 | 1.26168 | 132.00000 | 1.00000 | 5.00000 | Q180 |
| Q181 | 49 | 2.87755 | 1.23546 | 141.00000 | 1.00000 | 5.00000 | Q181 |
| Q182 | 49 | 3.36735 | 1.05463 | 165.00000 | 1.00000 | 5.00000 | Q182 |
| Q183 | 49 | 2.61224 | 0.97503 | 128.00000 | 1.00000 | 5.00000 | Q183 |
| Q184 | 49 | 2.79592 | 1.07973 | 137.00000 | 1.00000 | 5.00000 | Q184 |
| Q185 | 49 | 2.51020 | 1.02312 | 123.00000 | 1.00000 | 5.00000 | Q185 |
| Q186 | 49 | 1.55102 | 0.61445 | 76.00000 | 1.00000 | 3.00000 | Q186 |
| Q187 | 49 | 2.12245 | 0.85714 | 104.00000 | 1.00000 | 4.00000 | Q187 |
| Q188 | 49 | 2.95918 | 1.27409 | 145.00000 | 1.00000 | 5.00000 | Q188 |
| Q189 | 49 | 2.87755 | 0.97110 | 141.00000 | 1.00000 | 4.00000 | Q189 |
| Q190 | 49 | 3.51020 | 1.15691 | 172.00000 | 1.00000 | 5.00000 | Q190 |
| Q191 | 49 | 3.77551 | 1.00551 | 185.00000 | 1.00000 | 5.00000 | Q191 |
| Q192 | 49 | 2.75510 | 0.87870 | 135.00000 | 1.00000 | 5.00000 | Q192 |
| Q193 | 49 | 2.61224 | 0.93131 | 128.00000 | 1.00000 | 5.00000 | Q193 |
| Q194 | 49 | 3.20408 | 1.13614 | 157.00000 | 1.00000 | 5.00000 | Q194 |
| Q195 | 49 | 3.73469 | 0.78463 | 183.00000 | 2.00000 | 5.00000 | Q195 |
| Q196 | 49 | 1.81633 | 0.88208 | 89.00000 | 1.00000 | 5.00000 | Q196 |
| Q197 | 49 | 2.38776 | 0.93131 | 117.00000 | 1.00000 | 4.00000 | Q197 |
| Q198 | 49 | 2.95918 | 1.01979 | 145.00000 | 1.00000 | 5.00000 | Q198 |
| Q199 | 49 | 2.63265 | 0.80865 | 129.00000 | 1.00000 | 4.00000 | Q199 |

Cronbach Coefficient Alpha

| Variables | Alpha |
|---|---|
| Raw | 0.864887 |
| Standardized | 0.866292 |

Cronbach Coefficient Alpha with Deleted Variable

| | Raw Variables | | Standardized Variables | | |
|---|---|---|---|---|---|
| Deleted Variable | Correlation with Total | Alpha | Correlation with Total | Alpha | Label |
| Q180 | 0.420965 | 0.861039 | 0.424559 | 0.861496 | Q180 |
| Q181 | 0.671430 | 0.849202 | 0.659155 | 0.852710 | Q181 |
| Q182 | 0.480047 | 0.857872 | 0.486174 | 0.859225 | Q182 |
| Q183 | 0.522582 | 0.856384 | 0.528125 | 0.857664 | Q183 |
| Q184 | 0.440214 | 0.859471 | 0.434090 | 0.861147 | Q184 |
| Q185 | 0.543162 | 0.855466 | 0.551177 | 0.856802 | Q185 |
| Q186 | 0.286339 | 0.863949 | 0.280185 | 0.866717 | Q186 |
| Q187 | 0.592545 | 0.854627 | 0.592243 | 0.855255 | Q187 |
| Q188 | 0.576651 | 0.853712 | 0.580946 | 0.855682 | Q188 |
| Q189 | 0.534812 | 0.855952 | 0.552697 | 0.856745 | Q189 |
| Q190 | 0.467843 | 0.858496 | 0.447865 | 0.860640 | Q190 |
| Q191 | 0.352450 | 0.862608 | 0.331918 | 0.864863 | Q191 |
| Q192 | 0.497129 | 0.857602 | 0.493287 | 0.858962 | Q192 |
| Q193 | 0.600475 | 0.853806 | 0.614477 | 0.854413 | Q193 |
| Q194 | 0.240273 | 0.867819 | 0.238228 | 0.868208 | Q194 |
| Q195 | 0.494967 | 0.858109 | 0.488825 | 0.859127 | Q195 |
| Q196 | 0.320348 | 0.863308 | 0.333311 | 0.864812 | Q196 |
| Q197 | 0.351636 | 0.862407 | 0.360225 | 0.863840 | Q197 |
| Q198 | 0.386421 | 0.861402 | 0.371255 | 0.863440 | Q198 |
| Q199 | 0.420521 | 0.860205 | 0.431585 | 0.861239 | Q199 |

## *E.7 Factor Analysis - RTCI*

The PRINCOMP Procedure

| | |
|---|---|
| Observations | 36 |
| Variables | 9 |

Simple Statistics

| | RTCINV | CHGSCL | ADDEFM | IRBSCL | CAS |
|---|---|---|---|---|---|
| Mean | 5.662500000 | 4.902777778 | 3.048611111 | 5.081250000 | 3.548076923 |
| StD | 0.722829263 | 1.135903947 | 1.823281426 | 1.194412213 | 1.466889424 |

Simple Statistics

| | EIQPOW | LEVORG | SUPCHG | MOTIVA |
|---|---|---|---|---|
| Mean | 3.903846154 | 5.173076923 | 3.638392857 | 2.450000000 |
| StD | 0.992267228 | 2.555710626 | 1.132943892 | 1.697813720 |

Correlation Matrix

| | | RTCINV | CHGSCL | ADDEFM | IRBSCL | CAS | EIQPOW | LEVORG | SUPCHG | MOTIVA |
|---|---|---|---|---|---|---|---|---|---|---|
| RTCINV | RTCINV | 1.0000 | 0.1646 | 0.0621 | 0.2335 | 0.1020 | 0.1134 | -.0596 | 0.3421 | 0.1042 |
| CHGSCL | CHGSCL | 0.1646 | 1.0000 | 0.4188 | 0.3174 | 0.4393 | 0.5212 | -.1339 | -.0861 | 0.0852 |
| ADDEFM | ADDEFM | 0.0621 | 0.4188 | 1.0000 | 0.0033 | 0.1104 | 0.4926 | -.0511 | -.1017 | 0.2154 |
| IRBSCL | IRBSCL | 0.2335 | 0.3174 | 0.0033 | 1.0000 | 0.1188 | 0.3562 | -.0476 | -.0886 | 0.0897 |
| CAS | CAS | 0.1020 | 0.4393 | 0.1104 | 0.1188 | 1.0000 | 0.3142 | -.2679 | -.0160 | 0.1122 |
| EIQPOW | EIQPOW | 0.1134 | 0.5212 | 0.4926 | 0.3562 | 0.3142 | 1.0000 | 0.1557 | 0.0896 | 0.1984 |
| LEVORG | LEVORG | -.0596 | -.1339 | -.0511 | -.0476 | -.2679 | 0.1557 | 1.0000 | 0.1225 | 0.0016 |
| SUPCHG | SUPCHG | 0.3421 | -.0861 | -.1017 | -.0886 | -.0160 | 0.0896 | 0.1225 | 1.0000 | 0.0197 |
| MOTIVA | MOTIVA | 0.1042 | 0.0852 | 0.2154 | 0.0897 | 0.1122 | 0.1984 | 0.0016 | 0.0197 | 1.0000 |

Eigenvalues of the Correlation Matrix

| | Eigenvalue | Difference | Proportion | Cumulative |
|---|---|---|---|---|
| 1 | 2.46358189 | 1.07994235 | 0.2737 | 0.2737 |
| 2 | 1.38363955 | 0.15039661 | 0.1537 | 0.4275 |
| 3 | 1.23324293 | 0.21529220 | 0.1370 | 0.5645 |
| 4 | 1.01795074 | 0.09733813 | 0.1131 | 0.6776 |
| 5 | 0.92061261 | 0.14334610 | 0.1023 | 0.7799 |
| 6 | 0.77726651 | 0.23420120 | 0.0864 | 0.8663 |
| 7 | 0.54306531 | 0.14504643 | 0.0603 | 0.9266 |

| | | | | |
|---|---|---|---|---|
| 8 | 0.39801889 | 0.13539732 | 0.0442 | 0.9708 |
| 9 | 0.26262157 | | 0.0292 | 1.0000 |

Eigenvectors

| | | Prin1 | Prin2 | Prin3 | Prin4 | Prin5 |
|---|---|---|---|---|---|---|
| RTCINV | RTCINV | 0.206810 | 0.550727 | -.364943 | 0.027664 | 0.111826 |
| CHGSCL | CHGSCL | 0.513431 | -.135819 | -.049918 | -.094730 | -.227934 |
| ADDEFM | ADDEFM | 0.389256 | -.135088 | 0.377911 | 0.345078 | -.112782 |
| IRBSCL | IRBSCL | 0.314231 | 0.093264 | -.154297 | -.693562 | 0.387720 |
| CAS | CAS | 0.365313 | -.172833 | -.372663 | 0.171892 | -.222412 |
| EIQPOW | EIQPOW | 0.504028 | 0.110118 | 0.310806 | -.115183 | -.165582 |
| LEVORG | LEVORG | -.092722 | 0.353677 | 0.641423 | -.285548 | -.125908 |
| SUPCHG | SUPCHG | -.005907 | 0.687331 | -.125394 | 0.259231 | -.295653 |
| MOTIVA | MOTIVA | 0.217317 | 0.108617 | 0.187287 | 0.445648 | 0.769641 |

Eigenvectors

| | Prin6 | Prin7 | Prin8 | Prin9 |
|---|---|---|---|---|
| RTCINV | -.392215 | 0.540814 | -.171193 | -.178486 |
| CHGSCL | -.045990 | 0.164049 | 0.789915 | -.039101 |
| ADDEFM | -.517980 | -.045096 | -.240706 | 0.476800 |
| IRBSCL | -.029043 | -.288622 | -.092173 | 0.380469 |
| CAS | 0.604546 | 0.246849 | -.336415 | 0.281423 |
| EIQPOW | 0.122511 | -.276519 | -.317540 | -.635800 |
| LEVORG | 0.306608 | 0.456358 | 0.025676 | 0.233605 |
| SUPCHG | 0.136760 | -.499601 | 0.183234 | 0.235219 |
| MOTIVA | 0.285848 | 0.003379 | 0.179028 | -.034332 |

# Appendix F. Example Data Analysis for Phase II Using Phase I Data

## *F.1 Example Data Analysis Using Phase I Data*

This appendix discusses the data analysis performed using the methods discussed in section 5.3.2 - Data Analysis Method, testing them with the Phase I data collected. The Phase II analysis closely resembled this example analysis.

The specific hypotheses tested are presented along with the results from testing the Phase I data. A discussion of the background of each hypothesis is located in section 5.1 - Hypotheses Identified for Phase II. A summary of these hypotheses and their results is presented in section F.2. The data analysis output for each hypothesis test from *SAS®* and *Analyse-it for Microsoft Excel* is provided in the remainder of this appendix.

***Hypothesis 1:* Profession**

- Null: There is no difference in the mean RTCI value for different professions.
- Alternate: At least one profession has a different mean RTCI value.

This hypothesis was tested using one-way ANOVA with nine possible professions: administrator, architect, construction manager, construction superintendent, construction tradesman, drafter, engineer, management, and technician. It should be noted that the results of this test were technically not appropriate when using the Phase I data, but they were included for a demonstration of the technique. Several of the profession groups were represented by less than five individuals each, which is not enough data in a single group to be valid for comparisons. The Phase I data was much smaller than was anticipated in the full study, so this was less of an issue for the final data analysis. Any groups that were represented by less than five individuals in the Phase II study, were omitted from this analysis.

The one-way ANOVA test on the nine possible professions found that at least one profession has a different mean RTCI value. The p-value was 0.0208, which is less than the significance level of 0.05 previously decided, implying statistical significance.

Since a statistical difference was found (i.e., at least one group differs), Tukey's multiple comparison test was used to compare each group with each of the other groups to determine which groups differ on the mean RTCI value. The only groups found to have statistically different means using this test were Management < Technicians.

***Hypothesis 2:* Gender**

- Null: There is no difference in the mean RTCI value for different genders.
- Alternate: There is a difference in mean RTCI value for the different genders.

This hypothesis was tested using a t-test with two groups: male and female. This test found that there is no difference in the mean RTCI value for males vs. females (p-value = 0.8279).

***Hypothesis 3:* Age**

- Null: There is no linear relationship between the RTCI value and an individual's age.
- Alternate: There is a linear relationship between the RTCI value and an individual's age.

Because age is measured as a continuous variable, Pearson's correlation test was used. If the points are nearly on a line, the magnitude of $r$ will be large (near 1.0), and if they are mostly random, the magnitude of $r$ will be close to 0. The Pearson correlation for the test of age vs. RTCI was $r = -0.09$ with a p-value of 0.5568, indicating that there is no linear relationship between RTCI value and age.

***Hypothesis 4:* Personality Type**

- Null: There is no difference in the mean RTCI value for different subsets of personality type using the Keirsey Temperament Sorter II.
- Alternate: There is a difference in mean RTCI value for the different subsets of personality type.

This hypothesis was tested four separate times using a t-test with two groups in each instance: S vs. N (sensing vs. intuition), T vs. F (thinking vs. feeling), J vs. P (judging vs. perceiving), and E vs. I (extrovert vs. introvert). Since the Keirsey Temperament Sorter II is a shortened version of

the Myers Briggs Testing Instrument (MBTI), it sometimes cannot categorize an individual and it is recommended that these persons take the longer test. Any persons that could not be categorized in a given subset using the Keirsey Temperament Sorter II were not included in this analysis.

The first test found that there is a significant difference in the mean RTCI value for Sensors vs. Intuitors (p-value = 0.0241). Sensors have a higher mean RTCI value than do Intuitors. The second test found that there was no difference in the mean RTCI value for Thinkers vs. Feelers (p-value = 0.3211). The third and fourth tests also found no difference for Judgers vs. Perceivers (p-value = 0.2103) or Extroverts vs. Introverts (p-value = 0.8980).

***<u>Hypothesis 5:</u> Education Level***

- Null: There is no linear relationship between the RTCI value and an individual's education level.
- Alternate: There is a linear relationship between the RTCI value and an individual's education level.

Because education level is a discrete, ordered variable, Spearman's correlation test was used. If the points are nearly on a line the magnitude of $r_s$ will be large (near 1.0), and if they are mostly random, the magnitude of $r_s$ will be close to 0. The Spearman correlation for this test was $r_s = -0.34$ with a p-value of 0.0172, indicating that there is a statistically significant negative correlation between RTCI value and education level. This means that a person with more education has a lower likelihood of resistance to change and vice versa.

***<u>Hypothesis 6:</u> Computer Understanding and Experience***

- Null: There is no linear relationship between the RTCI value and an individual's computer understanding and experience.
- Alternate: There is a linear relationship between the RTCI value and an individual's computer understanding and experience.

Because computer understanding and experience is measured as a continuous variable, Pearson's correlation test was used. The Pearson correlation for the test of computer understanding and experience was $r = -0.23$ with a p-value of 0.1148, indicating that there is no linear relationship between RTCI value and computer understanding and experience.

***<u>Hypothesis 7:</u> Perceived Past (Future) Technology Change***

- Null: There is no difference in the mean RTCI value for individuals that perceived a technology change in the last (next) 12 months vs. individuals that did not perceive a technology change in the last (next) 12 months.
- Alternate: There is a difference in mean RTCI value for the different groups in perception of a past (future) technology change.

This hypothesis was tested twice using a t-test with two groups: change perceived and no change perceived. The first test examined past changes perceived and found that there is no difference in the mean RTCI value for the two groups (p-value = 0.4403). The second test examined future changes perceived. This test found that there is a difference in the mean RTCI value for the two groups (p-value = 0.0494). Those that perceive a future change have a lower mean RTCI value than individuals that do not perceive a future change.

***<u>Hypothesis 8:</u> Prediction of RTCI from Demographics***

- Null: No prediction of RTCI is possible from these demographic variables.
- Alternate: A prediction of RTCI is possible from these demographic variables.

A linear regression test was performed to determine if a prediction of RTCI was possible with the following demographic variables: profession, gender, age, each subset of personality type (S/N, T/F, J/P, E/I), education level, computer understanding and experience, and perceived past and future changes. Because many of the variables are categorical and include more than two options, an ANOVA linear model was used instead of a regression model. The results are equivalent in meaning however. Based on this test, no prediction is possible from these demographic variables (p-value = 0.1230).

## *F.2 Summary of Example Data Analysis*

| Hypothesis Number | Null Hypothesis | Study Result Using Phase I Data |
|---|---|---|
| Hypothesis 1 | There is no difference in the mean RTCI value for different professions. | At least one profession has a different mean RTCI value: Management vs. Technicians (p-value = 0.0208) |
| Hypothesis 2 | There is no difference in the mean RTCI value for different genders. | No difference in the mean RTCI value for males vs. females (p-value = 0.8279). |
| Hypothesis 3 | There is no linear relationship between the RTCI value and an individual's age. | No linear relationship between RTCI value and age (p-value = 0.5568) |
| Hypothesis 4A | There is no difference in the mean RTCI value for the S vs. N subset of personality type using the Keirsey Temperament Sorter II. | There is a difference in the mean RTCI value for Sensors vs. Intuitors (p-value = 0.0241). Sensors have a higher mean RTCI value than do Intuitors. |
| Hypothesis 4B | There is no difference in the mean RTCI value for the T vs. F subset of personality type using the Keirsey Temperament Sorter II. | No difference in the mean RTCI value for Thinkers vs. Feelers (p-value = 0.3211) |
| Hypothesis 4C | There is no difference in the mean RTCI value for the J vs. P subset of personality type using the Keirsey Temperament Sorter II. | No difference in the mean RTCI value for Judgers vs. Perceivers (p-value = 0.2103) |
| Hypothesis 4D | There is no difference in the mean RTCI value for the E vs. I subset of personality type using the Keirsey Temperament Sorter II. | No difference in the mean RTCI value for Extroverts vs. Introverts (p-value = 0.8980). |
| Hypothesis 5 | There is no linear relationship between the RTCI value and an individual's education level. | There is a negative correlation between RTCI value and education level (p-value = 0.0172) |
| Hypothesis 6 | There is no linear relationship between the RTCI value and an individual's computer understanding and experience. | No linear relationship between RTCI value and computer understanding and experience (p-value = 0.1148) |

| Hypothesis Number | Null Hypothesis | Study Result Using Phase I Data |
|---|---|---|
| Hypothesis 7A | There is no difference in the mean RTCI value for individuals that perceived a technology change in the last 12 months vs. individuals that did not perceive a technology change in the last 12 months. | No difference in the mean RTCI value for the two groups (p-value = 0.4403) |
| Hypothesis 7B | There is no difference in the mean RTCI value for individuals that perceived a technology change in the next 12 months vs. individuals that did not perceive a technology change in the next 12 months. | There is a difference in the mean RTCI value for the two groups (p-value = 0.0494) |
| Hypothesis 8 | No prediction of RTCI is possible from these demographic variables. | No prediction is possible from these demographic variables (p-value = 0.1230) |

From these preliminary data analyses, it can be seen that there are some demographic groups that differ in their RTCI values. When comparing professions, management had a statistically significant different mean value of the RTCI than technicians did. When comparing subsets of personality type, Sensors (S) have a higher mean RTCI value than do Intuitors (N). There is also a statistically significant negative correlation between RTCI value and education level. Finally, those that perceive a future change have a lower mean RTCI value than individuals that do not perceive a future change. All of the other hypotheses accepted the null.

## *F.3 Example Data Analysis Output*

### F.3.1 Hypothesis 1: Profession – One-Way ANOVA

```
                                    The ANOVA Procedure

                                  Class Level Information

Class       Levels  Values

PROF             9  Administrator Architect Construction Man Construction Sup Construction Tra
                    Drafter Engineer Management Technician

                                 Number of observations    117

NOTE: Due to missing values, only 49 observations can be used in this analysis.

                                    The ANOVA Procedure

Dependent Variable: RESIST   RESIST
                                                Sum of
       Source                      DF          Squares     Mean Square    F Value    Pr > F

       Model                        8       7.09206713      0.88650839       2.62    0.0208

       Error                       40      13.52076393      0.33801910

       Corrected Total             48      20.61283106


                      R-Square     Coeff Var      Root MSE    RESIST Mean
                      0.344061      13.75983      0.581394       4.225300


       Source                      DF         Anova SS     Mean Square    F Value    Pr > F
       PROF                         8       7.09206713      0.88650839       2.62    0.0208

                        Tukey's Studentized Range (HSD) Test for RESIST

                  NOTE: This test controls the Type I experimentwise error rate.

                           Alpha                                      0.05
                           Error Degrees of Freedom                     40
                           Error Mean Square                      0.338019
                           Critical Value of Studentized Range    4.63447

                  Comparisons significant at the 0.05 level are indicated by ***.

                                                   Difference
                           PROF                       Between     Simultaneous 95%
                       Comparison                       Means    Confidence Limits

            Technician       - Architect               0.5408     -1.1985   2.2801
            Technician       - Drafter                 0.5420     -1.3633   2.4472
            Technician       - Construction Tra        0.6085     -1.1308   2.3478
            Technician       - Construction Sup        0.9074     -0.6483   2.4630
            Technician       - Administrator           0.9344     -0.5932   2.4621
            Technician       - Engineer                1.0731     -0.3741   2.5202
            Technician       - Construction Man        1.3708     -0.1050   2.8466
            Technician       - Management              1.8292      0.0900   3.5685  ***
            Architect        - Technician             -0.5408     -2.2801   1.1985
            Architect        - Drafter                 0.0012     -1.7381   1.7404
            Architect        - Construction Tra        0.0677     -1.4879   1.6234
            Architect        - Construction Sup        0.3666     -0.9807   1.7138
            Architect        - Administrator           0.3937     -0.9211   1.7084
```

| | | | | | |
|---|---|---|---|---|---|
| Architect | - Engineer | 0.5323 | -0.6881 | 1.7526 | |
| Architect | - Construction Man | 0.8300 | -0.4242 | 2.0842 | |
| Architect | - Management | 1.2884 | -0.2672 | 2.8441 | |
| Drafter | - Technician | -0.5420 | -2.4472 | 1.3633 | |
| Drafter | - Architect | -0.0012 | -1.7404 | 1.7381 | |
| Drafter | - Construction Tra | 0.0665 | -1.6727 | 1.8058 | |
| Drafter | - Construction Sup | 0.3654 | -1.1903 | 1.9210 | |
| Drafter | - Administrator | 0.3925 | -1.1351 | 1.9201 | |
| Drafter | - Engineer | 0.5311 | -0.9160 | 1.9783 | |
| Drafter | - Construction Man | 0.8288 | -0.6470 | 2.3047 | |
| Drafter | - Management | 1.2873 | -0.4520 | 3.0265 | |
| Construction Tra | - Technician | -0.6085 | -2.3478 | 1.1308 | |
| Construction Tra | - Architect | -0.0677 | -1.6234 | 1.4879 | |
| Construction Tra | - Drafter | -0.0665 | -1.8058 | 1.6727 | |
| Construction Tra | - Construction Sup | 0.2988 | -1.0484 | 1.6461 | |
| Construction Tra | - Administrator | 0.3259 | -0.9888 | 1.6407 | |
| Construction Tra | - Engineer | 0.4646 | -0.7558 | 1.6849 | |
| Construction Tra | - Construction Man | 0.7623 | -0.4919 | 2.0165 | |
| Construction Tra | - Management | 1.2207 | -0.3349 | 2.7764 | |
| Construction Sup | - Technician | -0.9074 | -2.4630 | 0.6483 | |
| Construction Sup | - Architect | -0.3666 | -1.7138 | 0.9807 | |
| Construction Sup | - Drafter | -0.3654 | -1.9210 | 1.1903 | |
| Construction Sup | - Construction Tra | -0.2988 | -1.6461 | 1.0484 | |
| Construction Sup | - Administrator | 0.0271 | -1.0329 | 1.0871 | |
| Construction Sup | - Engineer | 0.1657 | -0.7746 | 1.1061 | |
| Construction Sup | - Construction Man | 0.4635 | -0.5204 | 1.4473 | |
| Construction Sup | - Management | 0.9219 | -0.4253 | 2.2691 | |
| Administrator | - Technician | -0.9344 | -2.4621 | 0.5932 | |
| Administrator | - Architect | -0.3937 | -1.7084 | 0.9211 | |
| Administrator | - Drafter | -0.3925 | -1.9201 | 1.1351 | |
| Administrator | - Construction Tra | -0.3259 | -1.6407 | 0.9888 | |
| Administrator | - Construction Sup | -0.0271 | -1.0871 | 1.0329 | |
| Administrator | - Engineer | 0.1386 | -0.7546 | 1.0318 | |
| Administrator | - Construction Man | 0.4364 | -0.5025 | 1.3753 | |
| Administrator | - Management | 0.8948 | -0.4200 | 2.2096 | |
| Engineer | - Technician | -1.0731 | -2.5202 | 0.3741 | |
| Engineer | - Architect | -0.5323 | -1.7526 | 0.6881 | |
| Engineer | - Drafter | -0.5311 | -1.9783 | 0.9160 | |
| Engineer | - Construction Tra | -0.4646 | -1.6849 | 0.7558 | |
| Engineer | - Construction Sup | -0.1657 | -1.1061 | 0.7746 | |
| Engineer | - Administrator | -0.1386 | -1.0318 | 0.7546 | |
| Engineer | - Construction Man | 0.2977 | -0.5037 | 1.0991 | |
| Engineer | - Management | 0.7562 | -0.4642 | 1.9765 | |
| Construction Man | - Technician | -1.3708 | -2.8466 | 0.1050 | |
| Construction Man | - Architect | -0.8300 | -2.0842 | 0.4242 | |
| Construction Man | - Drafter | -0.8288 | -2.3047 | 0.6470 | |
| Construction Man | - Construction Tra | -0.7623 | -2.0165 | 0.4919 | |
| Construction Man | - Construction Sup | -0.4635 | -1.4473 | 0.5204 | |
| Construction Man | - Administrator | -0.4364 | -1.3753 | 0.5025 | |
| Construction Man | - Engineer | -0.2977 | -1.0991 | 0.5037 | |
| Construction Man | - Management | 0.4584 | -0.7958 | 1.7126 | |
| Management | - Technician | -1.8292 | -3.5685 | -0.0900 | *** |
| Management | - Architect | -1.2884 | -2.8441 | 0.2672 | |
| Management | - Drafter | -1.2873 | -3.0265 | 0.4520 | |
| Management | - Construction Tra | -1.2207 | -2.7764 | 0.3349 | |
| Management | - Construction Sup | -0.9219 | -2.2691 | 0.4253 | |
| Management | - Administrator | -0.8948 | -2.2096 | 0.4200 | |
| Management | - Engineer | -0.7562 | -1.9765 | 0.4642 | |
| Management | - Construction Man | -0.4584 | -1.7126 | 0.7958 | |

## F.3.2 Hypothesis 2: Gender – t-test

analysed with: Analyse-it + General 1.67

| | |
|---|---|
| **Test** | **Independent samples t-test** |
| | RESIST by GENDER: Female ≠ Male |
| **Performed by** | Kirsten Davis |
| **Date** | ################ |

| | |
|---|---|
| **n** | 48 |

| RESIST by GENDER | n | Mean | SD | SE |
|---|---|---|---|---|
| **Female** | 12 | 4.2773 | 0.5184 | 0.14966 |
| **Male** | 36 | 4.2292 | 0.6977 | 0.11629 |

| | |
|---|---|
| **Difference between means** | 0.0481 |
| **95% CI** | -0.3943 to 0.4904 |

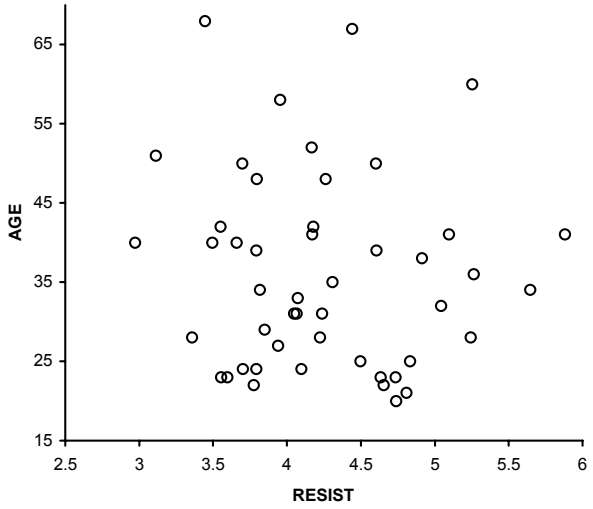
| | |
|---|---|
| **t statistic** | 0.22 |
| **2-tailed p** | 0.8279 |

## F.3.3 Hypothesis 3: Age – Pearson's correlation

analysed with: Analyse-it + General 1.67

| | | | |
|---|---|---|---|
| **Test** | **Pearson correlation** | | |
| | RESIST ≠ AGE | | |
| **Performed by** | Kirsten Davis | **Date** | 25 April 2003 |

| | |
|---|---|
| **n** | 48 (cases excluded: 69 due to missing values) |
| **r statistic** | -0.09 |
| **95% CI** | -0.36 to 0.20 |
| **2-tailed p** | 0.5568 (t approximation) |



## F.3.4 Hypothesis 4A: Personality Type S/N – t-test

analysed with: Analyse-it + General 1.67

| | | | |
|---|---|---|---|
| **Test** | **Independent samples t-test** | | |
| | RESIST by KTSSN: N ≠ S | | |
| **Performed by** | Kirsten Davis | **Date** | ################ |

| | |
|---|---|
| **n** | 49 |

| RESIST by KTSSN | n | Mean | SD | SE |
|---|---|---|---|---|
| **N** | 8 | 3.7525 | 0.4570 | 0.16158 |
| **S** | 41 | 4.3175 | 0.6522 | 0.10185 |

| | |
|---|---|
| **Difference between means** | -0.5650 |
| **95% CI** | -1.0525 to -0.0775 |

| | |
|---|---|
| **t statistic** | -2.33 |
| **2-tailed p** | 0.0241 |

## F.3.5 Hypothesis 4B: Personality Type T/F – t-test

analysed with: Analyse-it + General 1.67

| | | | |
|---|---|---|---|
| **Test** | **Independent samples t-test** | | |
| | RESIST by KTSTF: F ≠ T | | |
| **Performed by** | Kirsten Davis | **Date** | ################ |

| | |
|---|---|
| **n** | 43 |

| RESIST by KTSTF | n | Mean | SD | SE |
|---|---|---|---|---|
| **F** | 23 | 4.2417 | 0.6973 | 0.14539 |
| **T** | 20 | 4.0530 | 0.5022 | 0.11230 |

| | |
|---|---|
| **Difference between means** | 0.1887 |
| **95% CI** | -0.1908 to 0.5682 |

| | |
|---|---|
| **t statistic** | 1.00 |
| **2-tailed p** | 0.3211 |

## F.3.6 Hypothesis 4C: Personality Type J/P – t-test

analysed with: Analyse-it + General 1.67

| | | | |
|---|---|---|---|
| **Test** | **Independent samples t-test** | | |
| | RESIST by KTSJP: J ≠ P | | |
| **Performed by** | Kirsten Davis | **Date** | ################ |

| | |
|---|---|
| **n** | 46 |

| RESIST by KTSJP | n | Mean | SD | SE |
|---|---|---|---|---|
| **J** | 36 | 4.2678 | 0.6442 | 0.10737 |
| **P** | 10 | 3.9679 | 0.7184 | 0.22719 |

| | |
|---|---|
| **Difference between means** | 0.3000 |
| **95% CI** | -0.1756 to 0.7755 |
| **t statistic** | 1.27 |
| **2-tailed p** | 0.2103 |

## F.3.7 Hypothesis 4D: Personality Type E/I – t-test

analysed with: Analyse-it + General 1.67

| | | | |
|---|---|---|---|
| **Test** | **Independent samples t-test** | | |
| | RESIST by KTSEI: E ≠ I | | |
| **Performed by** | Kirsten Davis | **Date** | ################ |

| | |
|---|---|
| **n** | 44 |

| RESIST by KTSEI | n | Mean | SD | SE |
|---|---|---|---|---|
| **E** | 22 | 4.1903 | 0.6441 | 0.13733 |
| **I** | 22 | 4.1651 | 0.6487 | 0.13830 |

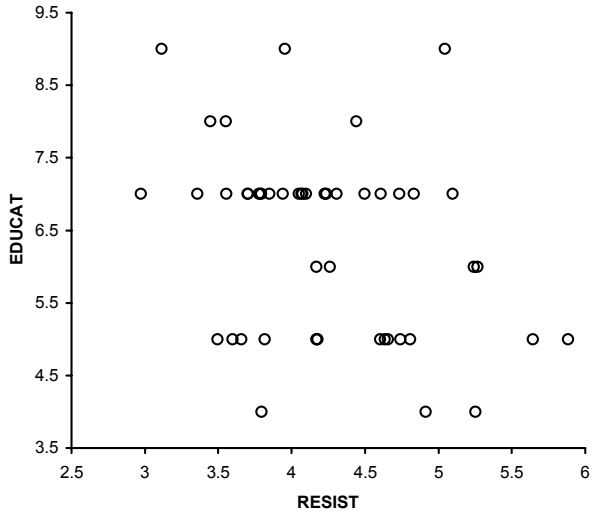
| | |
|---|---|
| **Difference between means** | 0.0251 |
| **95% CI** | -0.3682 to 0.4185 |
| **t statistic** | 0.13 |
| **2-tailed p** | 0.8980 |

## F.3.8 Hypothesis 5: Education Level – Spearman's correlation

analysed with: Analyse-it + General 1.67

| | | | |
|---|---|---|---|
| **Test** | **Spearman rank correlation** | | |
| | RESIST ≠ EDUCAT | | |
| **Performed by** | Kirsten Davis | **Date** | 25 April 2003 |

| | |
|---|---|
| **n** | 48 (cases excluded: 69 due to missing values) |
| **rs statistic** | -0.34 |
| **95% CI** | -0.57 to -0.06 |
| **2-tailed p** | 0.0172 (t approximation, corrected for ties) |

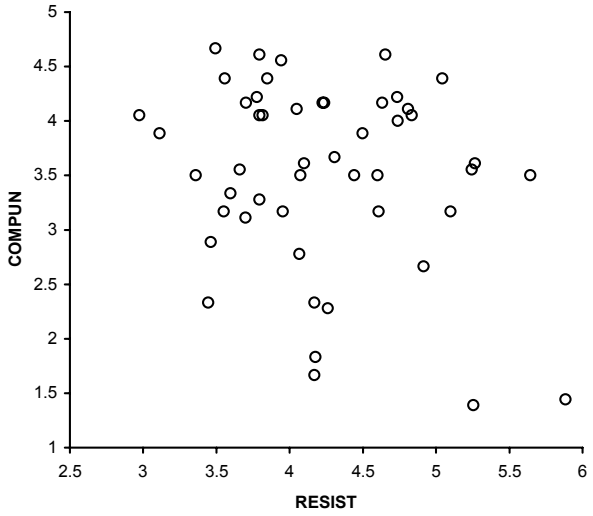


## F.3.9 Hypothesis 6: Computer Understanding & Experience – Pearson's correlation

analysed with: Analyse-it + General 1.67

| | | | |
|---|---|---|---|
| **Test** | **Pearson correlation** | | |
| | RESIST ≠ COMPUN | | |
| **Performed by** | Kirsten Davis | **Date** | 25 April 2003 |

| | |
|---|---|
| **n** | 49 (cases excluded: 68 due to missing values) |
| **r statistic** | -0.23 |
| **95% CI** | -0.48 to 0.06 |
| **2-tailed p** | 0.1148 (t approximation) |



## F.3.10 Hypothesis 7A: Perceived Past Technology Change – t-test

analysed with: Analyse-it + General 1.67

| | | | |
|---|---|---|---|
| **Test** | **Independent samples t-test** | | |
| | RESIST by PERPAS: no change ≠ change | | |
| **Performed by** | Kirsten Davis | **Date** | ################ |

| | |
|---|---|
| **n** | 48 |

| RESIST by PERPAS | n | Mean | SD | SE |
|---|---|---|---|---|
| **no change** | 12 | 4.3688 | 0.7960 | 0.22978 |
| **change** | 36 | 4.1987 | 0.6044 | 0.10073 |

| | |
|---|---|
| **Difference between means** | 0.1701 |
| **95% CI** | -0.2697 to 0.6098 |
| **t statistic** | 0.78 |
| **2-tailed p** | 0.4403 |

## F.3.11 Hypothesis 7B: Perceived Future Technology Change – t-test

analysed with: Analyse-it + General 1.67

| | | | |
|---|---|---|---|
| **Test** | **Independent samples t-test** | | |
| | RESIST by PERFUT: no change ≠ change | | |
| **Performed by** | Kirsten Davis | **Date** | ################ |

| | |
|---|---|
| **n** | 48 |

| RESIST by PERFUT | n | Mean | SD | SE |
|---|---|---|---|---|
| **no change** | 30 | 4.3839 | 0.6441 | 0.11759 |
| **change** | 18 | 4.0035 | 0.6115 | 0.14414 |

| | |
|---|---|
| **Difference between means** | 0.3804 |
| **95% CI** | 0.0010 to 0.7599 |
| **t statistic** | 2.02 |
| **2-tailed p** | 0.0494 |

## F.3.12 Hypothesis 8: Prediction of RTCI from Demographics – ANOVA linear model

The GLM Procedure

Class Level Information

| Class | Levels | Values |
|---|---|---|
| KTSEI | 2 | E I |
| KTSSN | 2 | N S |
| KTSTF | 2 | F T |
| KTSJP | 2 | J P |
| PROF | 9 | Administrator Architect Construction Man Construction Sup Construction Tra Drafter Engineer Management Technician |
| GENDER | 2 | 1 2 |
| EDUCAT | 6 | 4 5 6 7 8 9 |
| PERPAS | 2 | 1 2 |
| PERFUT | 2 | 1 2 |
| OFFSIZ | 5 | 1 2 3 4 5 |
| COMSIZ | 6 | 1 2 3 4 5 6 |

Number of observations 117

NOTE: Due to missing values, only 33 observations can be used in this analysis.

Dependent Variable: RESIST RESIST

| Source | DF | Sum of Squares | Mean Square | F Value | Pr > F |
|---|---|---|---|---|---|
| Model | 31 | 10.62210788 | 0.34264864 | 41.08 | 0.1230 |
| Error | 1 | 0.00834011 | 0.00834011 | | |
| Corrected Total | 32 | 10.63044799 | | | |

| R-Square | Coeff Var | Root MSE | RESIST Mean |
|---|---|---|---|
| 0.999215 | 2.255986 | 0.091324 | 4.048084 |

| Source | DF | Type III SS | Mean Square | F Value | Pr > F |
|---|---|---|---|---|---|
| COMPUN | 1 | 0.05156331 | 0.05156331 | 6.18 | 0.2434 |
| AGE | 1 | 0.01273847 | 0.01273847 | 1.53 | 0.4331 |
| KTSEI | 1 | 0.02011442 | 0.02011442 | 2.41 | 0.3642 |
| KTSSN | 1 | 0.01068985 | 0.01068985 | 1.28 | 0.4606 |
| KTSTF | 1 | 0.20892018 | 0.20892018 | 25.05 | 0.1255 |
| KTSJP | 1 | 0.09332879 | 0.09332879 | 11.19 | 0.1849 |
| PROF | 8 | 1.41963293 | 0.17745412 | 21.28 | 0.1662 |
| GENDER | 1 | 0.02356825 | 0.02356825 | 2.83 | 0.3416 |
| EDUCAT | 5 | 0.25575539 | 0.05115108 | 6.13 | 0.2969 |
| PERPAS | 1 | 0.02352247 | 0.02352247 | 2.82 | 0.3419 |
| PERFUT | 1 | 0.03061883 | 0.03061883 | 3.67 | 0.3062 |
| OFFSIZ | 4 | 0.16918683 | 0.04229671 | 5.07 | 0.3200 |
| COMSIZ | 5 | 0.29164746 | 0.05832949 | 6.99 | 0.2791 |

| Parameter | | Estimate | | Standard Error | t Value | Pr > \|t\| |
|---|---|---|---|---|---|---|
| Intercept | | -0.507222836 | B | 1.95749958 | -0.26 | 0.8386 |
| COMPUN | | 0.724559193 | | 0.29139988 | 2.49 | 0.2434 |
| AGE | | 0.015681807 | | 0.01268888 | 1.24 | 0.4331 |
| KTSEI | E | -0.149597636 | B | 0.09632897 | -1.55 | 0.3642 |
| KTSEI | I | 0.000000000 | B | . | . | . |
| KTSSN | N | 0.198963768 | B | 0.17574137 | 1.13 | 0.4606 |
| KTSSN | S | 0.000000000 | B | . | . | . |
| KTSTF | F | 0.640242814 | B | 0.12792058 | 5.01 | 0.1255 |
| KTSTF | T | 0.000000000 | B | . | . | . |
| KTSJP | J | 1.017414425 | B | 0.30414171 | 3.35 | 0.1849 |
| KTSJP | P | 0.000000000 | B | . | . | . |
| PROF | Administrator | -1.352590856 | B | 0.37294582 | -3.63 | 0.1713 |
| PROF | Architect | -0.851487053 | B | 0.51015456 | -1.67 | 0.3436 |
| PROF | Construction Man | -1.155479356 | B | 0.34238923 | -3.37 | 0.1834 |
| PROF | Construction Sup | -1.489051650 | B | 0.52640173 | -2.83 | 0.2163 |
| PROF | Construction Tra | -0.489826151 | B | 0.37142787 | -1.32 | 0.4130 |
| PROF | Drafter | -1.708994309 | B | 0.77083830 | -2.22 | 0.2698 |
| PROF | Engineer | -0.769028831 | B | 0.11736331 | -6.55 | 0.0964 |
| PROF | Management | -2.376451499 | B | 0.56630714 | -4.20 | 0.1489 |
| PROF | Technician | 0.000000000 | B | . | . | . |
| GENDER | 1 | -0.773329160 | B | 0.46003045 | -1.68 | 0.3416 |
| GENDER | 2 | 0.000000000 | B | . | . | . |
| EDUCAT | 4 | 1.741651585 | B | 0.71289600 | 2.44 | 0.2473 |
| EDUCAT | 5 | 1.809844661 | B | 0.59265003 | 3.05 | 0.2015 |
| EDUCAT | 6 | 2.535088042 | B | 0.96433029 | 2.63 | 0.2314 |
| EDUCAT | 7 | 0.911066155 | B | 0.45130025 | 2.02 | 0.2928 |
| EDUCAT | 8 | 0.124592629 | B | 0.34311761 | 0.36 | 0.7783 |
| EDUCAT | 9 | 0.000000000 | B | . | . | . |
| PERPAS | 1 | 0.266895624 | B | 0.15892269 | 1.68 | 0.3419 |
| PERPAS | 2 | 0.000000000 | B | . | . | . |
| PERFUT | 1 | -0.235169769 | B | 0.12273631 | -1.92 | 0.3062 |
| PERFUT | 2 | 0.000000000 | B | . | . | . |
| OFFSIZ | 1 | -0.100698438 | B | 0.32607828 | -0.31 | 0.8093 |
| OFFSIZ | 2 | 0.409027786 | B | 0.29042430 | 1.41 | 0.3931 |
| OFFSIZ | 3 | -0.287261102 | B | 0.47501815 | -0.60 | 0.6537 |
| OFFSIZ | 4 | -0.221868791 | B | 0.37590620 | -0.59 | 0.6606 |
| OFFSIZ | 5 | 0.000000000 | B | . | . | . |
| COMSIZ | 1 | 0.932501581 | B | 0.48734410 | 1.91 | 0.3066 |
| COMSIZ | 2 | 0.859853158 | B | 0.69793496 | 1.23 | 0.4341 |
| COMSIZ | 3 | 0.852239606 | B | 0.77049925 | 1.11 | 0.4680 |
| COMSIZ | 4 | 0.691514334 | B | 0.45586188 | 1.52 | 0.3710 |
| COMSIZ | 5 | 0.125338426 | B | 0.41198066 | 0.30 | 0.8120 |
| COMSIZ | 6 | 0.000000000 | B | . | . | . |

NOTE: The X'X matrix has been found to be singular, and a generalized inverse was used to solve the normal equations. Terms whose estimates are followed by the letter 'B' are not uniquely estimable.

# Appendix G. Institutional Review Board Submission for Phase II

## *G.1 Request for Exemption*

# Form 3 - EXEMPT

IRB Proposal Review #:_____

### Request for Exemption of Research Involving Human Subjects

[please print or type responses below]

Principal Investigator (Faculty or Faculty Advisor and primary contact): Dr. Anthony Songer - adsonger@vt.edu 231-7255

Correspondence PI → Co-Investigators(Faculty or Student) Kirsten A. Davis

Department(s): Civil & Environ. Eng. Mail Code: 0105 E-mail: kidavis2@vt.edu Phone 961-4728 (home)

Project Title: Understanding Information Technology Change # of Human Subjects ±360

Source of Funding Support: X Departmental Research ____ Sponsored Research (OSP No.:_____)

[ ] All investigators of this project are qualified through completion of the formal training program or web-based training programs provided by the Virginia Tech Office of Research Compliance.

***Note:*** To qualify for Exemption, the research must be (a) of minimal risk to the subjects, (b) must not involve any of the special classes of subjects, and (c) must be in one or more of the following categories. A full description of these categories may be found in the Exempt Research section of the Virginia Tech "*IRB Protocol Submission Instructions Document* or in the federal regulations [45 CFR 46.101(b)(1-6)]. (http://ohrp.osophs.dhhs.gov/humansubjects/guidance/45cfr46.htm#46.101)

*Please mark/check the appropriate category or categories below which qualify the proposed project for exemption:*

[ ] 1. Research will be conducted in established or commonly accepted educational settings, involving normal educational practices [see item (1), page 6 of the "Instructions" document].

[X] 2. Research will involve the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures or observation of public behavior, **unless** the subjects can be identified directly or through identifiers linked to the subjects **and** disclosure of responses could reasonably place the subjects at risk or criminal or civil liability or be damaging to the subjects' financial standing , employability or reputation [see item (2), page 6 –"Instructions"].

[ ] 3. Research will involve the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures, or observation of public behavior that is not exempt under item 2) above **if** the subjects are elected or appointed public officials or candidates for public office; **or** Federal statute(s) require(s) that the confidentiality or other personally identifiable information will be maintained [see item (3), page 6 of the "Instructions" document].

[ ] 4. Research will involve the collection or study of existing data, documents, records, pathological specimens, or diagnostic specimens if these sources are publicly available or if the information is recorded by the investigator in such a manner that subjects cannot be identified directly or through identifiers linked to the subjects [see item (4), page 7 of the "Instructions" document].

[ ] 5. Research and demonstration projects designed to study, evaluate, or otherwise examine public benefit or service programs, procedures for obtaining benefits or proposed changes in such programs [see item (5), page 7 of the "Instructions" document].

[ ] 6. Taste and food quality evaluation and consumer acceptance studies [see item (6), page 7- "Instructions].

| | | |
|---|---|---|
| [redacted] | KIRSTEN DAVIS | 5/19/03 |
| Investigator(s) | Print name | Date |
| [redacted] | WTRKnocke | 5/19/03 |
| Departmental Reviewer | Print name | Date |
| Chair, Institutional Review Board | | Date |
| [redacted] | | 5/19/03 |
| Faculty Advisor | | rev. 4/27/01 |

## G.2 Protocol

### Protocol: Understanding Information Technology Change

**Justification of Project**

Continuously increasing technological capabilities exist in the architecture/engineering/construction (AEC) industry. Email, project specific websites, Computer Aided Drafting (CAD), and animations are but a few technologies adopted in recent years within the industry. The change methods used in the adoptions suggest a focus on technology, yet the technology itself is seen as a primary barrier to successful implementation. Fig. 1 illustrates technology centered change models.

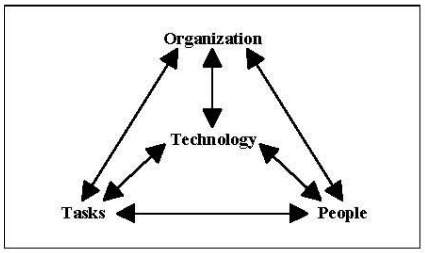



**Fig. 1.** **Technology is central to change** (Adapted from Sutton and Sutton 1990)

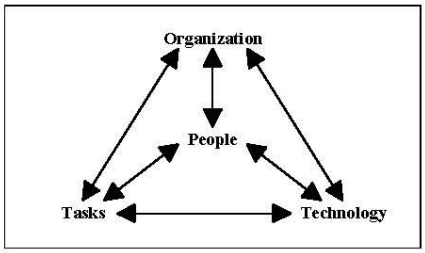



**Fig. 2.** **People are central to change** (Leavitt 1958 as adapted by Sutton and Sutton 1990)

In general, the AEC industry is extremely slow to embrace available technology. Executives often delay investing in new technologies, hoping that the rate of technological growth will stabilize. According to Moore's Law, stabilization is unlikely to occur in the next several years (Hayes and Jaikumar 1988). The hesitation in adoption originates because technology is the driver of change, rather than an enabler of change. Therefore, technology focused change models are inappropriate to ensure successful technology implementation in the AEC industry.

Historically, changes in technologies and the inventions of new machines alter the skill requirements, tasks, and relationships among workers. Improvements in industrial technologies profoundly changed organizations (Kingsford 1964). Examples of significant changes are not limited to a single industry. The telephone, while initially thought to be only for the elite, has changed global communication. The Internet, first thought of as a curiosity of academics and government researchers, is fundamentally changing the global economy.

The importance of cultural issues for technological implementation is well documented, yet predominantly unresearched within the building and construction industry (Cleveland 1999; Ford et al. 2000; Mitropoulos and Tatum 2000; O'Brien 2000; Songer et al. 2001; Thorpe and Mead 2001; Todd 1996). Technological changes will not be successful until researchers develop a fundamental understanding of how people change and why they react the way they do. Therefore, studying individuals and their change processes is essential to successful implementation of technology change.

Fig. 2 illustrates a people focused model for technological change. This model places technology in a change enabling position rather than being a driver of change. A people centered paradigm for developing technology implementation models provides the primary foundation of this research.

This research investigates individuals' resistance to change brought about by new information technology implementation in the AEC industry. Through relevant theories, potentially influential attitudes, beliefs, and fears towards technological change have been identified, as have potentially significant demographic characteristics of the individuals. Additionally, characteristics of the change itself and the individual's reactions to it have been noted.

Using the factors determined from above, a model of social architecture factors associated with impeding/promoting use of technologies was constructed. This model serves as a framework for the larger investigation into individual resistance and the creation of a social architecture assessment instrument for measuring individual factors.

The broad categorical measures indicative of individuals' resistance to change represented in the model are: type and scope of change; method and speed of introduction; demographics of individual; attitudes, beliefs, and fears of individual; and demographics of organization.

A pilot study was previously performed, which allowed the scale of the study to be reduced to one that is more manageable. This study uses a refined social architecture factor model that includes nine variables which, when combined, create the Resistance to Change Index, representing the likelihood of an individual to accept or reject technology change.

This research effort will collect data from a random sample of the population and investigate the hypothesized relationships between demographic variables and the Resistance to Change Index created. The results of this effort will be analyzed using statistical analysis to create benchmark statistics for the investigation. AEC participants (architects/engineers/contractors/construction managers) will be compared and contrasted and individual's likelihood of resistance and the relationship to their demographics will be identified.

**Procedures – Full Study**

A survey will be conducted using a researcher-developed questionnaire. The questionnaire is predominantly a compilation of existing measures identified through the literature review that reflect aspect of resistance to information technology change. The total time involved for participants is approximately 20 minutes to complete the questionnaire.

The sample population consists of English-speaking architecture, engineering, contractor, and construction management organization employees. The research includes all sizes of organizations, from sole proprietorships to 1000+ employee firms within the AEC industry. Additionally, all positions and all levels within an AEC organization are included in the population because technological changes in the industry can affect all employees within an organization. No employees will be chosen that are under the age of 18.

In order to be able to generalize the data to the entire AEC industry, a mail survey is the most appropriate method of achieving good coverage of the survey instrument. This allows the survey to be distributed throughout the entire U.S. without requiring substantial travel time for the researcher.

ZIP codes will be selected using simple random sampling from a list of all valid 5-digit ZIP codes. Within each randomly selected ZIP code, architecture, engineering, construction, and construction management companies will be identified. One individual from each business will be used in the sample population. A prescreening phone call will be used to verify that the business currently exists and that they have the appropriate characteristics for inclusion in the sample – i.e., they are a business operating in the AEC industry. This prescreening phone call will also be used to identify a person to whom the correspondence could be sent. In order to maintain the random sampling, the person with the most recent birthday will be selected as the respondent. It is anticipated that the total sample size will be approximately 360 individuals.

A prenotice letter will be personally addressed to the individual identified in the prescreening phone call. This letter announces that the individual will be receiving a request to help with the research study in a few days. It will be on letterhead and will be personally signed, which helps in promoting the legitimacy of the work. Three to five days after the prenotice letter is mailed, the second contact is initiated and consists of a cover letter introducing the research study, an informed consent form, and the questionnaire, along with an addressed, stamped envelope in which to place the completed questionnaire to be mailed back. Approximately one week after the questionnaire mailing, a postcard thank you/reminder will be sent to all individuals in the sample. This serves to thank those that have returned their survey and to remind those that have not yet done so.

Approximately two weeks after the thank you postcard, a new cover letter and replacement questionnaire will be sent to non-respondents. This is to appeal to those that have not yet responded and may have misplaced their original questionnaire. Approximately four weeks after the replacement questionnaire, a final contact is made with non-respondents. This is planned to be either a certified or priority mail delivery and/or a telephone call to emphasize its importance and establish whether the non-respondents are truly different than those that have responded already.

**Risks and Benefits**

No risks or hazards have been identified with this research. Benefits to the individual are limited to individual change profiles for those persons requesting one. Benefits are predominantly to the industry as a whole, in providing a better understanding of how individuals within the AEC industry react to technological change.

**Confidentiality/Anonymity**

All data collection and analysis will be conducted with strict confidentiality. Questionnaires will have identification numbers assigned by the primary investigator. These numbers will be associated with the respondent's name and home address only for those individuals requesting an individual change profile. The respondent's name and address will be destroyed once the individual profile is forwarded to them. The respondent's home address will be used instead of their work address to help ensure that strict confidentiality is met.

The identification numbers will also be used to track individuals in order to limit unnecessary contacts. Once an individual has returned their survey, their number will be deleted from future attempts.

The primary investigator will have access to the personal data. Subjects' names, addresses, company names, and locations will never be associated with the responses or the results, except to compile the individual change profiles requested and will be destroyed once the personalized profiles are forwarded.

**Informed Consent**

An informed consent form will be given to each respondent. Completing the questionnaire and returning it will be regarded as respondent's voluntary agreement to participate in this study. By not requiring respondents to sign and return the consent form, confidentiality can be maintained. This will be addressed in the cover letter. Upon request, a customized data analysis will be provided to individuals. Those wishing to receive this personalized profile will need to provide their name and address to the investigator.

**References**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Ford, D. N., Voyer, J. J., and Wilkinson, J. M. G. (2000). "Building Learning Organizations in Engineering Cultures: Case Study." *Journal of Management in Engineering*, 16(4), 72-83.

Hayes, R. H., and Jaikumar, R. (1988). "New Technologies, Obsolete Organizations." *Harvard Business Review*, Sep/Oct, 77.

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Leavitt, H. J. (1958). *Managerial psychology; an introduction to individuals, pairs, and groups in organizations.*, University of Chicago Press, Chicago.

Mitropoulos, P., and Tatum, C. B. (2000). "Management-Driven Integration." *Journal of Management in Engineering*, 16(1), 48-58.

O'Brien, W. J. (2000). "Implementation Issues In Project Web Sites: A Practitioner's Viewpoint." *Journal of Management in Engineering*, 16(3), 34-39.

Songer, A. D., Young, R. K., and Davis, K. A. "Social Architecture for Sustainable IT Implementation in AEC." *CIB-W78 International Conference: IT in Construction in Africa*, Mpumalanga, South Africa.

Sutton, D., and Sutton, M. (1990). "Wheels within Wheels: A Development of Traditional Socio-Technical Thinking." *Management Education and Development*, 21(2), 122-132.

Thorpe, T., and Mead, S. (2001). "Project-Specific Web Sites: Friend or Foe?" *Journal of Construction Engineering and Management*, 127(5), 406-413.

Todd, M. J. (1996). "21st Century Leadership and Technology." *Journal of Management in Engineering*, 12(4), 40-49.

## *G.3 Informed Consent Form*

### Informed Consent for Participants

**Title of Project:** Understanding Information Technology Change
**Principal Investigator:** Kirsten A. Davis

**I. Purpose of this Research**

You are invited to participate in a research study about individuals' perceptions of new information technology implementation within the Architecture/Engineering/Construction (AEC) industry.

**II. Procedures**

This research study uses a questionnaire to collect data. The total time involved is approximately 20 minutes to complete the questionnaire.

This study consists of architecture, engineering, contractor, and construction management organization employees at all levels and all positions. The research includes all sizes of organizations, from sole proprietorships to 1000+ employee firms within the AEC industry.

**III. Risks**

No risks or hazards have been identified with this research.

**IV. Benefits**

Your participation in this project will be used to provide information to researchers and practitioners interested in information technology change by providing a better understanding of how individuals within the AEC industry react to information technology change.

**V. Extent of Anonymity and Confidentiality**

The individual results of the study will be kept strictly confidential. At no time will the researcher release the individual results of this study to anyone other than the individuals working on the study without your written consent. An identification number is written on the front cover of the questionnaire. This number is used for tracking purposes to ensure that you are not bothered again once your questionnaire has been received.

If you would like to receive an individual change profile, please provide your name and home address on a separate page noting the identification number from the front cover of your questionnaire. Providing your home address instead of your business address helps to ensure that confidentiality is maintained. All information about you will have your name and address removed. No names or addresses will be used during the analysis or in any written reports of the research. This information will be destroyed once the personalized profile has been forwarded to you.

**VI. Compensation**

No compensation will be given to participants in this study. If requested, a personalized change profile will be provided.

**VII. Approval of Research**

This research project has been approved, as required, by the Institutional Review Board for Research Involving Human Subjects at Virginia Polytechnic Institute and State University and by the Department of Civil and Environmental Engineering.

**VIII. Subject's Responsibilities and Permission**

I voluntarily agree to participate in this study. I acknowledge that I am at least 18 years of age. I have read and understand this Informed Consent form and conditions of this project. I have had all of my questions answered. I hereby acknowledge the above and give my voluntary consent for participation in this project. I understand that if I participate, I may withdraw at any time without penalty.

Should you have any pertinent questions about this research or its conduct, please contact:

Kirsten Davis, principal investigator ..... (540) 961-4728 email: kidavis2@vt.edu
Dr. Anthony Songer, faculty advisor ..... (540) 231-7255 email: adsonger@vt.edu
David M. Moore, Chair, IRB Office of Research Compliance ..... (540) 231-4991 email: moored@vt.edu

## *G.4 Exemption Approval*

Virginia Tech
VIRGINIA POLYTECHNIC INSTITUTE
AND STATE UNIVERSITY

**Institutional Review Board**

Dr. David M. Moore
IRB (Human Subjects) Chair
Assistant Vice Provost for Research Compliance
CVM Phase II - Duckpond Dr., Blacksburg, VA 24061-0442
Office: 540/231-4991; FAX: 540/231-6033
e-mail: moored@vt.edu

May 21, 2003

**MEMORANDUM**

TO: Anthony Songer CE 0105
Kirsten Davis CE 0105

FROM: David M. Moore

SUBJECT: IRB EXEMPTION APPROVAL – "Understanding Information Technology Change" – IRB # 03-279

I have reviewed your request to the IRB for exemption for the above referenced project. I concur that the research falls within the exempt status. Approval is granted effective as of May 21, 2003.

cc: file
Department Reviewer: W.R. Knocke CE 0105

*A Land-Grant University—The Commonwealth Is Our Campus*
*An Equal Opportunity / Affirmative Action Institution*

# Appendix H. Phase II Instrumentation

## *H.1 Phone Script*

- Hi. My name is Kirsten Davis and I'm a graduate student calling from Virginia Tech in Blacksburg, VA. We are conducting a research study on people's perceptions of information technology change in the architecture, engineering, and construction industry.
- Your company's number was selected at random from the telephone directory.
  - ⇒ Before we continue, I need to confirm that your company does work in architecture or engineering related to the construction industry.

  ***OR***

  - ⇒ Before we continue, I need to confirm that your company does work as a contractor in the construction industry.
- If NO, end call by saying "Sorry to have bothered you"
- If YES, proceed.
- I would like to ask that one person in your company participate in this study. It involves filling out and returning a survey. We will mail the survey to you and, hopefully, it will be returned it to us. It will take about 20 minutes to complete.
- Right now, I'm just interested in the name of a person who will participate in the study and I also need to confirm your business mailing address.

  ***Comments if needed:***

  - ⇒ Name of the person is so that I can address the survey to them. (Only need enough of name to ensure that mailings go to same person every time.)
  - ⇒ You are not committing this person to participating in the research – it is entirely up to them whether they choose to participate in the research or not.
- If NOT INTERESTED, then end call by saying "Thank you very much for your time"
- If YES, proceed: GET/CONFIRM NAME
- I also need to confirm your company's mailing address. CONFIRM ADDRESS
- Thank you very much for your help. I will be sending a letter to (*name of person*) describing the research in about 3 weeks, followed by the survey about a week later.

## *H.2 Prenotice Letter A*

Virginia Tech
VIRGINIA POLYTECHNIC INSTITUTE
AND STATE UNIVERSITY

**The Vecellio Construction Engineering and Management Program**

The Charles E. Via, Jr. Department of Civil and
Environmental Engineering
200 Patton Hall, Blacksburg, Virginia 24061-0105

July 30, 2003

A few days from now, you will receive a request to fill out a questionnaire for an important research project being conducted at Virginia Tech.

This research project looks at how people in the Architecture, Engineering, and Construction (AEC) industry feel about information technology changes.

We are writing to you in advance because we have found that many people like to know ahead of time that they will be contacted. The study is an important one because it will help companies like yours to better understand how employees deal with change and with new technologies. When a change does occur, this knowledge can help make the transition easier for everyone involved.

You were randomly selected to represent others like you all over the country. Because we are only asking employees at a small number of companies, your response is very important to us. It is only with the generous help of people like yourself that our research can be successful.

Thank you in advance for your time and consideration.

Sincerely,

Kirsten A. Davis
Principal Investigator

Dr. Anthony Songer
Faculty Advisor

## *H.3 Prenotice Letter B*

Virginia Tech
VIRGINIA POLYTECHNIC INSTITUTE
AND STATE UNIVERSITY

**The Vecellio Construction Engineering and Management Program**

The Charles E. Via, Jr. Department of Civil and
Environmental Engineering
200 Patton Hall, Blacksburg, Virginia 24061-0105

October 3, 2003

A few days from now, your company will receive a request to fill out a questionnaire for an important research project being conducted at Virginia Tech. We'd like to ask that one person in your company participate in the project by filling out the questionnaire and returning it to us.

This research project looks at how people in the Architecture, Engineering, and Construction (AEC) industry feel about information technology changes.

We are writing to you in advance because we have found that many people like to know ahead of time that they will be contacted. The study is an important one because it will help companies like yours to better understand how employees deal with change and with new technologies. When a change does occur, this knowledge can help make the transition easier for everyone involved.

Your company was randomly selected to represent others like it all over the country. Because we are only asking employees at a small number of companies, your company's response is very important to us. It is only with the generous help of people like yourself that our research can be successful.

Thank you in advance for your time and consideration.

Sincerely,

Kirsten A. Davis
Principal Investigator

Dr. Anthony Songer
Faculty Advisor

## *H.4 Initial Questionnaire Cover Letter A & B*

Virginia Tech
VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY

**The Vecellio Construction Engineering and Management Program**

The Charles E. Via, Jr. Department of Civil and Environmental Engineering
200 Patton Hall, Blacksburg, Virginia 24061-0105

August 5, 2003

We need your assistance with a research study about individuals' perceptions of new information technology implementation within the Architecture, Engineering, and Construction (AEC) industry.

We would like your views of information technology change. There are no right or wrong answers for any of the questions in the survey – we are interested in what you think! The purpose of the study is to understand how individuals within the AEC industry feel about information technology change. With this information, we can help companies like yours to better understand how employees deal with change and with new technologies. When a change does occur, this knowledge can help make the transition easier for everyone involved.

You were randomly selected to represent others like you all over the country. Because we are only asking employees at a small number of companies, your response is very important to us.

Your answers are confidential and will only be reported as summaries in which no individual's answers can be identified. This is explained further on the sheet entitled Informed Consent for Participants.

This research has been approved by the Institutional Review Board for Research Involving Human Subjects at Virginia Polytechnic Institute and State University. By completing this survey and returning it, you acknowledge your voluntary participation in this study and give your consent for your responses to be used in data analysis.

If you have any questions or comments about this study, we would be happy to talk with you. Please feel free to email, call, or write to us.

Thank you very much for your assistance!

Sincerely,

Kirsten A. Davis
Principal Investigator

Dr. Anthony Songer
Faculty Advisor

### *H.5 Attachment to Initial Questionnaire Cover Letter B*

Would you please have one person in your company participate in this research project by filling out and returning the questionnaire?

Thanks for your help!

Kirsten

## *H.6 Questionnaire*

Copyright permission was not granted for reproduction of some survey questions. These questions were blacked out. The reader is directed to the original source for question wordings.

Blacked out Questions

Questions 90-159: The Keirsey Temperament Sorter II (Keirsey 1998)

# Understanding Information Technology Change: A Research Study

Kirsten A. Davis
The Vecellio Construction Engineering and Management Program
The Charles E. Via, Jr. Department of Civil and Environmental Engineering
Virginia Polytechnic Institute and State University
200 Patton Hall
Blacksburg, VA 24061-0105 USA

# Understanding Information Technology Change: A Research Study

## Section 1: Your Attitudes Towards Change

**1. Mark the words below that you most frequently associate with a change.**

| | | |
|---|---|---|
| ☐ Adjust | ☐ Alter | ☐ Ambiguity |
| ☐ Anxiety | ☐ Better | ☐ Challenging |
| ☐ Chance | ☐ Concern | ☐ Death |
| ☐ Deteriorate | ☐ Different | ☐ Disruption |
| ☐ Exciting | ☐ Fear | ☐ Fun |
| ☐ Grow | ☐ Improve | ☐ Learn |
| ☐ Modify | ☐ New | ☐ Opportunity |
| ☐ Rebirth | ☐ Replace | ☐ Revise |
| ☐ Stress | ☐ Transfer | ☐ Transition |
| ☐ Uncertainty | ☐ Upheaval | ☐ Vary |

To what extent do you agree or disagree with the statements for Questions 2 to 3?

**2. I am able to laugh at myself pretty easily.**

Agree Strongly ☐ ☐ ☐ ☐ ☐ ☐ ☐ Disagree Strongly

**3. I'm usually able to see the funny side of an otherwise painful predicament.**

Agree Strongly ☐ ☐ ☐ ☐ ☐ ☐ ☐ Disagree Strongly

To what extent do you agree or disagree with the statements for Questions 4 to 23? Please use the following response scale:
AS = Agree strongly
A = Agree
N = Neither agree nor disagree
D = Disagree
DS = Disagree strongly

**4. To be happy, I must maintain the approval of all the persons I consider significant.**

AS☐ A☐ N☐ D☐ DS☐

**5. To be a worthwhile person, I must be thoroughly competent in everything I do.**

AS☐ A☐ N☐ D☐ DS☐

**6. Individuals who take unfair advantage of me should be punished.**

AS☐ A☐ N☐ D☐ DS☐

**7. It is terrible when things do not go the way I would like.**

AS☐ A☐ N☐ D☐ DS☐

**8. My negative emotions are the result of external pressures.**

AS☐ A☐ N☐ D☐ DS☐

**9. If there is a risk that something bad will happen, it makes sense to be upset.**

AS☐ A☐ N☐ D☐ DS☐

**10. It is better to ignore personal problems than to try to solve them.**

AS☐ A☐ N☐ D☐ DS☐

**11. Many events from my past so strongly influence me that it is impossible to change.**

AS☐ A☐ N☐ D☐ DS☐

**12. I dislike having any uncertainty about my future.**

AS☐ A☐ N☐ D☐ DS☐

**13. Life should be easier than it is.**

AS☐ A☐ N☐ D☐ DS☐

**14. To be happy I must be loved by the persons who are important to me.**

AS☐ A☐ N☐ D☐ DS☐

**15. I must keep achieving in order to be satisfied with myself.**

AS☐ A☐ N☐ D☐ DS☐

**16. Most people who have been unfair to me are generally bad individuals.**

AS☐ A☐ N☐ D☐ DS☐

**17. It is awful when something I want to happen does not occur.**

AS☐ A☐ N☐ D☐ DS☐

**18. I cannot help how I feel when everything is going wrong.**

AS☐ A☐ N☐ D☐ DS☐

**19. When it looks as if something might be wrong, it is reasonable to be quite concerned.**

AS☐ A☐ N☐ D☐ DS☐

**20. It makes more sense to wait than to try to improve a bad life situation.**

AS☐ A☐ N☐ D☐ DS☐

**21. Some of my ways of acting are so ingrained that I could never change them.**

AS☐ A☐ N☐ D☐ DS☐

**22. I hate it when I cannot eliminate an uncertainty.**

AS☐ A☐ N☐ D☐ DS☐

**23. Things should turn out better than they usually do.**

AS☐ A☐ N☐ D☐ DS☐

To what extent do you agree or disagree with the statements for Questions 24 to 31? Please use the following response scale:
AS = agree strongly
A = agree somewhat
U = undecided
D = disagree somewhat
DS = disagree strongly

**24. If I could do as I pleased, I would change the kind of work I do every few months.**

AS☐ A☐ U☐ D☐ DS☐

**25. One can never feel at ease on a job where the ways of doing things are always being changed.**

AS☐ A☐ U☐ D☐ DS☐

**26. The trouble with most jobs is that you just get used to doing things in one way and then they want you to do them differently.**

AS☐ A☐ U☐ D☐ DS☐

**27. I would prefer to stay with a job that I know I can handle than to change to one where most things would be new to me.**

AS☐ A☐ U☐ D☐ DS☐

**28. The trouble with many people is that when they find a job they can do well, they don't stick with it.**

AS☐ A☐ U☐ D☐ DS☐

**29. I like a job where I know that I will be doing my work about the same way from one week to the next.**

AS☐ A☐ U☐ D☐ DS☐

**30. When I get used to doing things in one way it is disturbing to have to change to a new method.**

AS☐ A☐ U☐ D☐ DS☐

**31. It would take a sizeable raise in pay to get me to voluntarily transfer to another job.**

AS☐ A☐ U☐ D☐ DS☐

**32. The job that you would consider ideal for you would be one where the way you do your work:**

| Is always the same | | | | Changes a great deal |
|---|---|---|---|---|
| ☐ | ☐ | ☐ | ☐ | ☐ |

## Section 2: Information Technology Changes Occurring Within Your Company

**33. Over the past year, have any technological changes happened in your company?** Some examples of technological change include using computers for tasks that previously did not use them, introducing new computer software or programs, and changes in existing computer systems. Please include changes currently in progress.

☐ No
☐ Yes .....Please describe the changes below. Try to be as specific as you can.

_____
_____
_____
_____
_____
_____
_____

**34. Are you aware of any technological changes planned for the next year?**

☐ No
☐ Yes .....Please describe the changes below. Try to be as specific as you can.

_____
_____
_____
_____
_____
_____
_____

If you answered **No** to both Question 33 and Question 34, please skip to Question 40, page 3.
If you answered **Yes** to either question, please continue with Question 35.

**35. Of all the changes that you described, which one do you feel affected (or will affect) you the most?**

_____

_____

_____

Please answer Questions 36 to 39 based on the technological change that you indicated in Question 35.

**36. How motivated were you (or are you) to use the new technology?**

A great deal ☐ ☐ ☐ ☐ ☐ ☐ Not at all

**37. Do you think you resisted (or will resist) the technological change at all?**

A great deal ☐ ☐ ☐ ☐ ☐ ☐ Not at all

To what extent do you feel that the statements for Questions 38 to 39 are true or not?

**38. People will be able to maintain respect and status when the change is implemented (as opposed to losing these as a result of the change).**

True ☐ ☐ ☐ ☐ ☐ ☐ ☐ Not True

**39. The change will be mild (and not cause a major disruption of the status quo).**

True ☐ ☐ ☐ ☐ ☐ ☐ ☐ Not True

## Section 3: Your Company and Change

To what extent do you feel that the statements for Questions 40 to 45 are true or not?

**40. People throughout my organization share values or visions.**

True ☐ ☐ ☐ ☐ ☐ ☐ ☐ Not True

**41. My organization has a good track record in implementing change smoothly.**

True ☐ ☐ ☐ ☐ ☐ ☐ ☐ Not True

**42. There is a lot of cooperation and trust throughout my organization (as opposed to animosity).**

True ☐ ☐ ☐ ☐ ☐ ☐ ☐ Not True

**43. My organization's culture supports risk taking (as opposed to being highly bureaucratic and rule bound).**

True ☐ ☐ ☐ ☐ ☐ ☐ ☐ Not True

**44. People are able to handle change (as opposed to being worn out from recent, unsettling changes).**

True ☐ ☐ ☐ ☐ ☐ ☐ ☐ Not True

**45. My organization rewards people who take part in change efforts (as opposed to subtly punishing those who take the time off other work to get involved).**

True ☐ ☐ ☐ ☐ ☐ ☐ ☐ Not True

## Section 4: Your Computer Experience

**46. Do you use a computer at work?**

- ☐ Never
- ☐ Rarely
- ☐ Sometimes
- ☐ Often
- ☐ I use one for a majority of my work

**47. How would you rate your knowledge of computers?**

- ☐ Absolute zero
- ☐ Minimal
- ☐ Good
- ☐ Very good
- ☐ Extensive

**48. Have you ever taken a course in computer programming?**

- ☐ No
- ☐ Yes

**49. Have you ever taken an academic or job-training course in word processing?**

- ☐ No
- ☐ Yes

**50. Have you ever taken a test or exam where you were required to type responses using a computer?**

- ☐ No
- ☐ Yes

**51. Have you ever used computers that were linked to other computers?**

- ☐ No
- ☐ Yes
- ☐ I don't know

To what extent do you agree or disagree with the statements for Questions 52 - 63? Please use the following response scale:
AS = Agree strongly
A = Agree
N = Neither agree nor disagree
D = Disagree
DS = Disagree strongly

**52. I frequently read computer magazines or other sources of information that describe new computer technology.**

AS☐ A☐ N☐ D☐ DS☐

**53. I know how to recover deleted or "lost data" on a computer or PC.**

AS☐ A☐ N☐ D☐ DS☐

**54. I know what a LAN is.**

AS☐ A☐ N☐ D☐ DS☐

**55. I know what an operating system is.**

AS☐ A☐ N☐ D☐ DS☐

**56. I know how to write computer programs.**

AS☐ A☐ N☐ D☐ DS☐

**57. I know how to install software on a personal computer.**

AS☐ A☐ N☐ D☐ DS☐

**58. I know what email is.**

AS☐ A☐ N☐ D☐ DS☐

**59. I know what a database is.**

AS☐ A☐ N☐ D☐ DS☐

**60. I know what the Internet is.**

AS☐ A☐ N☐ D☐ DS☐

**61. I am computer literate.**

AS☐ A☐ N☐ D☐ DS☐

**62. I regularly use a PC for word processing.**

AS☐ A☐ N☐ D☐ DS☐

**63. I am good at using computers.**

AS☐ A☐ N☐ D☐ DS☐

To what extent do you agree or disagree with the statements for Questions 64 - 89? Please use the following response scale:
AS = Agree strongly
A = Agree somewhat
D = Disagree somewhat
DS = Disagree strongly

**64. Computers do not scare me at all.**

AS☐ A☐ D☐ DS☐

**65. I would like working with computers.**

AS☐ A☐ D☐ DS☐

**66. Working with a computer would make me very nervous.**

AS☐ A☐ D☐ DS☐

**67. I do not feel threatened when others talk about computers.**

AS☐ A☐ D☐ DS☐

**68. It wouldn't bother me at all to take computer courses.**

AS☐ A☐ D☐ DS☐

**69. I'm no good with computers.**

AS☐ A☐ D☐ DS☐

**70. The challenge of solving problems with computers does not appeal to me.**

AS☐ A☐ D☐ DS☐

**71. Computers make me feel uncomfortable.**

AS☐ A☐ D☐ DS☐

**72. Generally I would feel OK about trying a new problem on the computer.**

AS☐ A☐ D☐ DS☐

**73. I would feel at ease in a computer class.**

AS☐ A☐ D☐ DS☐

**74. I think working with computers would be enjoyable and stimulating.**

AS☐ A☐ D☐ DS☐

**75. I don't think I would enjoy doing advanced computer work.**

AS☐ A☐ D☐ DS☐

**76. Figuring out computer problems does not appeal to me.**

AS☐ A☐ D☐ DS☐

77. **I get a sinking feeling when I think of trying to use a computer.**

AS☐ A☐ D☐ DS☐

78. **I am sure I could do work with computers.**

AS☐ A☐ D☐ DS☐

79. **I would feel comfortable working with a computer.**

AS☐ A☐ D☐ DS☐

80. **I'm not the type to do well with computers.**

AS☐ A☐ D☐ DS☐

81. **I don't understand how some people can spend so much time working with computers and seem to enjoy it.**

AS☐ A☐ D☐ DS☐

82. **Once I start to work with a computer, I would find it hard to stop.**

AS☐ A☐ D☐ DS☐

83. **I think using a computer would be very hard for me.**

AS☐ A☐ D☐ DS☐

84. **I will do as little work with computers as possible.**

AS☐ A☐ D☐ DS☐

85. **Computers make me feel uneasy and confused.**

AS☐ A☐ D☐ DS☐

86. **If a problem is left unsolved in a computer class, I would continue to think about it afterward.**

AS☐ A☐ D☐ DS☐

87. **I do not enjoy talking with others about computers.**

AS☐ A☐ D☐ DS☐

88. **I do not think I could handle a computer course.**

AS☐ A☐ D☐ DS☐

89. **I have a lot of self-confidence when it comes to working with computers.**

AS☐ A☐ D☐ DS☐

## Section 5: Your Personality

For Questions 90 to 159, two choices are given. Please indicate which choice you prefer in each pair.

90. [redacted]

91. [redacted]

92. [redacted]

93. [redacted]

94. [redacted]

95. [redacted]

96. [redacted]

97. [redacted]

98. [redacted]

99. [redacted]

100. [redacted]

101. [redacted]

102. [redacted]

103. [redacted]

104. [redacted]

105. [redacted]

106. [redacted]

107. [redacted]

108. [redacted]

109. [redacted]

110. [redacted]

111. [redacted]

112. [redacted]

113. [redacted]

114. [redacted]

115. [redacted]

116. [redacted]

117. [redacted]

118. [redacted]

119. [redacted]

120. [redacted]

121. [redacted]

122. [redacted]

123. [redacted]

124. [redacted]

125. [redacted]

126. [redacted]

127. [redacted]

128. [redacted]

129. [redacted]

130. [redacted]

☐ [redacted]

☐ [redacted]

131. [redacted]

☐ [redacted]

☐ [redacted]

132. [redacted]

☐ [redacted]

☐ [redacted]

133. [redacted]

☐ [redacted]

☐ [redacted]

134. [redacted]

☐ [redacted]

☐ [redacted]

135. [redacted]

☐ [redacted]

☐ [redacted]

136. [redacted]

☐ [redacted]

☐ [redacted]

137. [redacted]

☐ [redacted]

☐ [redacted]

138. [redacted]

☐ [redacted]

☐ [redacted]

139. [redacted]

☐ [redacted]

☐ [redacted]

140. [redacted]

☐ [redacted]

☐ [redacted]

141. [redacted]

☐ [redacted]

☐ [redacted]

142. [redacted]

☐ [redacted]

☐ [redacted]

143. [redacted]

☐ [redacted]

☐ [redacted]

144. [redacted]

☐ [redacted]

☐ [redacted]

145. [redacted]

☐ [redacted]

☐ [redacted]

146. [redacted]

☐ [redacted]

☐ [redacted]

147. [redacted]

☐ [redacted]

☐ [redacted]

148. [redacted]

☐ [redacted]

☐ [redacted]

149. [redacted]

☐ [redacted]

☐ [redacted]

150. [redacted]

☐ [redacted]

☐ [redacted]

151. [redacted]

☐ [redacted]

☐ [redacted]

152. [redacted]

☐ [redacted]

☐ [redacted]

153. [redacted]

☐ [redacted]

☐ [redacted]

154. [redacted]

☐ [redacted]

☐ [redacted]

155. [redacted]

☐ [redacted]

☐ [redacted]

**156.** [redacted]

☐ [redacted]
☐ [redacted]

**157.** [redacted]

☐ [redacted]
☐ [redacted]

**158.** [redacted]

☐ [redacted]
☐ [redacted]

**159.** [redacted]

☐ [redacted]
☐ [redacted]

Think about the past month. For Questions 160 to 172, please indicate how well the statement describes your behavior or intention. Please use the following response scale:
VW = This describes me very well
MW = This describes me moderately well
L = This describes me a little
NAA = This does not describe me at all

**160. I can make things happen**

VW☐ MW☐ L☐ NAA☐

**161. Fate plays a strong role in my life**

VW☐ MW☐ L☐ NAA☐

**162. I find it useless to fight the established hierarchy at my company**

VW☐ MW☐ L☐ NAA☐

**163. Circumstances are beyond my control**

VW☐ MW☐ L☐ NAA☐

**164. I need recognition from others to make my life worthwhile**

VW☐ MW☐ L☐ NAA☐

**165. I am easy to like**

VW☐ MW☐ L☐ NAA☐

**166. I have a hard time accepting compliments**

VW☐ MW☐ L☐ NAA☐

**167. I have the ability to get what I want**

VW☐ MW☐ L☐ NAA☐

**168. I feel in control in my life**

VW☐ MW☐ L☐ NAA☐

**169. If I reflect on my life, I might find that I am basically unhappy**

VW☐ MW☐ L☐ NAA☐

**170. I feel frightened and out of control when things change rapidly**

VW☐ MW☐ L☐ NAA☐

**171. I enjoy taking charge of things**

VW☐ MW☐ L☐ NAA☐

**172. I know what I want and I go after it**

VW☐ MW☐ L☐ NAA☐

## Section 6: Your Job

**173. What is your job title?**

_____

**174. What are the primary responsibilities of your job?**

_____

_____

_____

**175. From the selections below, choose the profession that most closely identifies your job and that of your immediate supervisor:**

| | You | Your Immediate Supervisor |
|---|---|---|
| Architect | ☐ | ☐ |
| Engineer | ☐ | ☐ |
| Contractor | ☐ | ☐ |
| Construction Manager | ☐ | ☐ |
| Administrator | ☐ | ☐ |
| Management | ☐ | ☐ |
| Computer/IT Specialist | ☐ | ☐ |

**176. From the selections below, which level best identifies your position in your company?**

☐ I am the only person in this company
☐ Executive (CEO, CFO, etc.)
☐ Management (project managers, superintendents, etc.)
☐ Professional staff (architects, engineers, designers, etc.)
☐ Technical staff (drafters, inspectors, etc.)
☐ Construction labor (carpenters, masons, roofers, etc.)
☐ Administrative staff

**177. Are you responsible for supervising other employees?**

☐ No
☐ Yes .....How many?_____ employees supervised

**178. Do you have the power to hire or fire employees?**

- ☐ I only have the power to hire new employees
- ☐ I only have the power to fire existing employees
- ☐ I have the power to both hire and fire employees
- ☐ I do not have the power to hire or fire employees

**179. Do you have the power to reward or punish employees?**

- ☐ I only have the power to reward employees
- ☐ I only have the power to punish employees
- ☐ I have the power to both reward and punish employees
- ☐ I do not have the power to reward or punish employees

## Section 7: Your Company

**180. How many people does your company employ *at this location*?**

- ☐ 5 employees or less
- ☐ 6 - 20 employees
- ☐ 21 - 50 employees
- ☐ 51 - 200 employees
- ☐ 201 - 1000 employees
- ☐ 1001 or more employees

**181. How many people does your company employ *at all locations combined*?**

- ☐ 5 employees or less
- ☐ 6 - 20 employees
- ☐ 21 - 50 employees
- ☐ 51 - 200 employees
- ☐ 201 - 1000 employees
- ☐ 1001 or more employees

**182. What industry does your company work in *at this location*? Check all that apply.**

- ☐ Architecture
- ☐ Engineering
- ☐ General Building Construction (manufacturing, industrial, commercial, institutional)
- ☐ Residential Building Construction (single and multifamily housing)
- ☐ Heavy Construction (highways, streets, bridges, tunnels, utilities)
- ☐ Construction Management

**183. What industry does your company work in *at all locations combined*? Check all that apply.**

- ☐ Architecture
- ☐ Engineering
- ☐ General Building Construction (manufacturing, industrial, commercial, institutional)
- ☐ Residential Building Construction (single and multifamily housing)
- ☐ Heavy Construction (highways, streets, bridges, tunnels, utilities)
- ☐ Construction Management

## Section 8: Yourself

**184. What is your age?**

_____ years

**185. What is your gender?**

- ☐ Female
- ☐ Male

**186. What is the highest level of education you have completed?**

- ☐ Did not complete 8th grade
- ☐ Did not complete high school
- ☐ Did not complete high school, but received a GED
- ☐ High school diploma
- ☐ Some college
- ☐ Associate's degree
  In what? _____
- ☐ Bachelor's degree
  In what? _____
- ☐ Some graduate school
  In what? _____
- ☐ Master's degree or higher
  In what? _____

Thank you for taking the time to complete this questionnaire. Your assistance in providing this information is very much appreciated.

If there are any comments you might have about the survey or any items that may not have been addressed to your satisfaction, please do so in the space provided below. Thanks again for your help!

Please return your completed questionnaire in the envelope provided to:

Kirsten A. Davis
Construction Engineering and Management Program
Via Dept. of Civil and Environmental Engineering
Virginia Polytechnic Institute and State University
200 Patton Hall
Blacksburg, VA 24061-0105 USA

## *H.7 Thank You Postcard A*

October 7, 2003

About a week ago, a questionnaire seeking your opinions about information technology changes in the Architecture, Engineering, and Construction (AEC) industry was mailed to you. Your name was randomly selected to represent others like you all over the country.

If you have already completed and returned the questionnaire, please accept my sincere thanks. If not, I would like to ask that you please do so today. We are especially grateful for your help because it is only by asking people like you to share your opinions that we can understand how employees in our industry deal with change and with new technologies.

If you did not receive a questionnaire, or if it was misplaced, please call me at (540) 961-4728 and I will be happy to get another one in the mail to you immediately. Thanks again!

Kirsten A. Davis, Principal Investigator
Construction Engineering and Management Program
Department of Civil and Environmental Engineering
Virginia Polytechnic Institute and State University

## *H.8 Thank You Postcard B*

November 12, 2003

About a week ago, a questionnaire seeking opinions about information technology changes in the Architecture, Engineering, and Construction (AEC) industry was mailed to your company. Your company was randomly selected to represent others like it all over the country.

If someone in your company has already completed and returned the questionnaire, please accept my sincere thanks. If not, I would like to ask that someone please do so today. We are especially grateful for your help because it is only by asking people like you to share your opinions that we can understand how employees in our industry deal with change and with new technologies.

If your company did not receive a questionnaire, or if it was misplaced, please call me at (540) 961-4728 and I will be happy to get another one in the mail to you immediately. Thanks again!

Kirsten A. Davis, Principal Investigator
Construction Engineering and Management Program
Department of Civil and Environmental Engineering
Virginia Polytechnic Institute and State University

## *H.9 Replacement Questionnaire Cover Letter A*

Virginia Tech
VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY

**The Vecellio Construction Engineering and Management Program**

The Charles E. Via, Jr. Department of Civil and Environmental Engineering
200 Patton Hall, Blacksburg, Virginia 24061-0105

October 23, 2003

About four weeks ago, a questionnaire was sent to you seeking your opinions about information technology changes in the Architecture, Engineering, and Construction (AEC) industry. To the best of our knowledge, it has not yet been returned.

Many people have responded that they found the questionnaire interesting and it gave them an opportunity to voice their opinions, both good and bad, about technology change. We think this information can help companies like yours to better understand how employees deal with change when new technologies are introduced.

We are writing again because of the importance that your questionnaire has for helping us to get accurate results. We have sent questionnaires to people all over the country, but it is only by hearing from nearly everyone selected that we can be sure the results are truly representative of the industry.

A few people have written to say that they should not have received the questionnaire because they do not work in architecture, engineering, or construction. If this concern applies to you, please let us know on the cover of the questionnaire and return it in the enclosed envelope so that we can delete your name from the mailing list.

An identification number is printed on the front of the questionnaire so that we can check your name off the mailing list when it is received. The list of names is then destroyed so that individual names can never be connected to the results in any way. Protecting the confidentiality of your answers is very important to us, as well as to the University. This is explained further on the enclosed sheet entitled Informed Consent for Participants.

We hope that you will fill out and return the questionnaire soon, but if for any reason you prefer not to answer it, please let us know by returning the blank questionnaire in the enclosed stamped envelope.

If you have any questions or comments about this study, feel free to email, call, or write.

Sincerely,

Kirsten A. Davis
Principal Investigator
Email: kidavis2@vt.edu
Phone: (540) 961-4728

## *H.10 Replacement Questionnaire Cover Letter B*

Virginia Tech
VIRGINIA POLYTECHNIC INSTITUTE
AND STATE UNIVERSITY

**The Vecellio Construction Engineering and Management Program**

The Charles E. Via, Jr. Department of Civil and
Environmental Engineering
200 Patton Hall, Blacksburg, Virginia 24061-0105

December 3, 2003

About four weeks ago, a questionnaire was sent to your company seeking opinions about information technology changes in the Architecture, Engineering, and Construction (AEC) industry. To the best of our knowledge, it has not yet been returned.

Many people have responded that they found the questionnaire interesting and it gave them an opportunity to voice their opinions, both good and bad, about technology change. We think this information can help companies like yours to better understand how employees deal with change when new technologies are introduced.

We are writing again because of the importance that your questionnaire has for helping us to get accurate results. We have sent questionnaires to companies all over the country, but it is only by hearing from nearly everyone selected that we can be sure the results are truly representative of the industry.

A few people have written to say that they should not have received the questionnaire because their company does not do work in architecture, engineering, or construction. If this concern applies to you, please let us know on the cover of the questionnaire and return it in the enclosed envelope so that we can delete your name from the mailing list.

An identification number is printed on the front of the questionnaire so that we can check your company's name off the mailing list when it is received. The list of names is then destroyed so that individual names can never be connected to the results in any way. Protecting the confidentiality of your answers is very important to us, as well as to the University. This is explained further on the enclosed sheet entitled Informed Consent for Participants.

We hope that someone in your company will fill out and return the questionnaire soon, but if for any reason you prefer not to answer it, please let us know by returning the blank questionnaire in the enclosed stamped envelope.

If you have any questions or comments about this study, feel free to email, call, or write.

Sincerely,

Kirsten A. Davis
Principal Investigator
Email: kidavis2@vt.edu
Phone: (540) 961-4728

## *H.11 Final Postcard A*

November 20, 2003

To the best of our knowledge, your questionnaire about your opinions on information technology changes in the Architecture, Engineering, and Construction industry has not yet been returned.

It's not too late to fill it out and return it to us. We would really appreciate it if you could please do so today. If you have already completed and returned the questionnaire, please accept my sincere thanks. It is only by hearing from nearly everyone selected that we can be sure the results are truly representative of the industry.

If you have misplaced your questionnaire, please call me at (540) 961-4728, email me at kidavis2@vt.edu, or write to me at the address on the reverse side of this postcard and I will be happy to get another one in the mail to you immediately. Thanks again!

Kirsten A. Davis, Principal Investigator
Construction Engineering and Management Program
Department of Civil and Environmental Engineering
Virginia Polytechnic Institute and State University

## *H.12 Final Postcard B*

January 7, 2004

To the best of our knowledge, your company's questionnaire about your opinions on information technology changes in the Architecture, Engineering, and Construction industry has not yet been returned.

It's not too late to fill it out and return it to us. We would really appreciate it if someone in your company could please do so today. If you have already completed and returned the questionnaire, please accept my sincere thanks. It is only by hearing from nearly everyone selected that we can be sure the results are truly representative of the industry.

If you have misplaced your questionnaire, please call me at (540) 961-4728, email me at kidavis2@vt.edu, or write to me at the address on the reverse side of this postcard and I will be happy to get another one in the mail to you immediately. Thanks again!

Kirsten A. Davis, Principal Investigator
Construction Engineering and Management Program
Department of Civil and Environmental Engineering
Virginia Polytechnic Institute and State University

## *H.13 Zip Codes Selected*

| Zip Code | City | State | Total Surveys Sent | Returned | Not Returned | Refused | Returned to Sender by Post Office |
|---|---|---|---|---|---|---|---|
| 10040 | New York | New York | 1 | | 1 | | |
| 10279 | New York | New York | 0 | | | | |
| 10560 | North Salem | New York | 5 | 2 | 2 | | 1 |
| 11713 | Bellport | New York | 6 | | 4 | 1 | 1 |
| 11792 | Wading River | New York | 8 | 3 | 5 | | |
| 11967 | Shirley | New York | 11 | 4 | 6 | 1 | |
| 12172 | Stottville | New York | 0 | | | | |
| 12937 | Fort Covington | New York | 0 | | | | |
| 12993 | Westport | New York | 0 | | | | |
| 13040 | Cincinnatus | New York | 1 | 1 | | | |
| 13312 | Brantingham | New York | 0 | | | | |
| 13341 | Franklin Springs | New York | 0 | | | | |
| 13617 | Canton | New York | 3 | 1 | 2 | | |
| 13783 | Hancock | New York | 3 | | 3 | | |
| 13832 | Plymouth | New York | 0 | | | | |
| 14036 | Corfu | New York | 1 | 1 | | | |
| 14486 | Linwood | New York | 0 | | | | |
| 14548 | Shortsville | New York | 2 | 1 | 1 | | |
| 14856 | Kanona | New York | 0 | | | | |
| 15056 | Leetsdale | Pennsylvania | 0 | | | | |
| 15325 | Crucible | Pennsylvania | 0 | | | | |
| 15341 | Holbrook | Pennsylvania | 0 | | | | |
| 16347 | Sheffield | Pennsylvania | 0 | | | | |
| 16443 | West Springfield | Pennsylvania | 0 | | | | |
| 16563 | Erie | Pennsylvania | 0 | | | | |
| 17098 | Williamstown | Pennsylvania | 0 | | | | |
| 17225 | Greencastle | Pennsylvania | 10 | 2 | 7 | 1 | |
| 18610 | Blakeslee | Pennsylvania | 5 | 1 | 2 | | 2 |
| 18824 | Hop Bottom | Pennsylvania | 1 | 1 | | | |
| 19121 | Philadelphia | Pennsylvania | 1 | | 1 | | |
| 19510 | Blandon | Pennsylvania | 4 | 1 | 3 | | |
| 19529 | Kempton | Pennsylvania | 3 | | 3 | | |
| 20170 | Herndon | Virginia | 30 | 11 | 11 | 2 | 6 |
| 20526 | Washington | District of Columbia | 0 | | | | |
| 20719 | Bowie | Maryland | 0 | | | | |
| 23131 | Ordinary | Virginia | 1 | 1 | | | |
| 24250 | Fort Blackmore | Virginia | 0 | | | | |

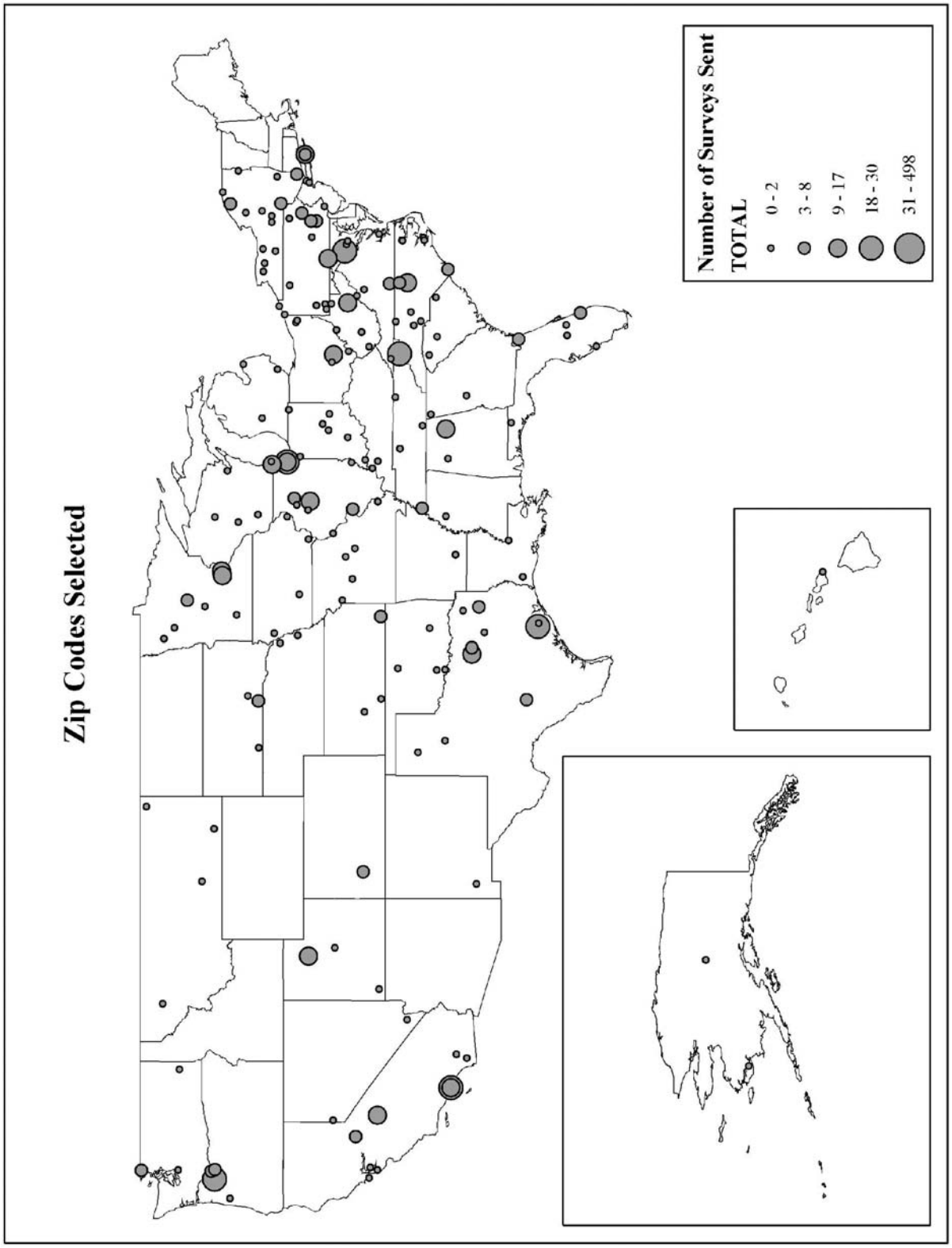
| Zip Code | City | State | Total Surveys Sent | Returned | Not Returned | Refused | Returned to Sender by Post Office |
|---|---|---|---|---|---|---|---|
| 24459 | Middlebrook | Virginia | 0 | | | | |
| 24465 | Monterey | Virginia | 1 | | 1 | | |
| 24558 | Halifax | Virginia | 5 | 1 | 3 | | 1 |
| 25136 | Montgomery | West Virginia | 0 | | | | |
| 25652 | Whitman | West Virginia | 1 | | 1 | | |
| 26241 | Elkins | West Virginia | 9 | 4 | 5 | | |
| 26534 | Granville | West Virginia | 0 | | | | |
| 27024 | Lowgap | North Carolina | 1 | 1 | | | |
| 27299 | Linwood | North Carolina | 1 | | 1 | | |
| 27583 | Timberlake | North Carolina | 5 | 2 | 3 | | |
| 27713 | Durham | North Carolina | 12 | 4 | 5 | 1 | 2 |
| 27924 | Colerain | North Carolina | 1 | | 1 | | |
| 28231 | Charlotte | North Carolina | 0 | | | | |
| 28469 | Ocean Isle Beach | North Carolina | 5 | | 3 | | 2 |
| 28515 | Bayboro | North Carolina | 1 | | 1 | | |
| 28529 | Grantsboro | North Carolina | 1 | | 1 | | |
| 28673 | Sherrills Ford | North Carolina | 1 | | 1 | | |
| 29178 | Whitmire | South Carolina | 1 | 1 | | | |
| 29516 | Blenheim | South Carolina | 0 | | | | |
| 29616 | Greenville | South Carolina | 1 | | 1 | | |
| 30258 | Molena | Georgia | 0 | | | | |
| 30707 | Chickamauga | Georgia | 2 | | 2 | | |
| 32218 | Jacksonville | Florida | 8 | 3 | 5 | | |
| 32452 | Noma | Florida | 0 | | | | |
| 33993 | Cape Coral | Florida | 2 | | 2 | | |
| 34759 | Kissimmee | Florida | 2 | | 1 | | 1 |
| 34773 | Saint Cloud | Florida | 2 | | 2 | | |
| 34947 | Fort Pierce | Florida | 4 | 1 | 3 | | |
| 35573 | Kansas | Alabama | 0 | | | | |
| 35906 | Rainbow City | Alabama | 10 | 1 | 7 | 1 | 1 |
| 37146 | Pleasant View | Tennessee | 1 | 1 | | | |
| 37383 | Sewanee | Tennessee | 0 | | | | |
| 37604 | Johnson City | Tennessee | 24 | 14 | 9 | | 1 |
| 37841 | Oneida | Tennessee | 1 | | | | 1 |
| 38157 | Memphis | Tennessee | 5 | | 4 | 1 | |
| 38963 | Tutwiler | Mississippi | 0 | | | | |
| 42441 | Nebo | Kentucky | 0 | | | | |
| 42459 | Sturgis | Kentucky | 1 | | 1 | | |
| 43138 | Logan | Ohio | 11 | 5 | 5 | 1 | |

| Zip Code | City | State | Total Surveys Sent | Returned | Not Returned | Refused | Returned to Sender by Post Office |
|---|---|---|---|---|---|---|---|
| 43154 | Stoutsville | Ohio | 1 | | 1 | | |
| 44402 | Bristolville | Ohio | 2 | | 2 | | |
| 44486 | Warren | Ohio | 0 | | | | |
| 45623 | Crown City | Ohio | 0 | | | | |
| 45768 | Newport | Ohio | 0 | | | | |
| 46051 | Lapel | Indiana | 0 | | | | |
| 46127 | Falmouth | Indiana | 0 | | | | |
| 46298 | Indianapolis | Indiana | 0 | | | | |
| 46379 | Sumava Resorts | Indiana | 0 | | | | |
| 46776 | Orland | Indiana | 1 | | 1 | | |
| 47470 | Williams | Indiana | 0 | | | | |
| 47744 | Evansville | Indiana | 0 | | | | |
| 48217 | Detroit | Michigan | 0 | | | | |
| 48468 | Port Hope | Michigan | 1 | | 1 | | |
| 49516 | Grand Rapids | Michigan | 0 | | | | |
| 50155 | Macksburg | Iowa | 0 | | | | |
| 51039 | Moville | Iowa | 1 | 1 | | | |
| 52657 | Saint Paul | Iowa | 0 | | | | |
| 52757 | Low Moor | Iowa | 0 | | | | |
| 53143 | Kenosha | Wisconsin | 10 | 4 | 5 | 1 | |
| 53194 | Woodworth | Wisconsin | 0 | | | | |
| 53556 | Lone Rock | Wisconsin | 0 | | | | |
| 54171 | Sobieski | Wisconsin | 2 | | 2 | | |
| 54490 | Westboro | Wisconsin | 1 | | 1 | | |
| 54643 | Millston | Wisconsin | 0 | | | | |
| 55109 | Saint Paul | Minnesota | 16 | 3 | 11 | | 2 |
| 55415 | Minneapolis | Minnesota | 9 | 7 | 2 | | |
| 56083 | Sanborn | Minnesota | 1 | 1 | | | |
| 56336 | Grey Eagle | Minnesota | 0 | | | | |
| 56473 | Pillager | Minnesota | 3 | | 3 | | |
| 56516 | Bejou | Minnesota | 0 | | | | |
| 56651 | Lengby | Minnesota | 1 | | 1 | | |
| 56722 | Euclid | Minnesota | 0 | | | | |
| 57326 | Chamberlain | South Dakota | 0 | | | | |
| 57533 | Gregory | South Dakota | 3 | 2 | 1 | | |
| 57714 | Allen | South Dakota | 0 | | | | |
| 59062 | Otter | Montana | 0 | | | | |
| 59103 | Billings | Montana | 1 | | 1 | | |
| 59256 | Raymond | Montana | 0 | | | | |

| Zip Code | City | State | Total Surveys Sent | Returned | Not Returned | Refused | Returned to Sender by Post Office |
|---|---|---|---|---|---|---|---|
| 59931 | Rollins | Montana | 0 | | | | |
| 60525 | La Grange | Illinois | 23 | 7 | 13 | 1 | 2 |
| 60657 | Chicago | Illinois | 17 | 5 | 11 | | 1 |
| 61345 | Neponset | Illinois | 0 | | | | |
| 61376 | Walnut | Illinois | 3 | | 3 | | |
| 61572 | Yates City | Illinois | 0 | | | | |
| 61602 | Peoria | Illinois | 16 | 7 | 6 | 3 | |
| 62208 | Fairview Heights | Illinois | 7 | 1 | 3 | 1 | 2 |
| 62417 | Bridgeport | Illinois | 2 | 1 | 1 | | |
| 63433 | Ashburn | Missouri | 0 | | | | |
| 63705 | Cape Girardeau | Missouri | 0 | | | | |
| 64053 | Independence | Missouri | 1 | | 1 | | |
| 65054 | Loose Creek | Missouri | 0 | | | | |
| 65212 | Columbia | Missouri | 0 | | | | |
| 65332 | Green Ridge | Missouri | 0 | | | | |
| 67155 | Wilmore | Kansas | 0 | | | | |
| 67357 | Parsons | Kansas | 4 | 3 | 1 | | |
| 67854 | Jetmore | Kansas | 0 | | | | |
| 68062 | Thurston | Nebraska | 0 | | | | |
| 68155 | Omaha | Nebraska | 0 | | | | |
| 70629 | Lake Charles | Louisiana | 0 | | | | |
| 70712 | Angola | Louisiana | 0 | | | | |
| 71631 | Banks | Arkansas | 0 | | | | |
| 73520 | Addington | Oklahoma | 0 | | | | |
| 73575 | Duncan | Oklahoma | 0 | | | | |
| 73705 | Enid | Oklahoma | 0 | | | | |
| 74565 | Savanna | Oklahoma | 0 | | | | |
| 75148 | Malakoff | Texas | 1 | | 1 | | |
| 75237 | Dallas | Texas | 3 | | 2 | | 1 |
| 75558 | Cookville | Texas | 0 | | | | |
| 75662 | Kilgore | Texas | 4 | 1 | | 2 | 1 |
| 76011 | Arlington | Texas | 11 | 5 | 5 | 1 | |
| 77478 | Sugar Land | Texas | 24 | 8 | 11 | | 5 |
| 77481 | Thompsons | Texas | 0 | | | | |
| 78024 | Hunt | Texas | 3 | 1 | 1 | | 1 |
| 79180 | Amarillo | Texas | 0 | | | | |
| 79258 | South Plains | Texas | 0 | | | | |
| 81427 | Ouray | Colorado | 3 | | | | 3 |
| 84102 | Salt Lake City | Utah | 13 | 4 | 6 | 2 | 1 |

| Zip Code | City | State | Total Surveys Sent | Returned | Not Returned | Refused | Returned to Sender by Post Office |
|---|---|---|---|---|---|---|---|
| 84662 | Spring City | Utah | 1 | 1 | | | |
| 84791 | Saint George | Utah | 0 | | | | |
| 88038 | Gila | New Mexico | 0 | | | | |
| 89164 | Las Vegas | Nevada | 0 | | | | |
| 89533 | Reno | Nevada | 0 | | | | |
| 91436 | Encino | California | 19 | 5 | 13 | 1 | |
| 91604 | Studio City | California | 12 | 4 | 6 | 1 | 1 |
| 92070 | Santa Ysabel | California | 1 | 1 | | | |
| 92539 | Anza | California | 2 | | | | 2 |
| 93644 | Oakhurst | California | 13 | 6 | 4 | | 3 |
| 94017 | Daly City | California | 1 | | | | 1 |
| 94147 | San Francisco | California | 1 | | 1 | | |
| 94614 | Oakland | California | 0 | | | | |
| 95689 | Volcano | California | 3 | 1 | 2 | | |
| 96713 | Hana | Hawaii | 0 | | | | |
| 97022 | Eagle Creek | Oregon | 3 | | 2 | | 1 |
| 97060 | Troutdale | Oregon | 7 | 1 | 3 | 2 | 1 |
| 97062 | Tualatin | Oregon | 26 | 8 | 9 | 3 | 6 |
| 97343 | Eddyville | Oregon | 0 | | | | |
| 98230 | Blaine | Washington | 5 | | 3 | | 2 |
| 98388 | Steilacoom | Washington | 1 | | 1 | | |
| 99158 | Oakesdale | Washington | 0 | | | | |
| 99630 | Mekoryuk | Alaska | 0 | | | | |
| 99691 | Nikolai | Alaska | 0 | | | | |
| | | TOTALS | 498 | 156 | 261 | 26 | 55 |

## *H.14 Map of Zip Codes Selected*



# Appendix I. Analysis of Phase II Data

## *I.1 Summary of Raw Data Set*

The questionnaire has been reproduced with a tally of the responses for each question from the participants of Phase II. Each question indicates how many people marked each choice. Duplicate responses (see section 4.3.1.1) are not included in this tally. Free-response questions (those that did not involve a multiple choice answer) are noted with a ✱✱ and are summarized in this section immediately following the questionnaire.

Copyright permission was not granted for reproduction of some survey questions. These questions were blacked out. The reader is directed to the original source for question wordings.

<u>Blacked out Questions</u>

Questions 90-159: The Keirsey Temperament Sorter II (Keirsey 1998)

# Understanding Information Technology Change: A Research Study

## Section 1: Your Attitudes Towards Change

**1. Mark the words below that you most frequently associate with a change.**

| | | | | | |
|---|---|---|---|---|---|
| 96 | Adjust | 45 | Alter | 6 | Ambiguity |
| 30 | Anxiety | 41 | Better | 66 | Challenging |
| 21 | Chance | 20 | Concern | 4 | Death |
| 4 | Deteriorate | 47 | Different | 19 | Disruption |
| 54 | Exciting | 10 | Fear | 23 | Fun |
| 60 | Grow | 74 | Improve | 64 | Learn |
| 51 | Modify | 50 | New | 81 | Opportunity |
| 8 | Rebirth | 30 | Replace | 42 | Revise |
| 30 | Stress | 9 | Transfer | 48 | Transition |
| 41 | Uncertainty | 9 | Upheaval | 17 | Vary |

To what extent do you agree or disagree with the statements for Questions 2 to 3?

**2. I am able to laugh at myself pretty easily.**

| Agree Strongly | | | | | | Disagree Strongly |
|---|---|---|---|---|---|---|
| 47 | 58 | 26 | 13 | 7 | 2 | 0 |

**3. I'm usually able to see the funny side of an otherwise painful predicament.**

| Agree Strongly | | | | | | Disagree Strongly |
|---|---|---|---|---|---|---|
| 26 | 59 | 35 | 19 | 10 | 3 | 1 |

To what extent do you agree or disagree with the statements for Questions 4 to 23? Please use the following response scale:
AS = Agree strongly
A = Agree
N = Neither agree nor disagree
D = Disagree
DS = Disagree strongly

**4. To be happy, I must maintain the approval of all the persons I consider significant.**

AS 4 A 56 N 37 D 45 DS 45

**5. To be a worthwhile person, I must be thoroughly competent in everything I do.**

AS 11 A 46 N 36 D 48 DS 11

**6. Individuals who take unfair advantage of me should be punished.**

AS 11 A 53 N 56 D 25 DS 7

**7. It is terrible when things do not go the way I would like.**

AS 1 A 23 N 66 D 55 DS 7

**8. My negative emotions are the result of external pressures.**

AS 7 A 56 N 44 D 42 DS 3

**9. If there is a risk that something bad will happen, it makes sense to be upset.**

AS 2 A 25 N 45 D 67 DS 13

**10. It is better to ignore personal problems than to try to solve them.**

AS 0 A 2 N 5 D 75 DS 71

**11. Many events from my past so strongly influence me that it is impossible to change.**

AS 3 A 9 N 15 D 83 DS 42

**12. I dislike having any uncertainty about my future.**

AS 3 A 45 N 32 D 61 DS 12

**13. Life should be easier than it is.**

AS 3 A 40 N 55 D 43 DS 11

**14. To be happy I must be loved by the persons who are important to me.**

AS 15 A 69 N 40 D 23 DS 6

**15. I must keep achieving in order to be satisfied with myself.**

AS 17 A 85 N 26 D 22 DS 3

**16. Most people who have been unfair to me are generally bad individuals.**

AS 6 A 15 N 57 D 68 DS 7

**17. It is awful when something I want to happen does not occur.**

AS 2 A 13 N 46 D 80 DS 11

**18. I cannot help how I feel when everything is going wrong.**

AS 0 A 35 N 44 D 60 DS 13

**19. When it looks as if something might be wrong, it is reasonable to be quite concerned.**

AS 11 A 92 N 26 D 21 DS 2

**20. It makes more sense to wait than to try to improve a bad life situation.**

AS 1 A 4 N 20 D 100 DS 27

**21. Some of my ways of acting are so ingrained that I could never change them.**

AS [1] A [17] N [25] D [89] DS [21]

**22. I hate it when I cannot eliminate an uncertainty.**

AS [3] A [37] N [48] D [57] DS [7]

**23. Things should turn out better than they usually do.**

AS [1] A [15] N [59] D [70] DS [7]

To what extent do you agree or disagree with the statements for Questions 24 to 31? Please use the following response scale:
AS = agree strongly
A = agree somewhat
U = undecided
D = disagree somewhat
DS = disagree strongly

**24. If I could do as I pleased, I would change the kind of work I do every few months.**

AS [3] A [21] U [15] D [83] DS [30]

**25. One can never feel at ease on a job where the ways of doing things are always being changed.**

AS [4] A [54] U [21] D [61] DS [12]

**26. The trouble with most jobs is that you just get used to doing things in one way and then they want you to do them differently.**

AS [2] A [17] U [32] D [87] DS [14]

**27. I would prefer to stay with a job that I know I can handle than to change to one where most things would be new to me.**

AS [5] A [22] U [22] D [85] DS [17]

**28. The trouble with many people is that when they find a job they can do well, they don't stick with it.**

AS [6] A [21] U [54] D [66] DS [6]

**29. I like a job where I know that I will be doing my work about the same way from one week to the next.**

AS [1] A [38] U [24] D [67] DS [22]

**30. When I get used to doing things in one way it is disturbing to have to change to a new method.**

AS [1] A [28] U [17] D [92] DS [14]

**31. It would take a sizeable raise in pay to get me to voluntarily transfer to another job.**

AS [13] A [42] U [24] D [55] DS [18]

**32. The job that you would consider ideal for you would be one where the way you do your work:**

| Is always the same | | | | Changes a great deal |
|---|---|---|---|---|
| [5] | [12] | [68] | [45] | [21] |

## Section 2: Information Technology Changes Occurring Within Your Company

**33. Over the past year, have any technological changes happened in your company?** Some examples of technological change include using computers for tasks that previously did not use them, introducing new computer software or programs, and changes in existing computer systems. Please include changes currently in progress.

[68] No
[83] Yes..... Please describe the changes below. Try to be as specific as you can.

_____

** _____

_____

_____

_____

_____

_____

**34. Are you aware of any technological changes planned for the next year?**

[113] No
[39] Yes..... Please describe the changes below. Try to be as specific as you can.

_____

** _____

_____

_____

_____

_____

_____

If you answered **No** to <u>both</u> Question 33 and Question 34, please skip to Question 40, page 3.
If you answered **Yes** to <u>either</u> question, please continue with Question 35.

**35. Of all the changes that you described, which one do you feel affected (or will affect) you the most?**

_____

**_____

_____

Please answer Questions 36 to 39 based on the technological change that you indicated in Question 35.

**36. How motivated were you (or are you) to use the new technology?**

| A great deal | | | | | Not at all |
|---|---|---|---|---|---|
| 43 | 27 | 11 | 3 | 2 | 1 |

**37. Do you think you resisted (or will resist) the technological change at all?**

| A great deal | | | | | Not at all |
|---|---|---|---|---|---|
| 0 | 5 | 10 | 8 | 19 | 42 |

To what extent do you feel that the statements for Questions 38 to 39 are true or not?

**38. People will be able to maintain respect and status when the change is implemented (as opposed to losing these as a result of the change).**

| True | | | | | | Not True |
|---|---|---|---|---|---|---|
| 42 | 23 | 6 | 9 | 1 | 1 | 4 |

**39. The change will be mild (and not cause a major disruption of the status quo).**

| True | | | | | | Not True |
|---|---|---|---|---|---|---|
| 38 | 18 | 6 | 9 | 8 | 6 | 2 |

## Section 3: Your Company and Change

To what extent do you feel that the statements for Questions 40 to 45 are true or not?

**40. People throughout my organization share values or visions.**

| True | | | | | | Not True |
|---|---|---|---|---|---|---|
| 45 | 35 | 36 | 10 | 10 | 5 | 9 |

**41. My organization has a good track record in implementing change smoothly.**

| True | | | | | | Not True |
|---|---|---|---|---|---|---|
| 39 | 38 | 31 | 24 | 11 | 6 | 2 |

**42. There is a lot of cooperation and trust throughout my organization (as opposed to animosity).**

| True | | | | | | Not True |
|---|---|---|---|---|---|---|
| 55 | 48 | 21 | 14 | 7 | 2 | 4 |

**43. My organization's culture supports risk taking (as opposed to being highly bureaucratic and rule bound).**

| True | | | | | | Not True |
|---|---|---|---|---|---|---|
| 45 | 37 | 25 | 22 | 11 | 3 | 8 |

**44. People are able to handle change (as opposed to being worn out from recent, unsettling changes).**

| True | | | | | | Not True |
|---|---|---|---|---|---|---|
| 35 | 47 | 35 | 13 | 12 | 4 | 5 |

**45. My organization rewards people who take part in change efforts (as opposed to subtly punishing those who take the time off other work to get involved).**

| True | | | | | | Not True |
|---|---|---|---|---|---|---|
| 39 | 46 | 19 | 24 | 11 | 5 | 7 |

## Section 4: Your Computer Experience

**46. Do you use a computer at work?**

- 11 Never
- 11 Rarely
- 19 Sometimes
- 36 Often
- 76 I use one for a majority of my work

**47. How would you rate your knowledge of computers?**

- 7 Absolute zero
- 31 Minimal
- 61 Good
- 34 Very good
- 20 Extensive

**48. Have you ever taken a course in computer programming?**

- 92 No
- 61 Yes

**49. Have you ever taken an academic or job-training course in word processing?**

- 104 No
- 49 Yes

**50. Have you ever taken a test or exam where you were required to type responses using a computer?**

- 78 No
- 75 Yes

**51. Have you ever used computers that were linked to other computers?**

42 No
107 Yes
3 I don't know

To what extent do you agree or disagree with the statements for Questions 52 - 63? Please use the following response scale:
AS = Agree strongly
A = Agree
N = Neither agree nor disagree
D = Disagree
DS = Disagree strongly

**52. I frequently read computer magazines or other sources of information that describe new computer technology.**

AS 11 A 20 N 26 D 51 DS 46

**53. I know how to recover deleted or "lost data" on a computer or PC.**

AS 16 A 48 N 15 D 45 DS 30

**54. I know what a LAN is.**

AS 42 A 42 N 8 D 27 DS 35

**55. I know what an operating system is.**

AS 66 A 51 N 5 D 18 DS 14

**56. I know how to write computer programs.**

AS 12 A 18 N 13 D 43 DS 68

**57. I know how to install software on a personal computer.**

AS 70 A 53 N 4 D 11 DS 16

**58. I know what email is.**

AS 109 A 39 N 2 D 0 DS 3

**59. I know what a database is.**

AS 88 A 50 N 4 D 6 DS 4

**60. I know what the Internet is.**

AS 110 A 40 N 2 D 1 DS 1

**61. I am computer literate.**

AS 50 A 66 N 15 D 14 DS 9

**62. I regularly use a PC for word processing.**

AS 81 A 31 N 11 D 17 DS 14

**63. I am good at using computers.**

AS 48 A 52 N 25 D 13 DS 16

To what extent do you agree or disagree with the statements for Questions 64 - 89? Please use the following response scale:
AS = Agree strongly
A = Agree somewhat
D = Disagree somewhat
DS = Disagree strongly

**64. Computers do not scare me at all.**

AS 57 A 65 D 24 DS 8

**65. I would like working with computers.**

AS 58 A 70 D 14 DS 10

**66. Working with a computer would make me very nervous.**

AS 2 A 11 D 46 DS 94

**67. I do not feel threatened when others talk about computers.**

AS 60 A 64 D 21 DS 9

**68. It wouldn't bother me at all to take computer courses.**

AS 73 A 67 D 9 DS 4

**69. I'm no good with computers.**

AS 5 A 9 D 47 DS 92

**70. The challenge of solving problems with computers does not appeal to me.**

AS 11 A 32 D 52 DS 58

**71. Computers make me feel uncomfortable.**

AS 2 A 12 D 54 DS 85

**72. Generally I would feel OK about trying a new problem on the computer.**

AS 53 A 73 D 20 DS 6

**73. I would feel at ease in a computer class.**

AS 59 A 74 D 17 DS 3

**74. I think working with computers would be enjoyable and stimulating.**

AS 51 A 75 D 20 DS 7

**75. I don't think I would enjoy doing advanced computer work.**

AS 23 A 52 D 45 DS 33

**76. Figuring out computer problems does not appeal to me.**

AS 12 A 56 D 53 DS 32

**77. I get a sinking feeling when I think of trying to use a computer.**

AS 3 A 6 D 64 DS 80

**78. I am sure I could do work with computers.**

AS 74 A 66 D 8 DS 5

**79. I would feel comfortable working with a computer.**

AS 73 A 69 D 8 DS 3

**80. I'm not the type to do well with computers.**

AS 5 A 14 D 56 DS 78

**81. I don't understand how some people can spend so much time working with computers and seem to enjoy it.**

AS 8 A 27 D 61 DS 57

**82. Once I start to work with a computer, I would find it hard to stop.**

AS 24 A 51 D 65 DS 13

**83. I think using a computer would be very hard for me.**

AS 5 A 8 D 51 DS 89

**84. I will do as little work with computers as possible.**

AS 7 A 19 D 45 DS 82

**85. Computers make me feel uneasy and confused.**

AS 3 A 10 D 54 DS 86

**86. If a problem is left unsolved in a computer class, I would continue to think about it afterward.**

AS 34 A 89 D 22 DS 7

**87. I do not enjoy talking with others about computers.**

AS 8 A 32 D 81 DS 32

**88. I do not think I could handle a computer course.**

AS 2 A 4 D 68 DS 79

**89. I have a lot of self-confidence when it comes to working with computers.**

AS 42 A 68 D 35 DS 9

## Section 5: Your Personality

For Questions 90 to 159, two choices are given. Please indicate which choice you prefer in each pair.

**90.** [redacted]

71 [redacted]
72

**91.** [redacted]

118 [redacted]
33

**92.** [redacted]

27 [redacted]
125

**93.** [redacted]

47 [redacted]
104

**94.** [redacted]

64 [redacted]
86

**95.** [redacted]

70 [redacted]
81

**96.** [redacted]

74 [redacted]
77

**97.** [redacted]

89 [redacted]
64

**98.** [redacted]

110 [redacted]
40

**99.** [redacted]

58 [redacted]
91

**100.** [redacted]

94 [redacted]
55

**101.** [redacted]

40 [redacted]
112

**102.** [redacted]

93 [redacted]
59

**103.** [redacted]

122 [redacted]
30

**104.** [redacted]

70
81 [redacted]

**105.** [redacted]

117
34 [redacted]

**106.** [redacted]

126
24 [redacted]

**107.** [redacted]

79
72 [redacted]

**108.** [redacted]

54
97 [redacted]

**109.** [redacted]

112
38 [redacted]

**110.** [redacted]

73
75 [redacted]

**111.** [redacted]

90
58 [redacted]

**112.** [redacted]

93
55 [redacted]

**113.** [redacted]

40
105 [redacted]

**114.** [redacted]

58
90 [redacted]

**115.** [redacted]

69
78 [redacted]

**116.** [redacted]

59
90 [redacted]

**117.** [redacted]

137
13 [redacted]

**118.** [redacted]

64
86 [redacted]

**119.** [redacted]

141
10 [redacted]

**120.** [redacted]

57
89 [redacted]

**121.** [redacted]

35
114 [redacted]

**122.** [redacted]

62
86 [redacted]

**123.** [redacted]

55
93 [redacted]

**124.** [redacted]

94
56 [redacted]

**125.** [redacted]

80
68 [redacted]

**126.** [redacted]

138
12 [redacted]

**127.** [redacted]

104
45 [redacted]

**128.** [redacted]

114
36 [redacted]

**129.** [redacted]

92
56 [redacted]

**130.** [redacted]

113
37 [redacted]

**131.** [redacted]

111
38 [redacted]

**132.** [redacted]

43
106 [redacted]

**133.** [redacted]

103
46 [redacted]

**134.** [redacted]

96
53 [redacted]

**135.** [redacted]

65
84 [redacted]

**136.** [redacted]

51
99 [redacted]

**137.** [redacted]

107
43 [redacted]

**138.** [redacted]

89
61 [redacted]

**139.** [redacted]

115
36 [redacted]

**140.** [redacted]

136
14 [redacted]

**141.** [redacted]

142
9 [redacted]

**142.** [redacted]

49
100 [redacted]

**143.** [redacted]

85
64 [redacted]

**144.** [redacted]

130
21 [redacted]

**145.** [redacted]

62
88 [redacted]

**146.** [redacted]

50
96 [redacted]

**147.** [redacted]

106
40 [redacted]

**148.** [redacted]

125
23 [redacted]

**149.** [redacted]

46
105 [redacted]

**150.** [redacted]

126
24 [redacted]

**151.** [redacted]

77
71 [redacted]

**152.** [redacted]

119
30 [redacted]

**153.** [redacted]

113
38 [redacted]

**154.** [redacted]

112
36 [redacted]

**155.** [redacted]

76
72 [redacted]

**156.** [redacted]

102 [redacted]
46

**157.** [redacted]

85 [redacted]
65

**158.** [redacted]

54 [redacted]
94

**159.** [redacted]

109 [redacted]
40

Think about the past month. For Questions 160 to 172, please indicate how well the statement describes your behavior or intention. Please use the following response scale:
VW = This describes me very well
MW = This describes me moderately well
L = This describes me a little
NAA = This does not describe me at all

**160. I can make things happen**

VW 69 MW 74 L 7 NAA 0

**161. Fate plays a strong role in my life**

VW 17 MW 42 L 64 NAA 26

**162. I find it useless to fight the established hierarchy at my company**

VW 9 MW 16 L 51 NAA 74

**163. Circumstances are beyond my control**

VW 4 MW 19 L 68 NAA 59

**164. I need recognition from others to make my life worthwhile**

VW 7 MW 37 L 62 NAA 45

**165. I am easy to like**

VW 53 MW 79 L 18 NAA 1

**166. I have a hard time accepting compliments**

VW 10 MW 52 L 61 NAA 28

**167. I have the ability to get what I want**

VW 31 MW 88 L 29 NAA 2

**168. I feel in control in my life**

VW 42 MW 84 L 17 NAA 7

**169. If I reflect on my life, I might find that I am basically unhappy**

VW 1 MW 5 L 35 NAA 109

**170. I feel frightened and out of control when things change rapidly**

VW 1 MW 12 L 62 NAA 76

**171. I enjoy taking charge of things**

VW 53 MW 79 L 16 NAA 3

**172. I know what I want and I go after it**

VW 47 MW 80 L 20 NAA 3

## Section 6: Your Job

**173. What is your job title?**

**

**174. What are the primary responsibilities of your job?**

**

**175. From the selections below, choose the profession that most closely identifies your job and that of your immediate supervisor:**

| | You | Your Immediate Supervisor |
|---|---|---|
| Architect | 32 | 8 |
| Engineer | 34 | 14 |
| Contractor | 35 | 17 |
| Construction Manager | 5 | 7 |
| Administrator | 17 | 5 |
| Management | 25 | 16 |
| Computer/IT Specialist | 1 | 0 |

**176. From the selections below, which level best identifies your position in your company?**

34 I am the only person in this company
49 Executive (CEO, CFO, etc.)
24 Management (project managers, superintendents, etc.)
16 Professional staff (architects, engineers, designers, etc.)
3 Technical staff (drafters, inspectors, etc.)
4 Construction labor (carpenters, masons, roofers, etc.)
20 Administrative staff

**177. Are you responsible for supervising other employees?**

57 No
92 Yes..... How many? ** employees supervised

**178. Do you have the power to hire or fire employees?**

- [1] I only have the power to hire new employees
- [0] I only have the power to fire existing employees
- [109] I have the power to both hire and fire employees
- [41] I do not have the power to hire or fire employees

**179. Do you have the power to reward or punish employees?**

- [2] I only have the power to reward employees
- [0] I only have the power to punish employees
- [112] I have the power to both reward and punish employees
- [36] I do not have the power to reward or punish employees

## Section 7: Your Company

**180. How many people does your company employ *at this location*?**

- [75] 5 employees or less
- [60] 6 - 20 employees
- [8] 21 - 50 employees
- [5] 51 - 200 employees
- [3] 201 - 1000 employees
- [0] 1001 or more employees

**181. How many people does your company employ *at all locations combined*?**

- [67] 5 employees or less
- [54] 6 - 20 employees
- [11] 21 - 50 employees
- [11] 51 - 200 employees
- [6] 201 - 1000 employees
- [2] 1001 or more employees

**182. What industry does your company work in *at this location*? Check all that apply.**

- [41] Architecture
- [46] Engineering
- [45] General Building Construction (manufacturing, industrial, commercial, institutional)
- [55] Residential Building Construction (single and multifamily housing)
- [8] Heavy Construction (highways, streets, bridges, tunnels, utilities)
- [18] Construction Management

**183. What industry does your company work in *at all locations combined*? Check all that apply.**

- [42] Architecture
- [47] Engineering
- [51] General Building Construction (manufacturing, industrial, commercial, institutional)
- [58] Residential Building Construction (single and multifamily housing)
- [9] Heavy Construction (highways, streets, bridges, tunnels, utilities)
- [21] Construction Management

## Section 8: Yourself

**184. What is your age?**

** years

**185. What is your gender?**

- [36] Female
- [115] Male

**186. What is the highest level of education you have completed?**

- [0] Did not complete 8th grade
- [1] Did not complete high school
- [3] Did not complete high school, but received a GED
- [21] High school diploma
- [25] Some college
- [14] Associate's degree
  In what? **
- [54] Bachelor's degree
  In what? **
- [15] Some graduate school
  In what? **
- [18] Master's degree or higher
  In what? **

**Summary of Free-Response Questions** (noted with a ** on reproduced survey)

**Question 33:** Over the past year, have any technological changes happened in your company? (Note that not all responses match with the definition of technology from section 1.5.1. Additionally, some respondents provided responses that did not appear to relate to any sort of technology change. These responses are omitted from this summary.)

- access database
- accounting software, project management software
- advent of PDF files and ftp sites allows me to work with consultants all over the country as if they are in town. Also, info transfer is instant, not FedEx Overnight!
- changes in how files are saved, high end plotter, copier, scanner, utilizing workstation capabilities for creating 3d graphics, topo maps to surfaces for presentations
- client mandated changes in delivery of software records
- computer system changes - all phases - AIP, AIR, GIL, BR
- continual software and hardware updates
- continual updating of design software and addition access to data through the internet
- database, outlook
- electronic data transfer with the equipment that we provide has taken a leap forward via 'redflex' total encrypted data integration (which is still evolving)
- emailing proposals to customers
- having to relearn "new and improved" software revisions
- I added an additional computer and printer and we are networked using the same programs as previous
- imaging software
- implemented new software for hydraulics, added larger server and additional printers to print queue
- introduction of new cad methods (arch desktop), modularization of all proposal/marketing/ presentation information
- much more reliance on e-mail - including bidding, we have initiated a website, looking at computer estimating, money mgmt at bank by computer tie in
- networked offices, more email, laptop friendly/mobile
- new accounting program
- new building codes, new computer programs, changing our programs, use of digital photography, more use of internet
- new cad software, new scheduling software
- new computer added to accommodate a software upgrade in cad drafting program forced on the company by clients
- new computer & software
- new computer software
- new computer software programs
- new computer system, new software
- new computer systems & software, expanded use of internet for work

- new computer with new software for drawing. Picture imaging, telephone system
- new computers and better software
- new database program, switched from ACT to JPP
- new flooring & installation has been doing many changes for the 40+ years I have been in business w/ materials and installation
- new heating & cooling calculation software and new fault study software being used
- new IT system & requirements
- new phone system, changes in existing software
- new products - electrical, computer system
- new program to keep track of time spent on projects. New AutoCAD program
- new programs/new software (x4)
- new scanner, new internet provider, new operating system
- new software, changed accountants, hired new employees, rearranged office
- new software for job tracking, job costing, product selection of job components such as beam new software, new clients
- new software, new phone system
- new software programs, software updates, word, excel, expedition, etc
- new versions of engineering software, new computer operating systems, new backup methods for network, new virus control, working w/ software developer on new accounting system
- online invoicing, online bidding
- personal computers for bookkeeping
- preliminary training on a new solid-modeling drafting software, preliminary training on DreamWorks, website designing software
- project management files (financial) are accessed thru intranet. Project managers must now review about 15 reports as opposed to 3 previously. They are not easy for a non-accountant to understand!!!
- QuickBooks - mainly printing checks, changed from win 98 to winXP
- receiving house plans through the computer
- reporting tax liability & forms via internet
- sizing. Also evaluation and testing reports of marketplace products
- software programs, office network
- started using GPS, get more info off internet
- time management, information transfer
- time sheet tracking
- too numerous to remember. We routinely "tweak" to improve
- transferred portfolio from print to QuickTime files on a Mac g4. burn portfolio discs, give to prospective clients
- updating server and backup software, increasing number of personnel and upgrading obsolete machines to top of the line and increasing networking abilities as well as internet/intranet
- upgrade computer programs
- upgrade computer system, added AutoCAD 2000 & stopped using AutoCAD lt2000. got copies of studiomas and 3dstudio - wow! Bought an hp100 printer & hp1200 - upgrade from 10 year old printer

- upgrade in computer programs and software - yearly, new equipment such as manual to automatic
- upgraded cad software - new commands, new palm upgrade, new internet dsl
- upgraded computer and programs, changing government reporting
- upgraded microstation version, internet access, new printers
- upgraded operating system from win95 to win xp
- upgraded to faster computers
- upgrading cad design software, upgrading windows/networking, new computer, new pda, new office software
- upgrading our cadd software to the most current version, utilizing new management software
- use of e-builder website for project communication
- use of internet to renew plumbing license instead of mail, some new materials introduced that make certain tasks easier
- using a basic word processing program I've converted many documents I used to type to computer forms. We've upgraded our cadd program
- using computers for tasks that previously did not use them (x3)
- using new generation of field survey equipment, software & methodology, also using new electronic safety monitoring equipment & processes
- we are using AutoCAD/computer for all new projects, we have new networking between computers
- we have purchased 3d software and are learning to use it
- we moved from a windows 98 peer to peer 10 base t network to a windows 2000 client server 100 base t network and new accounting software
- working with people all over the world via telephone and web cams

**Question 34:** Are you aware of any technological changes planned for the next year? (Note that not all responses match with the definition of technology from section 1.5.1. Additionally, some respondents provided responses that did not appear to relate to any sort of technology change. These responses are omitted from this summary.)

- AutoCAD 2004 upgrade, acquiring static IP address for homepage to allow clients to view their construction plans online and order copies if needed, will be purchasing another workstation
- cad software for civil design is having a major philosophical change
- change to upgraded AutoCAD software - maybe 3d
- changes in computer operating system and hardware
- changing from notepad sketches & notes to laptop & penbased software
- continuation of the first
- cyber 3d is the trend! 3dstudio will be required next year! Or other 3d system - Archicad, etc.
- expand network, office database
- further upgrades in management software, new billing and project management software
- increase use of cad for design work, possibly upgrade computer hardware
- implementation of additional parametric information into our cad models. Begin modeling detail level info into plans via smart objects/parametrics

- implementation of wireless LAN, web programming, new opportunities in web based services to clients
- likely to upgrade other computers if/when we can afford the expense & disruption involved in order to maintain compatibility internally & with clients
- major upgrade to cad software company-wide
- more integration, MS desktop, upgraded accounting/finance system
- more interactive/usable website, new computer programs
- more online invoicing, more online bidding
- more tasks computerized
- new 3-d program for drafting
- new application for requirements management
- new computer based phone system, various software upgrades
- new computer purchase
- new computers, new software
- new server & workstation, pressure from CPA to change acct program from QBPro to QBContractor - no plans to do so
- office location change, with that will come increase in computer aided applications and getting rid of seldom used equipment
- palm for service
- plan to implement more 3-D AutoCAD into planning process
- some sales expansion via computer
- software companies must change or die
- upgrade computer hardware, revise office master specs
- upgrade in software that will require training of individuals
- upgraded workstations, possibly more accounting software clients (users) added. Currently at 5 clients
- upgrades in computer software
- upgrading computers and software for some employees, possible use of new accounting software, developing new spreadsheets for building code changes that make calcs more complex, adding new software & learning to use it for in-house post-tensioned concrete design
- upgrading software
- using palm pilots more, using laptops
- website program updates

**Question 35:** Of all the changes that you described, which one do you feel affected (or will affect) you the most? (Note that not all responses match with the definition of technology from section 1.5.1. Additionally, some respondents provided responses that did not appear to relate to any sort of technology change. These responses are omitted from this summary.)

- 3d graphics
- ability to allow our clients to view their construction drawings online. We will charge for this service and bring in extra income
- ability to work on computers in other locations from our office
- accounting software
- all (x3)
- AutoCAD for all projects
- banking by computer (to date), sales might be bigger
- both (x4)
- building code changes and software
- changing hand written notes & sketches to computer programs solely
- civil cad change
- computer
- computer billing
- computer operating system
- computer software changes
- computer system
- different software
- doing the 3D AutoCAD
- email contracts and house plans
- getting into cyber art in addition to 2d graphics
- I have no excuse to go home at 7pm because FedEx went out…. Now I can work to midnight and send an email!
- inconsistency in software packages
- in-house post-tension design
- learn new system
- listed
- major upgrade to cad software
- more financial management of projects
- more tasks computerized
- network
- new AutoCAD program
- new field survey instrumentation & resultant data processing/handling practices
- new management software
- new software (x5)
- new versions of cad software have dramatic, but not always positive impact
- none (x3)
- one large program

- online bidding
- personal computer
- phone system - I use it everyday as do most of the staff
- product selection evaluation and testing reports
- scanner
- software, hardware, integration
- software operating system upgrades
- software updates
- specification revisions
- the forms - I can do the forms much faster on the computer
- the inefficiency of time due to the learning curve of the software
- the software upgrade
- unrealistic requirements for government standardization when each agency still has different requirements
- upgrade computer programs
- upgraded computers will make productivity much quicker
- upgraded microstation version
- upgraded (modernized) accounting/financial/PM system
- use of cad for design work
- use of internet
- using computers for drawing instead of drawing by hand
- very positive results from digital portfolio
- website for project communication makes me check my email more frequently
- website program development
- XP upgrade

**Question 173:** What is your job title?

- accts payable manager, network admin, real estate agent
- AutoCAD technician
- Architect (x8)
- architect/engineer
- architect/owner (x5)
- architect/partner
- architectural intern
- assistant buyer/regional manager
- associate (civil engineer)
- bookkeeper (x2)
- branch manager/vice president
- CEO
- CFO
- civil engineer (x2)
- construction manager (x2)
- consulting railway engineer

- controller
- co-owner, bookkeeper
- co-owner & manager
- corporate executive
- corporate president
- corporate secretary
- designer
- director of federal services
- electrical contractor
- electrician (2)
- engineer (x2)
- engineer/owner
- foreman
- general contractor, certified building inspector
- general manager (x2)
- general manager, owner
- interior design intern
- intern architect
- IT/accounting specialist
- jack of all trades
- junior partner
- land surveys division manager
- manager
- office clerk
- office manager (x10)
- office manager, co-owner
- office manager, corp secretary, bookkeeper
- owner (x21)
- owner, clerk
- owner/job coordinator
- owner/manager/dad
- owner/partner (x2)
- owner & president
- partner
- president (x14)
- president/CEO
- president, co owner
- president, owner
- president, electrical engineer
- president & structural engineer
- principal
- principal architect (x2)
- principal electrical engineer/vice president
- principal - owner

- principal & president
- project architect
- project designer
- project manager (x2)
- purchasing manager
- rehab specialist
- roofing contractor - owner
- secretary (x2)
- secretary/receptionist
- self-employed
- self-employed electrician
- senior associate
- senior engineering technician
- senior project engineer
- sheet metal worker
- sole proprietor
- staff architect
- staff engineer
- staff structural engineer
- vice president (x4)
- vice president/project manager
- VP of engineering
- VP of operations
- VP of technology

**Question 174:** What are the primary responsibilities of your job?

- accounting
- accounting, general office duties
- accounting, office, marketing, PR
- accounting, project management
- accounting, sales support, IT specialist
- administrative assistant, employee management
- all/everything (x11)
- all business decisions, chief cook & bottle washer for management company
- analyze and design structures using steel, wood, masonry, and produce drawings
- answer phone, filing
- answer phone, take messages, payroll
- architect, owner
- architect, project management consultant
- architectural design
- bidding & checking jobs, payroll, A/R, A/P, ordering materials & supervising
- billing, invoicing, check writing, keep track of monies
- bookkeeping, payroll

- business development, manage design projects & personnel
- construction work (residential), computer input and reporting
- calculations, drawings, correspondence
- CEO
- civil & mechanical design, computer technology & updates at work
- client contact, run the business, I am self-employed
- construction documents
- construction drawings, presentation boards, specifications
- consulting
- contracting services, proposals & estimating
- design (x2)
- design/analysis of infrastructure and construction
- design documents, office organization, making sure projects are on task and appointing responsibilities
- design, drafting, sales, invoicing, buying, maintenance
- design, supervision, etc. of architecture firm
- design & manage projects, lead team
- design & marketing
- design & prepare construction documents - commercial, industrial, institutional & residential
- design and production (x2)
- design and writing specifications
- design/sales in kit/bath remodel, most customer contact and run the business
- develop leads, manage office resources, provide technical assistance
- doing estimates, getting jobs, arranging jobs, doing jobs, taking care of money & paying workers
- drafting
- electrical design on all projects
- electrical troubleshooting & construction
- engineering/design
- establish work plans and manage a team of consultants accomplish the customer objectives
- estimate, oversee employees, all phases of planning
- estimating and overall job management
- estimator, job sup., lead operator
- family business started by me and I can do it all except computer work - my daughter does that
- financial area of company, purchasing, collections
- finding jobs and getting them done
- inspecting construction projects for compliance with state building codes, part-time construction management (small firm)
- install heat & air units
- landscape architect, project manager, chief estimator
- lead & motivate
- lead designer for roadway & utility projects, coordinate draftsmen
- leads, schedule, procedures, inspections, actual on hand work

- long-term planning, problem solving, brainstorming, company coordination
- maintaining computer network of 7 computers and all software. Also handle large portions of accounting medical and retirement benefits work
- making things out of sheet metal, ordering some supplies, repairing tools and equipment, technical advisor
- manage contractors
- manage engineering & project management business
- manage projects, manage sales, manage business
- manage sub-contractors and employees
- manage the business in cooperation with my partner, responsible for all electrical design and engineering
- manage value engineering department
- management of architectural projects
- managing business, drawing up all proposals and closing all deals
- managing construction projects, estimating, HR management
- managing day to day operations, planning
- managing projects in office, get new jobs
- managing the daily functions of the office
- meet with clients, design, contracts, structural calculations, business finances
- misc. clerical work, payroll preparation, preparation of payroll tax returns
- nurturing, bid, invoice, payroll, supervise
- office manager, field manager, site superintendent, human resource manager
- office management
- office manager, financial operations
- "one-girl" office manager
- operate building business
- order parts & materials & schedule work for construction co
- ordering supplies, bookkeeping, clerk
- overall design & management
- oversee office
- overall operations of my business
- overseeing the electrician below me. Setting up jobs for them
- oversight of small construction company
- owner
- own & operate
- p & l, sales management, production management
- payables & receivables, all computers & network, selling real estate
- payroll, accts rec & payable, taxes, ordering supplies, proposals
- payroll, accounts rec/payable, answering phone, relay messages, bookkeeping
- payroll, bills
- personnel, sales, scheduling
- phone, accts payable, bids, invoices, payroll
- plumbing
- prepare and coordinate the construction documents and specs

- primarily administrative. Significant responsibility for decision making except on construction issues
- principal/owner of office
- project design, documents, and administration
- project management and electrical design
- project management, business decisions w/ partner, working w/ clients to develop work
- project management, mechanical design, construction management, client contact
- project management, project design, personnel management
- project manager (x2)
- purchasing, billing, accounting, installation
- residential architect
- responsible for setting office policies and goals
- running company (x7)
- run day to day office procedures - billings, banking, guiding company
- run the company, lead client relationships, win work (x2)
- running the office and control the contracts, a/r & a/p
- sales
- sales, engineering, operations (the buck stops here)
- schedule & coordinate work with employees & sub-contractors
- soil testing, report writing, lab work, data reduction
- start & carry out business from start to finish
- structural engineering & architecture - design, engineering, management, marketing
- supervise & coordinate building of new homes
- supervise field & office operations, personnel mgt, production of survey products & services (i.e. maps, drawings, etc)
- supervise, install electronic military systems (secret)
- supervising, payroll, working with employees, bidding on jobs
- technology expert, cad, project manager
- technology management
- typing, filing, answering phones, misc. paperwork, computer work

**Question 177:** How many employees supervised?

| 0 supervised | 1-2 supervised | 3-5 supervised | 6-9 supervised | 10-15 supervised | 16-40 supervised | 41 or more supervised |
|---|---|---|---|---|---|---|
| 57 | 20 | 29 | 16 | 16 | 7 | 3 |

**Question 184:** What is your age?

| 20-24 years | 25-29 years | 30-34 years | 35-39 years | 40-44 years | 45-49 years | 50-54 years | 55-59 years | 60-64 years | 65-69 years | 70+ years |
|---|---|---|---|---|---|---|---|---|---|---|
| 5 | 7 | 7 | 17 | 21 | 38 | 19 | 17 | 10 | 5 | 5 |

**Question 186:** What is the highest level of education you have completed?

Associate's degree, in what?

- Architectural technology
- Arts & science
- Business (x3)
- Business administration
- Business management
- Computer information systems
- Drafting & design
- Electro-mechanical engineering
- Mechanical design
- Residential design
- Science (x2)

Bachelor's degree, in what?

- Accounting (x4)
- Animal science
- Architecture (x16)
- Aviation business management
- Business
- Business administration
- Business admin/management
- Business management
- Civil engineering (x10)
- Construction engineering
- Electrical engineering (x2)
- Engineering
- English, business minor
- Finance
- Health sciences
- History
- Interior architecture
- Landscape architecture
- Management, HR management
- Mechanical engineering (x2)
- Mining engineering
- Physics
- Secondary ed - history, political science

Some graduate school, in what?

- Architecture (x3)
- Business administration
- Computer science C++ programming
- Education
- Electrical engineering
- Engineering (x2)
- Human resources management
- Law school
- MBA (x2)
- Mechanical engineering
- Nursing - pediatric nurse practitioner
- Recreational education administration

Master's degree or higher, in what?

- Architecture (x9)
- Chemical engineering
- Chemistry
- Engineering
- HVAC
- Management
- MBA (x2)
- Systems management (x2)
- Technology management

## *I.2 Hypothesis 1: Profession – One-Way ANOVA*

The ANOVA Procedure

Class Level Information

| Class | Levels | Values |
|---|---|---|
| PROF | 6 | Administrator Architect Construction Man Construction Tra Engineer Management |

Number of observations 784

NOTE: Due to missing values, only 142 observations can be used in this analysis.

Dependent Variable: RESIST RESIST

| Source | DF | Sum of Squares | Mean Square | F Value | Pr > F |
|---|---|---|---|---|---|
| Model | 5 | 10.69671658 | 2.13934332 | 4.62 | 0.0006 |
| Error | 136 | 62.96538175 | 0.46298075 | | |
| Corrected Total | 141 | 73.66209833 | | | |

| R-Square | Coeff Var | Root MSE | RESIST Mean |
|---|---|---|---|
| 0.145213 | 17.24595 | 0.680427 | 3.945430 |

| Source | DF | Anova SS | Mean Square | F Value | Pr > F |
|---|---|---|---|---|---|
| PROF | 5 | 10.69671658 | 2.13934332 | 4.62 | 0.0006 |

Tukey's Studentized Range (HSD) Test for RESIST

NOTE: This test controls the Type I experimentwise error rate.

| | |
|---|---|
| Alpha | 0.05 |
| Error Degrees of Freedom | 136 |
| Error Mean Square | 0.462981 |
| Critical Value of Studentized Range | 4.08817 |

Comparisons significant at the 0.05 level are indicated by ***.

| PROF Comparison | Difference Between Means | Simultaneous 95% Confidence Limits | | |
|---|---|---|---|---|
| Construction Tra - Administrator | 0.3225 | -0.5684 | 1.2134 | |
| Construction Tra - Construction Man | 0.3823 | -0.7534 | 1.5179 | |
| Construction Tra - Engineer | 0.3891 | -0.4931 | 1.2713 | |
| Construction Tra - Architect | 0.8536 | -0.0237 | 1.7309 | |
| Construction Tra - Management | 0.8600 | 0.0040 | 1.7160 | *** |
| Administrator - Construction Tra | -0.3225 | -1.2134 | 0.5684 | |
| Administrator - Construction Man | 0.0598 | -0.8311 | 0.9506 | |
| Administrator - Engineer | 0.0666 | -0.4647 | 0.5978 | |
| Administrator - Architect | 0.5311 | 0.0080 | 1.0542 | *** |
| Administrator - Management | 0.5375 | 0.0510 | 1.0241 | *** |
| Construction Man - Construction Tra | -0.3823 | -1.5179 | 0.7534 | |
| Construction Man - Administrator | -0.0598 | -0.9506 | 0.8311 | |
| Construction Man - Engineer | 0.0068 | -0.8753 | 0.8890 | |
| Construction Man - Architect | 0.4713 | -0.4060 | 1.3486 | |
| Construction Man - Management | 0.4778 | -0.3782 | 1.3338 | |
| Engineer - Construction Tra | -0.3891 | -1.2713 | 0.4931 | |
| Engineer - Administrator | -0.0666 | -0.5978 | 0.4647 | |
| Engineer - Construction Man | -0.0068 | -0.8890 | 0.8753 | |

| | | | | | |
|---|---|---|---|---|---|
| Engineer | - Architect | 0.4645 | -0.0437 | 0.9726 | |
| Engineer | - Management | 0.4709 | 0.0005 | 0.9414 | *** |
| Architect | - Construction Tra | -0.8536 | -1.7309 | 0.0237 | |
| Architect | - Administrator | -0.5311 | -1.0542 | -0.0080 | *** |
| Architect | - Construction Man | -0.4713 | -1.3486 | 0.4060 | |
| Architect | - Engineer | -0.4645 | -0.9726 | 0.0437 | |
| Architect | - Management | 0.0064 | -0.4548 | 0.4677 | |
| Management | - Construction Tra | -0.8600 | -1.7160 | -0.0040 | *** |
| Management | - Administrator | -0.5375 | -1.0241 | -0.0510 | *** |
| Management | - Construction Man | -0.4778 | -1.3338 | 0.3782 | |
| Management | - Engineer | -0.4709 | -0.9414 | -0.0005 | *** |
| Management | - Architect | -0.0064 | -0.4677 | 0.4548 | |

Means and Descriptive Statistics

| PROF | Mean of RESIST | Std. Dev. of RESIST | Std. Error of RESIST | Variance of RESIST |
|---|---|---|---|---|
| | 3.94543 | 0.72279 | 0.06066 | 0.52243 |
| Administrator | 4.23042 | 0.69070 | 0.13546 | 0.47706 |
| Architect | 3.69934 | 0.69164 | 0.12422 | 0.47836 |
| Construction Manager | 4.17067 | 0.58512 | 0.23888 | 0.34237 |
| Construction Tradesman | 4.55292 | 0.89080 | 0.36367 | 0.79353 |
| Engineer | 4.16383 | 0.90135 | 0.16738 | 0.81244 |
| Management | 3.69291 | 0.43829 | 0.06607 | 0.19210 |

| PROF | Number Non-missing of RESIST | Number Missing of RESIST | Minimum of RESIST | Maximum of RESIST |
|---|---|---|---|---|
| | 142 | 3 | 2.18355 | 6.57993 |
| Administrator | 26 | 1 | 2.35331 | 5.46659 |
| Architect | 31 | 1 | 2.18355 | 4.88590 |
| Construction Manager | 6 | 0 | 3.19872 | 4.97392 |
| Construction Tradesman | 6 | 0 | 3.77175 | 6.09808 |
| Engineer | 29 | 0 | 2.73654 | 6.57993 |
| Management | 44 | 1 | 2.63472 | 5.04748 |

## *I.3 Hypothesis 2: Gender – t-test*

analysed with: Analyse-it + General 1.67

| | | | |
|---|---|---|---|
| **Test** | **Independent samples t-test** | | |
| | RESIST by GENDER: Female ≥ Male | | |
| **Performed by** | Kirsten Davis | **Date** | ################ |

| | | |
|---|---|---|
| **n** | 150 | (cases excluded: 3 due to missing values) |

| RESIST by GENDER | n | Mean | SD | SE |
|---|---|---|---|---|
| **Female** | 36 | 4.1654 | 0.6946 | 0.11577 |
| **Male** | 114 | 3.9159 | 0.7407 | 0.06938 |

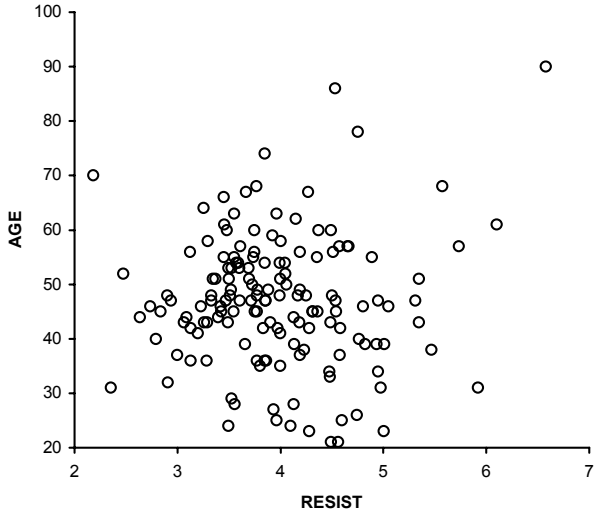
| | | |
|---|---|---|
| **Difference between means** | 0.2494 | |
| **95% CI** | 0.0184 | to +∞ |
| **t statistic** | 1.79 | |
| **1-tailed p** | 0.0380 | |

## *I.4 Hypothesis 3: Age – Pearson's correlation*

analysed with: Analyse-it + General 1.67

| | | | |
|---|---|---|---|
| **Test** | **Pearson correlation** | | |
| | RESIST ≠ AGE | | |
| **Performed by** | Kirsten Davis | **Date** | 11 February 2004 |

| | |
|---|---|
| **n** | 150 (cases excluded: 634 due to missing values) |
| **r statistic** | 0.03 |
| **95% CI** | -0.13 to 0.19 |
| **2-tailed p** | 0.6753 (t approximation) |



## *I.5 Hypothesis 4A: Personality Type S/N – t-test*

analysed with: Analyse-it + General 1.67

| | | | |
|---|---|---|---|
| **Test** | **Independent samples t-test** | | |
| | RESIST by KTSSN: N ≤ S | | |
| **Performed by** | Kirsten Davis | **Date** | ################ |

| | | |
|---|---|---|
| **n** | 140 | (cases excluded: 6 due to missing values) |

| RESIST by KTSSN | n | Mean | SD | SE |
|---|---|---|---|---|
| **N** | 19 | 3.7592 | 0.6065 | 0.13914 |
| **S** | 121 | 4.0420 | 0.7475 | 0.06795 |

| | |
|---|---|
| **Difference between means** | -0.2828 |
| **95% CI** | −∞ to 0.0158 |
| **t statistic** | -1.57 |
| **1-tailed p** | 0.0595 |

## *I.6 Hypothesis 4B: Personality Type T/F – t-test*

analysed with: Analyse-it + General 1.67

| | | | |
|---|---|---|---|
| **Test** | **Independent samples t-test** | | |
| | RESIST by KTSTF: F ≥ T | | |
| **Performed by** | Kirsten Davis | **Date** | ################ |

| | | |
|---|---|---|
| **n** | 142 | (cases excluded: 6 due to missing values) |

| RESIST by KTSTF | n | Mean | SD | SE |
|---|---|---|---|---|
| **F** | 76 | 4.0498 | 0.7557 | 0.08669 |
| **T** | 66 | 3.9257 | 0.7157 | 0.08810 |

| | |
|---|---|
| **Difference between means** | 0.1240 |
| **95% CI** | -0.0814 to +∞ |
| **t statistic** | 1.00 |
| **1-tailed p** | 0.1596 |

## *I.7 Hypothesis 4C: Personality Type J/P – t-test*

analysed with: Analyse-it + General 1.67

| | | | |
|---|---|---|---|
| **Test** | **Independent samples t-test** | | |
| | RESIST by KTSJP: J ≥ P | | |
| **Performed by** | Kirsten Davis | **Date** | ################ |

**n** 141 (cases excluded: 5 due to missing values)

| RESIST by KTSJP | n | Mean | SD | SE |
|---|---|---|---|---|
| **J** | 111 | 4.0134 | 0.7563 | 0.07178 |
| **P** | 30 | 3.7742 | 0.7034 | 0.12842 |

| | |
|---|---|
| **Difference between means** | 0.2392 |
| **95% CI** | -0.0148 to +∞ |

| | |
|---|---|
| **t statistic** | 1.56 |
| **1-tailed p** | 0.0606 |

## *I.8 Hypothesis 4D: Personality Type E/I – t-test*

analysed with: Analyse-it + General 1.67

| | | | |
|---|---|---|---|
| **Test** | **Independent samples t-test** | | |
| | RESIST by KTSEI: E ≠ I | | |
| **Performed by** | Kirsten Davis | **Date** | ################ |

**n** 138 (cases excluded: 5 due to missing values)

| RESIST by KTSEI | n | Mean | SD | SE |
|---|---|---|---|---|
| **E** | 77 | 3.9118 | 0.7281 | 0.08297 |
| **I** | 61 | 4.1005 | 0.7760 | 0.09935 |

| | |
|---|---|
| **Difference between means** | -0.1887 |
| **95% CI** | -0.4427 to 0.0654 |

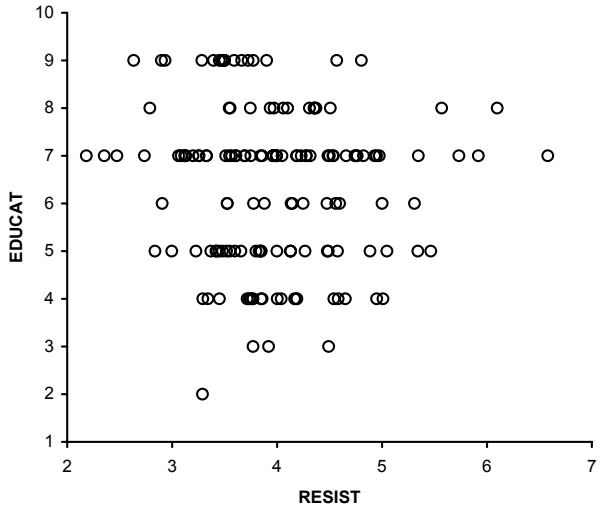
| | |
|---|---|
| **t statistic** | -1.47 |
| **2-tailed p** | 0.1443 |

## *I.9 Hypothesis 5: Education Level – Spearman's correlation*

analysed with: Analyse-it + General 1.67

| | | | |
|---|---|---|---|
| **Test** | **Spearman rank correlation** | | |
| | RESIST ≤ EDUCAT | | |
| **Performed by** | Kirsten Davis | **Date** | 11 February 2004 |

| | |
|---|---|
| **n** | 150 (cases excluded: 634 due to missing values) |
| **rs statistic** | -0.11 |
| **95% CI** | -1.00 to 0.03 |
| **1-tailed p** | 0.0972 (t approximation, corrected for ties) |

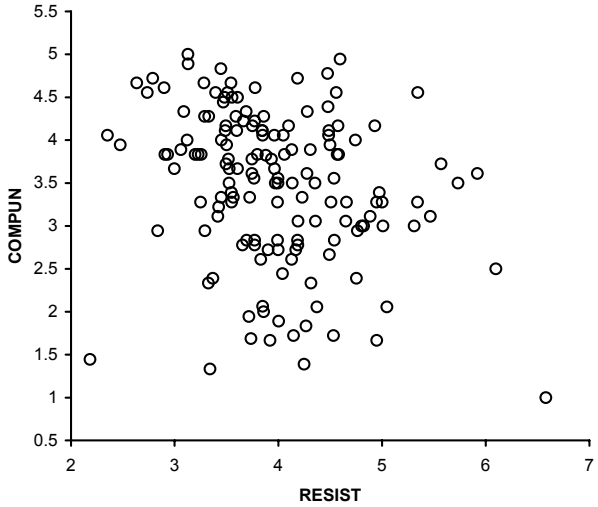


## *I.10 Hypothesis 6: Computer Understanding & Experience – Pearson's correlation*

analysed with: Analyse-it + General 1.67

| | | | |
|---|---|---|---|
| **Test** | **Pearson correlation** | | |
| | RESIST ≤ COMPUN | | |
| **Performed by** | Kirsten Davis | **Date** | 11 February 2004 |

| | |
|---|---|
| **n** | 150 (cases excluded: 634 due to missing values) |
| **r statistic** | -0.27 |
| **95% CI** | -1.00 to -0.14 |
| **1-tailed p** | 0.0004 (t approximation) |



## *I.11 Hypothesis 7A: Perceived Past Information Technology Change – t-test*

analysed with: Analyse-it + General 1.67

| | | | |
|---|---|---|---|
| **Test** | **Independent samples t-test** | | |
| | RESIST by PERPAS: no change ≥ change | | |
| **Performed by** | Kirsten Davis | **Date** | ################ |

**n** 149 (cases excluded: 4 due to missing values)

| RESIST by PERPAS | n | Mean | SD | SE |
|---|---|---|---|---|
| **no change** | 67 | 4.1651 | 0.6760 | 0.08259 |
| **change** | 82 | 3.8261 | 0.7538 | 0.08324 |

| | |
|---|---|
| **Difference between means** | 0.3390 |
| **95% CI** | 0.1427 to +∞ |
| **t statistic** | 2.86 |
| **1-tailed p** | 0.0024 |

## *I.12 Hypothesis 7B: Perceived Future Information Technology Change – t-test*

analysed with: Analyse-it + General 1.67

| | | | |
|---|---|---|---|
| **Test** | **Independent samples t-test** | | |
| | RESIST by PERFUT: no change ≥ change | | |
| **Performed by** | Kirsten Davis | **Date** | ################ |

**n** 149 (cases excluded: 5 due to missing values)

| RESIST by PERFUT | n | Mean | SD | SE |
|---|---|---|---|---|
| **no change** | 109 | 4.0856 | 0.7416 | 0.07104 |
| **change** | 40 | 3.6868 | 0.6478 | 0.10243 |

| | |
|---|---|
| **Difference between means** | 0.3989 |
| **95% CI** | 0.1792 to +∞ |
| **t statistic** | 3.01 |
| **1-tailed p** | 0.0016 |

## *I.13 Hypothesis 8: Prediction of RTCI from Demographics – ANOVA linear model*

The GLM Procedure

Class Level Information

| Class | Levels | Values |
|---|---|---|
| KTSEI | 2 | E I |
| KTSSN | 2 | N S |
| KTSTF | 2 | F T |
| KTSJP | 2 | J P |
| PROF | 6 | Administrator Architect Construction Man Construction Tra Engineer Management |
| GENDER | 2 | 1 2 |
| EDUCAT | 8 | 2 3 4 5 6 7 8 9 |
| PERPAS | 2 | 1 2 |
| PERFUT | 2 | 1 2 |

Number of observations 784

NOTE: Due to missing values, only 108 observations can be used in this analysis.

Dependent Variable: RESIST RESIST

| Source | DF | Sum of Squares | Mean Square | F Value | Pr > F |
|---|---|---|---|---|---|
| Model | 21 | 24.28942247 | 1.15663917 | 2.74 | 0.0006 |
| Error | 86 | 36.24292852 | 0.42142940 | | |
| Corrected Total | 107 | 60.53235099 | | | |

| R-Square | Coeff Var | Root MSE | RESIST Mean |
|---|---|---|---|
| 0.401263 | 16.23230 | 0.649176 | 3.999284 |

| Source | DF | Type III SS | Mean Square | F Value | Pr > F |
|---|---|---|---|---|---|
| KTSEI | 1 | 0.82778833 | 0.82778833 | 1.96 | 0.1647 |
| KTSSN | 1 | 0.00034245 | 0.00034245 | 0.00 | 0.9773 |
| KTSTF | 1 | 0.51586899 | 0.51586899 | 1.22 | 0.2716 |
| KTSJP | 1 | 1.53614425 | 1.53614425 | 3.65 | 0.0596 |
| PROF | 5 | 9.87180095 | 1.97436019 | 4.68 | 0.0008 |
| GENDER | 1 | 0.08089835 | 0.08089835 | 0.19 | 0.6624 |
| EDUCAT | 7 | 2.01394999 | 0.28770714 | 0.68 | 0.6863 |
| PERPAS | 1 | 0.71628776 | 0.71628776 | 1.70 | 0.1958 |
| PERFUT | 1 | 0.30497891 | 0.30497891 | 0.72 | 0.3973 |
| AGE | 1 | 0.02486232 | 0.02486232 | 0.06 | 0.8087 |
| COMPUN | 1 | 2.23493852 | 2.23493852 | 5.30 | 0.0237 |

| Parameter | | Estimate | | Standard Error | t Value | Pr > \|t\| |
|---|---|---|---|---|---|---|
| Intercept | | 3.662057142 | B | 0.65313378 | 5.61 | <.0001 |
| KTSEI | E | -0.209874155 | B | 0.14974824 | -1.40 | 0.1647 |
| KTSEI | I | 0.000000000 | B | . | . | . |
| KTSSN | N | 0.006207767 | B | 0.21777170 | 0.03 | 0.9773 |
| KTSSN | S | 0.000000000 | B | . | . | . |
| KTSTF | F | 0.155030389 | B | 0.14012304 | 1.11 | 0.2716 |
| KTSTF | T | 0.000000000 | B | . | . | . |
| KTSJP | J | 0.372632656 | B | 0.19517641 | 1.91 | 0.0596 |
| KTSJP | P | 0.000000000 | B | . | . | . |
| PROF | Administrator | 0.652334447 | B | 0.25386966 | 2.57 | 0.0119 |
| PROF | Architect | 0.062221444 | B | 0.22573110 | 0.28 | 0.7835 |
| PROF | Construction Man | 0.644158825 | B | 0.39004559 | 1.65 | 0.1023 |
| PROF | Construction Tra | 0.710402503 | B | 0.36590174 | 1.94 | 0.0555 |
| PROF | Engineer | 0.808227153 | B | 0.23103668 | 3.50 | 0.0007 |
| PROF | Management | 0.000000000 | B | . | . | . |
| GENDER | 1 | 0.092453111 | B | 0.21101538 | 0.44 | 0.6624 |
| GENDER | 2 | 0.000000000 | B | . | . | . |
| EDUCAT | 2 | -0.621463476 | B | 0.73945074 | -0.84 | 0.4030 |
| EDUCAT | 3 | 0.094108461 | B | 0.58680794 | 0.16 | 0.8730 |
| EDUCAT | 4 | -0.050331401 | B | 0.31885738 | -0.16 | 0.8749 |
| EDUCAT | 5 | 0.236076578 | B | 0.29267736 | 0.81 | 0.4221 |
| EDUCAT | 6 | 0.395055011 | B | 0.33103179 | 1.19 | 0.2360 |
| EDUCAT | 7 | 0.223169678 | B | 0.24456174 | 0.91 | 0.3640 |
| EDUCAT | 8 | 0.143345952 | B | 0.29777193 | 0.48 | 0.6315 |
| EDUCAT | 9 | 0.000000000 | B | . | . | . |
| PERPAS | 1 | 0.206852665 | B | 0.15866450 | 1.30 | 0.1958 |
| PERPAS | 2 | 0.000000000 | B | . | . | . |
| PERFUT | 1 | 0.144488563 | B | 0.16984821 | 0.85 | 0.3973 |
| PERFUT | 2 | 0.000000000 | B | . | . | . |
| AGE | | 0.001517204 | | 0.00624648 | 0.24 | 0.8087 |
| COMPUN | | -0.218273084 | | 0.09478286 | -2.30 | 0.0237 |

NOTE: The X'X matrix has been found to be singular, and a generalized inverse was used to solve the normal equations. Terms whose estimates are followed by the letter 'B' are not

uniquely estimable.

## Appendix J. Personal Change Profile

## *J.1 Cover Letter*

Virginia Tech
VIRGINIA POLYTECHNIC INSTITUTE
AND STATE UNIVERSITY

**The Vecellio Construction Engineering and Management Program**

The Charles E. Via, Jr. Department of Civil and
Environmental Engineering
200 Patton Hall, Blacksburg, Virginia 24061-0105

March 19, 2004

Thank you very much for your help with our research project entitled "Understanding Information Technology Change." The project has been successfully completed. The project findings have implications on how companies in the Architecture, Engineering, and Construction (AEC) industry deal with information technology changes.

As you requested, I have enclosed your personal change profile. I hope this will provide valuable insight for you about how you view information technology and change.

A complete document containing the results of this project should be available in the summer of 2004 through the library of Virginia Tech. If you have internet access and desire to view the document, you may search by author (use *Davis Kirsten A*) on their website: http://addison.lib.vt.edu/addison2.2/vtls-basic.html You will need Adobe Acrobat Reader on your computer to view the document.

Again, thank you very much for your time and help with this project.

Sincerely,

Kirsten A. Davis
Principal Investigator

Dr. Anthony Songer
Faculty Advisor

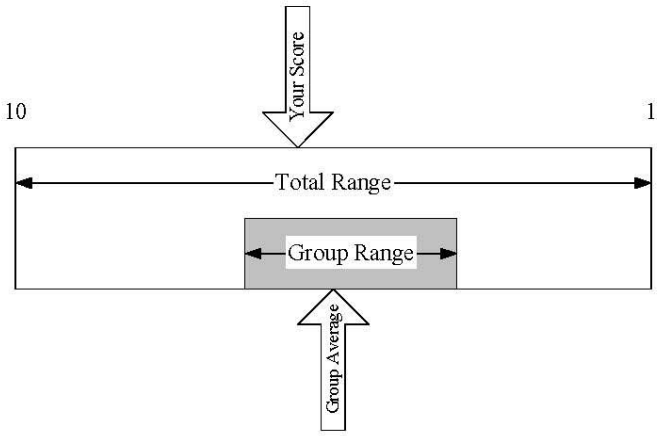
## *J.2 Personal Change Profile*

### Understanding Information Technology Change: A Research Study
### Personal Change Profile

In all figures, the left end indicates lower resistance to change and the right end indicates higher resistance to change. A reference list is provided on the last page if you would like to learn more about any of the change measures shown here. Thanks again for your help with this project!

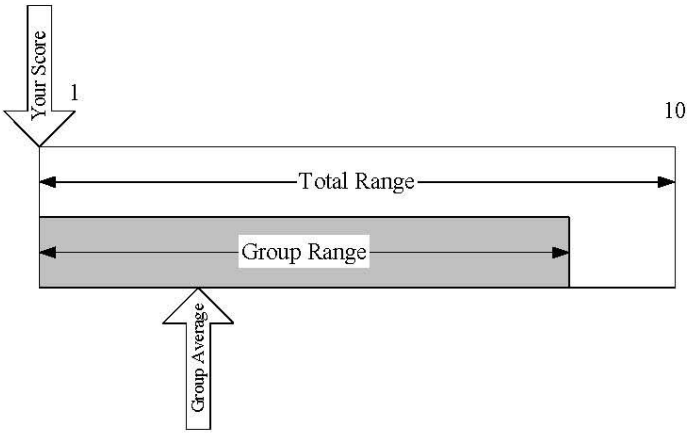
**Reaction-to-Change Inventory (De Meuse and McDaris 1994)**

The Reaction-to-Change Inventory measures an individual's perceptions about change. Higher scores indicate stronger support for change and lower scores indicate stronger resistance to change.




**Adaptive Defense Mechanisms (Bovey and Hede 2001)**

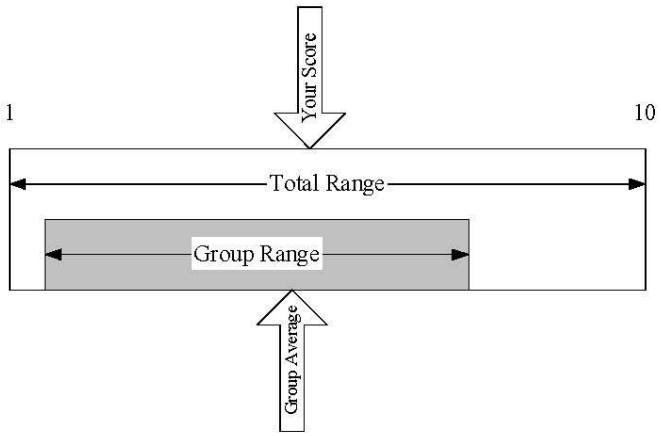
Adaptive defense mechanisms are generally unconscious responses to perceived danger and include humor and anticipation of change. Lower scores indicate stronger support for change and higher scores indicate stronger resistance to change.




Personal Change Profile Page 1

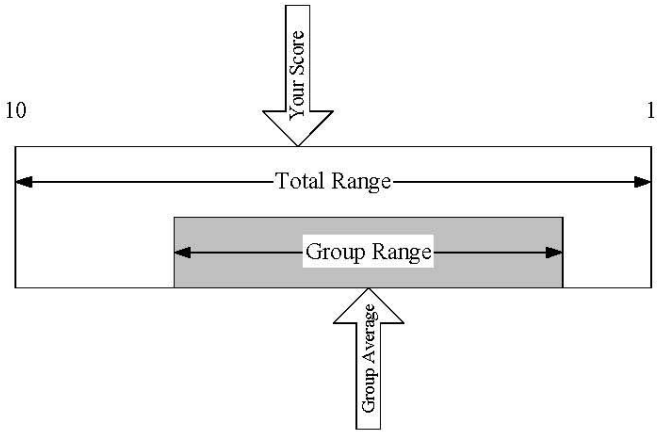
**Irrational Belief Scale (Malouff and Schutte 1986)**

The Irrational Belief Scale measures the level of irrational ideas about change a person might have. Lower scores indicate stronger support for change and higher scores indicate stronger resistance to change.




**The Change Scale (Trumbo 1961)**

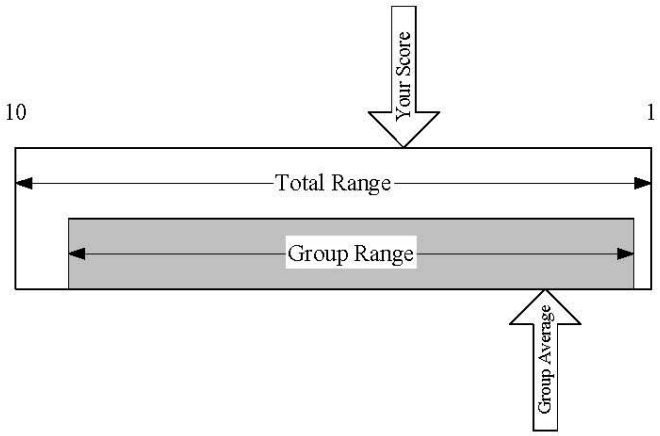
The Change Scale indicates a person's attitudes toward change. Higher scores indicate stronger support for change and lower scores indicate stronger resistance to change.




Personal Change Profile Page 2

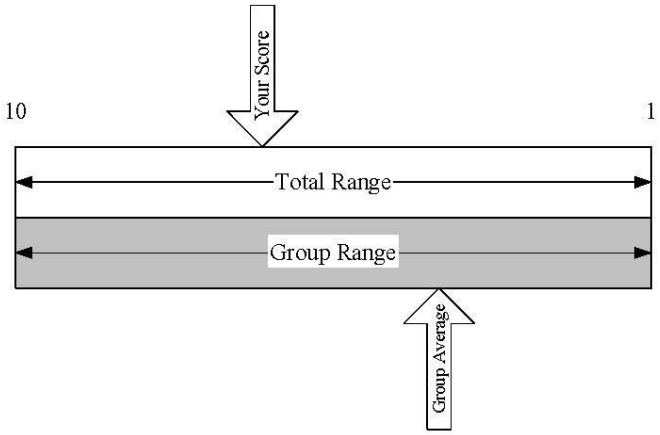
**Motivation to Use New Technologies**

An individual's motivation to use new technology indicates what their likely reaction to the new technology will be. A strong motivation to use the new technology can overcome many difficulties, whereas a strong motivation not to use the technology can cause an individual to build additional barriers as protection. Higher scores indicate stronger support for change and lower scores indicate stronger resistance to change.




**Support for Change Questionnaire (Maurer 1996)**

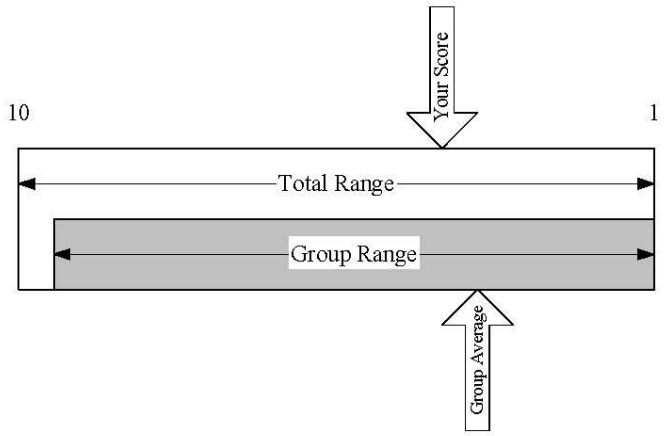
The Support for Change Questionnaire indicates a person's perception of whether their organization supports or opposes change. Higher scores indicate stronger support for change and lower scores indicate stronger resistance to change.




Personal Change Profile Page 3

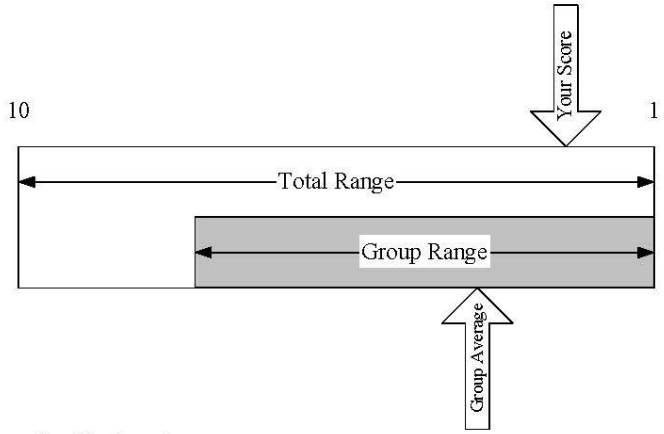
**Computer Attitude Scale (Loyd and Gressard 1984)**

The Computer Attitude Scale indicates a person's feelings about the impact of computer in society and their understanding of computers. Three types of attitudes are represented in this scale: computer anxiety, computer liking, and computer confidence. Higher scores indicate stronger support for change and lower scores indicate stronger resistance to change.




**Emotional Intelligence – Personal Power (Cooper and Sawaf 1997)**

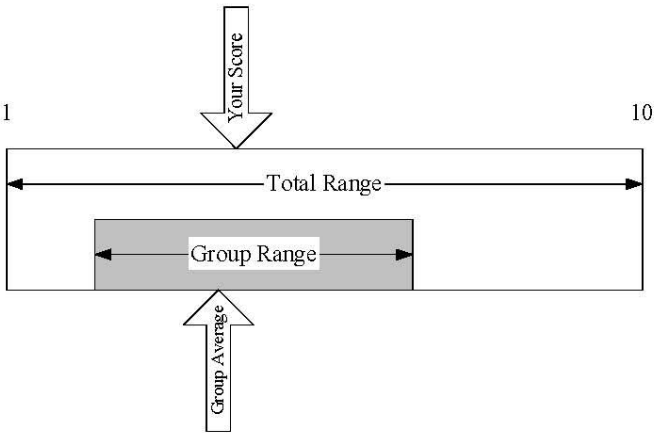
The Emotional Intelligence EQ Map subscale indicating Personal Power indicates a person's perception of their referent power. A person with high personal power can influence decisions and use manipulation to successfully resist changes. Higher scores indicate stronger support for change and lower scores indicate stronger resistance to change.




Personal Change Profile Page 4

**Resistance to Change Index**

The Resistance to Change Index measures a person's likelihood to resist an information technology change. Lower scores indicate stronger support for change and higher scores indicate stronger resistance to change.

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## Vita

## Kirsten A. Davis

Kirsten A. Davis was born on November 4, 1969 in Seattle, Washington, the daughter of Jeri and Jack Davis. She graduated from Farragut High School in Knoxville, Tennessee in 1987. She studied architecture at the University of Tennessee - Knoxville, graduating Cum Laude in the spring of 1992 with a Bachelor of Architecture. She continued her studies at the University of Tennessee - Knoxville, graduating Magna Cum Laude with a Bachelor of Science in Civil Engineering in the spring of 1994. She then accepted a joint architecture/civil engineering position at the Sear-Brown Group in Albany, New York, where she worked full-time on a variety of assignments, including public school design, construction administration, and highway engineering. She returned to school in the fall of 1998, earning a Master of Science degree in Civil Engineering specializing in Construction Engineering and Management in December of 1999 from the University of Colorado – Boulder. She began her doctoral studies at the University of Colorado – Boulder under the direction of Dr. Anthony D. Songer. She transferred to Virginia Polytechnic Institute and State University in the spring of 2001 when Dr. Songer relocated to Blacksburg, Virginia. At Virginia Polytechnic Institute and State University, she was selected as both a Marion Via Doctoral Fellow and a Cunningham Fellow. Upon completion of her Ph.D. in Civil Engineering specializing in Construction Engineering and Management in May of 2004, Kirsten intends to begin a career teaching at the University level in the field of construction management.