ASSESSING INDIVIDUALS' RESISTANCE PRIOR TO IT IMPLEMENTATION IN THE AEC INDUSTRY

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ABSTRACT

Ever increasing technological capabilities exist in the architecture/engineering/construction (AEC) industry. Email, project specific websites, Computer Aided Drafting (CAD), animations, and Building Information Modeling (BIM) are but a few information 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.

In general, the AEC industry is extremely slow to embrace available information technology. Companies often have difficulty with technology implementations because technology is the driver of change, rather than an enabler of change. Resistance of people is the primary reason for failure of any organizational change, including an information technology change. Technological changes will be more successful when researchers develop a fundamental understanding of how people change. Studying individuals and their change processes is essential to improving implementation of technology change, yet change management theories present processes and guidelines for changing organizations and tasks with limited emphasis on individuals involved in change. This research uses a people centered paradigm for developing technology implementation models, placing technology in a change enabling position rather than being a driver of change.

This research investigates individuals' resistance to change brought about by new information technology implementation in the AEC industry. Resistance to change is a combination of three factors: cause of resistance, level of resistance, and manifestation of resistance. Previous work investigated the importance of specific behavioral characteristics indicative of resistance to change and correlated these characteristics to the level of resistance in individuals. This paper discusses methodology continuing this work, which aims to confirm the previous work, as well as to develop and validate new predictive tools to identify potential resisters prior to an information technology change implementation. The results from analysis of preliminary data are also discussed.

KEYWORDS

Resistance, Change Management, Information Technology, Technology.

1. INTRODUCTION

Ever increasing information technology capabilities exist in the AEC industry. Email, project specific websites, Computer Aided Drafting (CAD), animations, and Building Information Modeling (BIM) exemplify technologies adopted in recent years within the industry. In general, the AEC industry is extremely slow to embrace available information technology (Emond 1999; Gambatese et al. 2007; 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[9], stabilization is unlikely to occur in the next several years (Intel Corporation 2008). This places financial implications on new technology adoptions, limiting their introduction into the AEC industry (Allen et al. 2005).

[9] 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 2008). In common usage, it implies that information technology development continues to dramatically improve at an exponential rate.

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, unsuccessful information technology adoption originates from too much emphasis on technology and too little focus on people. 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 change organizations (Kingsford 1964). 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, CAD, or BIM are implemented in an organization, they affect the way work is done. "[C]hanges in *Technology* will alter the nature of the *Tasks* and *vice versa*; changes in the tasks to be done will affect the *People* and *vice versa*; changes in people change the *Organization* and *vice versa*" (Sutton and Sutton 1990). Frequently, when new information technology is introduced, 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.

Change theory provides a theoretical framework for investigating individual resistance to the implementation of information technologies. Current change models 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). Within the AEC industry, Peansupap and Walker (2005) reviewed 24 recent IT adoption studies. Nearly all were noted to have issues with what they termed 'individual and social issues' and ten studies specifically mentioned issues with individuals resisting the IT change. Cultural issues such as these continue to be a major barrier to IT implementation in the AEC industry (Rojas and Locsin 2007; Ruikar et al. 2005), yet they are 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). The existing change models have limitations, particularly with respect to cultural issues. These limitations have a direct effect on the successfulness of implementation of information technology changes in the AEC industry.

To address these challenges, this paper discusses a plan of work aimed at identifying resisters prior to the implementation of an information technology innovation. Working closely with industry organizations, this research investigates adoption of information technologies by individuals in organizations within the AEC industry and studies the impact of the adoption on communication, productivity, and processes through analysis of existing models of implementation. The project promotes a realignment of cultural and technological implementation issues through the development of prediction models aimed at identifying technology resisters prior to technology adoption, a step towards developing new organizational change models.

2. OBJECTIVES

The goal of this research is to develop new knowledge in the areas of social implications of information technology, change management, and attitude-behavior theory. This work integrates and extends previous research in cultural aspects of information technology implementation. Specific research objectives for this project include:

- Isolate attitudes, fears, and beliefs that are indicative of resistance to information technology change within individuals in the AEC industry;
- Estimate the intensity of resistance an individual is likely to exhibit using the personality traits and behavioral characteristics identified;
- Identify any variances that exist between different demographic groups based on the estimates of intensity of resistance likely to be exhibited; and
- Predict likely resisters prior to technology adoption based on demographics.

3. PLAN OF WORK

A typical construction project involves three parties: owners, designers, and constructors. Owners often require designers and constructors to use specific information technologies when working on their project, such as a project website or a specific CAD program. This seemingly simple owner's

requirement forces multiple organizations to comply and adopt what is often a new technology for them. This, in turn, trickles down to the employees of these organizations who now must adopt the new technology, often without having any say in the decision process – a less than ideal situation. Identifying which employees are likely to resist this adoption and addressing their resistance immediately is crucial to successful implementation of the technology, but can also be crucial to the success of the project as a whole. The AEC industry is ideal for studying this resistance, as it has a reputation of not being particularly receptive to the introduction of new information technologies.

This research examines AEC projects with owner-required technologies. The employees of multiple organizations involved in each project are surveyed to benchmark their initial level of resistance at the beginning of the project. These individuals are tracked longitudinally to ascertain the type of resistance (passive or active) exhibited and whether their resistance increases, decreases, or is constant over time. Resistance levels are measured with the Resistance to Change Index (Davis 2004; Davis and Songer 2008) and are validated through qualitative methods, including interviews and direct observations. Using the level of resistance and basic demographic information regarding each individual, regression analysis enables the prediction of likely resisters prior to technology adoption.

The plan of work is comprised of two phases: (1) Assessment, and (2) Analysis & Prediction. The first phase assesses, documents, benchmarks, and validates individuals' likelihood of resistance and its intensity. The second phase analyzes the relationships between social variables and demographics of the individual to identify relationships that exist, enabling prediction of resistance. Phase II also develops and validates new predictive tools to enable more successful information technology implementation in the AEC industry.

3.1 PHASE I: ASSESSMENT

Phase I addresses the first two objectives of the study, which are (1) to isolate attitudes, fears, and beliefs that are indicative of resistance to information technology change within individuals in the AEC industry and (2) to estimate the intensity of resistance an individual is likely to exhibit using the personality traits and behavioral characteristics identified.

The Social Architecture Factor Model illustrated in Figure 3 and developed by the researcher (Davis 2004) guides the investigation into individual change with a focus on the cultural aspects. The initial framework of the model, shown in white, 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. 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.

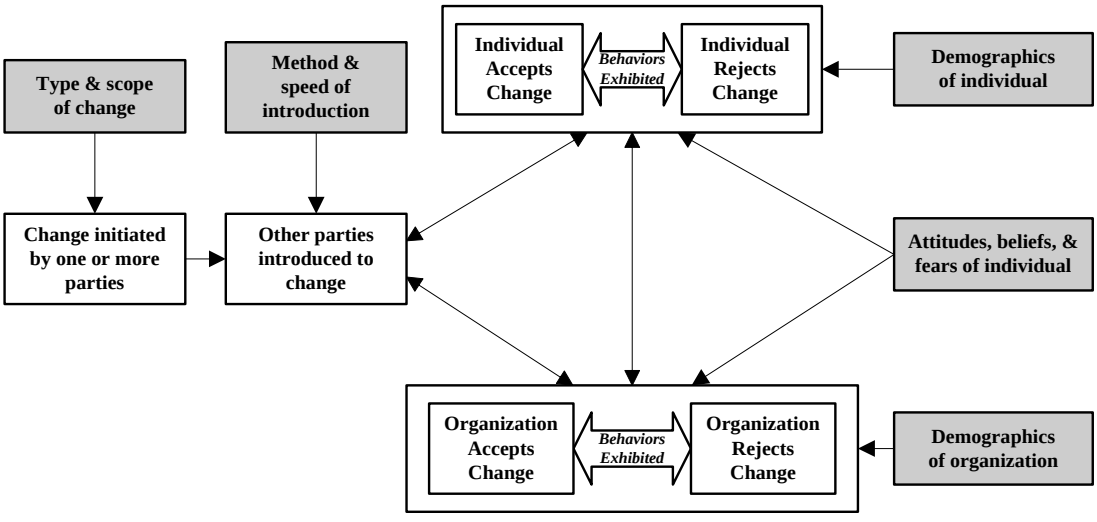

Figure 3. Social Architecture Factor Model

The basic change process model was augmented through a rigorous 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 (all of Figure 3). This model illustrates the change process from an individual perspective.

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. An in-depth discussion of the specific factors for technological change identified in each of these categories and the associated literature is available in Davis (2004).

Using the social architecture factor model, a prior study (Davis 2004; Davis and Songer 2008) created and tested a Resistance to Change Index (RTCI), providing estimations of the intensity of resistance an individual is likely to exhibit during an information technology change. This project uses the Resistance to Change Index to measure the level of resistance during an information technology change. Phase I of the project collects data from the established relationships of resistance to change (the right side of Figure 4) and validates the level of resistance (the center of Figure 4). Phase II investigates the hypothesized relationships between the demographic variables (the left side of Figure 4) and the Resistance to Change Index (the center of Figure 4) and uses these relationships to predict resisters. Existing data indicate that these relationships do exist. For example, prior work (Davis 2004; Davis and Songer 2004) found that individuals do have a different likelihood of resistance based on their profession, gender, computer understanding and experience, and awareness of past or future changes occurring in their company. Relationships between the RTCI and other demographics including age, education level, and personality type, were either not supported or were inconclusive, in part due to the size of the study. Data from this work also supported predictions of RTCI from demographic variables, although no prediction models were created.

3.1.1 BACKGROUND – RESISTANCE TO CHANGE INDEX

The Resistance to Change Index is made up of seven factors that represent nine variables (the right side of Figure 4): Attitudes towards computers and information technology, Motivation to use new technology, Readiness for change, Irrational ideas, Defense mechanisms related to the behavior of an individual during change, Perceived interpersonal power, and Perceived support for change. The relevance of each factor included in the Index and the process by which these factors were combined to create the RTCI (the center of Figure 4) is discussed below.

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 is measured with the Computer Attitude Scale (CAS) (Loyd and Gressard 1984). Three types of attitudes are represented in this scale: computer anxiety, computer liking, and computer confidence. A positive attitude towards computers is an indication of lower resistance towards technological change and vice-versa.

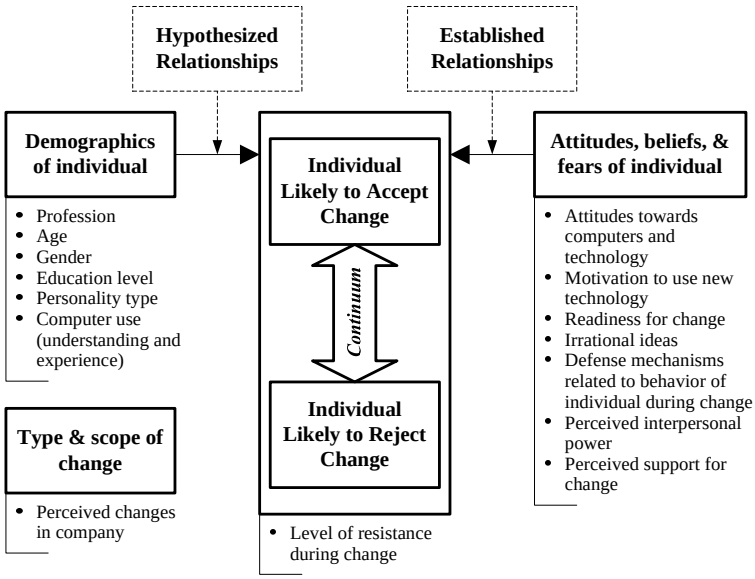

Figure 4. Level of Resistance to Information Technology Change

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 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 are used: 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).

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) is used for measurement. 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 included 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 (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) is included 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 are 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 included for measurement of an organization's support for change is the Support for Change Questionnaire (Maurer 1996). 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 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 scale of each variable was algebraically modified to a common 1 to 10 scale indicating resistance to information technology change in a common direction. One (1) is representative of a low resistance to change and ten (10) is representative of a high resistance to change for each individual variable in the common scale.

Regression analysis and factor analysis were evaluated to establish weighting of the variables and both failed to provide an appropriate method. Therefore, each of the variables was given equal weight in the RTCI. The index takes the average value of the nine variables, after the algebraic modifications to a common scale and common direction are performed. 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.

3.1.2 TASK 1 – DATA COLLECTION

The first phase of this project involves extensive data collection. Data collection techniques include self-report surveys, individual structured interviews, researcher observation, and document analysis. Table 2 depicts the general data collection techniques, whether they are assessing the individual or the organization, how they relate to the Social Architecture Factor Model (Figure 3), and the purpose and expected outcome for each collection activity.

Self-report surveys are used to benchmark the initial level of resistance at the beginning of a construction project that has an owner-required technology using the Resistance to Change Index. The sample includes employees of architecture, engineering, contractor, and construction management organizations involved in the project that are affected by the technology. All positions and all levels within each AEC organization affected by the change are included in the sample, as technological changes in the industry can affect all employees within an organization. To validate the appropriateness and accuracy of the initial self-report survey, individual structured interviews will be performed with random members of the sample population. These interviews also allow the researcher to gain additional information regarding the anticipated change beyond that measured in the self-report survey. To date, preliminary data collection using self-report surveys has been completed.

Table 2. General Data Collection Techniques

Data Collection Activity	**Assessing?**	**Target Area of Social Architecture Factor Model**	**Purpose/Expected Outcome**
Self-report surveys	Individuals	Demographics of individual; Attitudes, beliefs, & fears of individual; Expected behaviors exhibited by individual	Provides a sense of how each individual perceives the change and how they believe they will handle it
Individual structured interviews	Individuals	Attitudes, beliefs, & fears of individual; Expected behaviors exhibited by individual	Provides a sense of how each individual perceives the change and how others are perceived to change. Also verifies or refutes the survey information
Researcher observation	Individuals	Attitudes, beliefs, & fears of individual; Actual behaviors	Provides a general sense of the environment and verifies or refutes

Data Collection Activity	Assessing?	Target Area of Social Architecture Factor Model	Purpose/Expected Outcome
		exhibited by individual	the interviews and surveys
Individual structured interviews	Organizations	Expected behaviors exhibited by organization	Provides a sense of how the organization perceives the change
Researcher observation	Organizations	Actual behaviors exhibited by organization	Provides a general sense of the environment and verifies or refutes the interviews
Document analysis	Organizations	Type & scope of change; Method & speed of introduction; Demographics of organization; Expected behaviors exhibited by organization; Actual behaviors exhibited by organization	Provides explicit information about the environment in terms of rules, regulations, and acceptable behaviors and standards. Also verifies or refutes the interviews

Individuals will be tracked longitudinally to ascertain whether their resistance increases, decreases, or is constant over time. Resistance levels will again be measured with the Resistance to Change Index and will be validated through qualitative methods, including interviews and observations by the researcher. The interviews and observations also allow the type of resistance (passive or active) exhibited to be determined. Data will be collected from the sample population approximately every 3-4 months for a minimum of one year.

To ensure that the influence of organizations is recognized in the change process, data collection will also be done at the organizational level. Individual structured interviews will be performed with company executives, owners, and IT staff from each participating organization at 3-4 month intervals to collect data regarding their impressions of the status of the technology change, their opinions regarding the success of the change at that point, and any lessons learned to date. Observations by the researcher will validate these interviews.

Finally, document analysis will be performed, beginning with the change initiation, to track the change process from the organizational perspective. The type and scope of the change, the method and speed of the introduction, and the demographics of each organization involved will be included in the document analysis. The type and scope of the change is dictated by the owner and is therefore the owner-required information technology on the project. The method and speed of introduction will vary from one company to the next within the scope of the project and will need to be assessed for each participating organization. Organizational demographics will likewise vary from company to company and each will be assessed individually. Additionally, within each organization, specific aspects that will be sought include training available, the reward and punishment system used, and any support provided by the organization (as perceived by the organization). These aspects help establish the corporate culture and management style of each participating company. The document analysis also provides validation of the organizational aspects measured through the interviews of executives, owners, and IT staff.

3.2 PHASE II: ANALYSIS & PREDICTION

Phase II addresses the third and fourth objectives of the study, which are (3) to identify any variances that exist between different demographic groups based on the estimates of intensity of resistance likely to be exhibited and (4) to predict likely resisters prior to technology adoption based on demographics.

Using the results of the Phase I data collection, which benchmarks individuals' likelihood of resistance and its intensity, Phase II consists of two tasks. Task 1 analyzes the data to examine patterns and relationships between social variables and demographics of the individual. Task 2 is the development and validation of a new prediction tool to identify likely resisters prior to technology adoption. Such a prediction tool will be invaluable to organizations when planning and implementing change models. Additionally, a comprehensive understanding of individual resistance levels is critical prior to investigating group, project team, and organizational change models and resistance.

3.2.1 TASK 1 – DATA ANALYSIS

This task within Phase II investigates the hypothesized relationships between the demographic variables (the left side of Figure 4) and the Resistance to Change Index (the center of Figure 4). The demographic variables under consideration are: profession, gender, age, personality type, education level, computer understanding and experience, and perceived past and future information technology changes. Statistical tests compare the RTCI values obtained from different demographic groups represented in the sample population.
The main statistical methods used are ANOVA, t-tests, and correlation tests. One-way ANOVA methods are used to compare the mean RTCI values of the different professions to determine whether any groups differ and the method is most appropriate for tests involving three or more groups. If a statistical difference is found (i.e., at least one group differs), Tukey's multiple comparison test is used to compare each group with each of the other groups to determine which groups differ on the mean RTCI value. The t-test is used to compare the RTCI values for several of the demographic groups to determine if any groups differ. While similar to ANOVA, the t-test provides more concise information when only two groups are involved in a test. Specifically, the t-test is used to compare mean RTCI values for demographic variables with two categories such as gender (male/female) and perceived changes (change/no change). The t-test can also provide information on which mean value is larger and which is smaller, if a difference exists. The remainder of the demographic variables use correlation tests for testing possible relationships with RTCI. Correlation tests discern the level of dependence/independence that two variables have with each other. Continuous variables, such as age and computer use, are tested by using Pearson's correlation test. Ordered variables, such as education level, use Spearman's correlation test.

Based on preliminary data collected, demographics that indicate high likelihood of resistance to IT change are gender (female), computer understanding and experience (low), past IT changes (none experienced), future IT changes (not aware of any planned), and profession (construction trades). Individuals in these demographic groups appear to be more likely to resist IT 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, though this has not been tested to date. Demographics that indicate low likelihood of resistance to IT change are gender (male), computer understanding and experience (high), past IT changes (at least one experienced), future IT changes (aware of at least one planned), and profession (management or architect). These individuals are less likely to resist IT changes than individuals who are not a member of any of these groups. Likewise, 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. Age, education level, and personality type have no relationship with resistance to IT change based on the data collected to date.
Additional data analysis includes an examination of the data from a longitudinal perspective and will be a more qualitative analysis. Individuals will be analyzed longitudinally to understand how their resistance may have changed over time, the type of resistance they presented (passive or active), if any, and whether that is related to organizational aspects, such as the corporate culture, management style, training provided, rewards and/or punishments enacted, and support provided by the organization.

3.2.2 TASK 2 – PREDICTION TOOL

Following completion of further data collection and analysis, a prediction tool will be created to enable more successful information technology implementation in the AEC industry. This task within Phase II develops and validates this new predictive tool. Using the level of resistance and basic demographic information regarding each individual, regression analysis will be performed to enable predictions of likely resisters prior to technology adoption.

Based on the results from the data analysis in Task 1, appropriate demographic information regarding each individual will be chosen and included in the regression analysis. Likewise, demographic information which does not appear to have a relevant relationship with the Resistance to Change Index (based on the analysis discussed above) will be excluded from the regression analysis. Additionally, the model should not only address the demographic information of the individual, but also any relevant organizational modifiers (i.e., corporate culture and management styles), as determined from the qualitative data analysis.

Depending on the final demographic variables included, an appropriate modeling technique will be used in the development of the prediction tool. Linear regression modeling is a fundamental technique relating independent variables (X_1, X_2, … X_{K-1}) with a dependent variable (Y) in a linear fashion. If the relationship is not linear, a nonlinear estimation is a more general modeling technique that can be used to relate independent variables with a dependent variable. If the independent variables are categorical and include more than two options, an ANOVA linear model is more appropriate than a regression model.

Using the preliminary data collected, a linear regression test was performed with an ANOVA linear model to determine if a prediction was possible using the demographic variables discussed above. Based on this test, prediction of RTCI is possible (p-value = 0.0006).

To validate the prediction model that is created, additional survey data sets will be collected and input into the optimum model. The results will be analyzed to compare the two populations. The method for testing the model involves entering data from these test cases into the equations and comparing the actual results to the predicted results. The model is considered valid if the predicted values are within an acceptable range for practical application. It is not crucial that the model predicts with 100% accuracy, but rather that it conveys meaningful information to organizations regarding individuals' resistance to information technology change. Although the model need not be 100% accurate, it still must be accurate enough to make reasonable predictions.

4. CONCLUSION

Identifying likely resisters prior to the adoption of a compulsory technology innovation aids organizations in accommodating the resistance as it occurs. The predictive tools that will result from this work promote sustainable implementation of IT within AEC organizations and multi-organizational project teams. 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 both researchers and practitioners to understand how new technologies should be introduced within organizations. Additionally, providing companies in the industry with the ability to identify their potential resisters using more than stereotypes is the first step in helping ensure that new IT implementations succeed. This, in turn, enhances the responsiveness of AEC organizations to market needs and global competitiveness. Therefore, the research, at its completion, will significantly impact individuals and organizations within the AEC industry.

Once complete, the work will add to the theories related to adoption and diffusion of innovations, as well as to attitudinal-behavioral theories. Additionally, the process and predictive tools outlined in this study are scalable to all organizations involved in complex, multi-participant, project driven domains.

REFERENCES

Allen, R. K., Becerik, B., Pollalis, S. N., and Schwegler, B. R. (2005). "Promise and Barriers to Technology Enabled and Open Project Team Collaboration." Journal of Professional Issues in Engineering Education and Practice, 131(4), 301-311.

Bovey, W. H., and Hede, A. (2001a). "Resistance to organisational change: the role of defence mechanisms." Journal of Managerial Psychology, 16(7), 534-548.

Bovey, W. H., and Hede, A. (2001b). "Resistance to organizational change: the role of cognitive and affective processes." Leadership and Organization Development Journal, 22(8), 372-382.

Cleveland, A. B., Jr. (1999). "Knowledge Management: Why It's Not an Information Technology Issue." Journal of Management in Engineering, 15(6), 28.

Cooper, R. K., and Sawaf, A. (1997). Executive EQ: emotional intelligence in leadership and organizations, Penguin Putnam Inc., New York.

Davis, K. A. (2004). "Information Technology Change in the Architecture, Engineering, and Construction Industry: An Investigation of Individuals' Resistance," Ph.D. dissertation, Virginia Polytechnic Institute and State University, Blacksburg, VA.

Davis, K. A., and Songer, A. D. (2004). "Individuals' Resistance to IT Implementation in the AEC Industry." CIB World Building Congress 2004, Toronto, Ontario, Canada, NRCC-IRC - National Research Council Canada - Institute for Research in Construction, Ottawa, Canada, 716.1-716.9.
Davis, K. A., and Songer, A. D. (2008). Resistance to IT Change in the AEC Industry: an Individual Assessment Tool, Journal of Information Technology in Construction, 13(4), 56-68, http://www.itcon.org/2008/4
De Meuse, K. P., and McDaris, K. K. (1994). "An Exercise in Managing Change." Training and Development Journal, 48(2), 55-57.
Emond, M. (1999). "Trends in Construction." ConstrucTECH, Winter, 15-23.
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.
French, J. R. P., and Raven, B. (1959). "The Basis of Social Power." Studies in Social Power, D. Cartwright, ed., Institute for Social Research, University of Michigan, Ann Arbor, 150-167.
Gambatese, J., Hallowell, M., and Sillars, D. N. (2007). "Benchmark of Innovation in the Architecture/Engineering/Construction Industry." 2007 ASCE Construction Research Congress, Freeport, Bahamas, ASCE, Reston, VA, 150.1-150.8.
Heinssen, R. K., Jr, Glass, C. R., and Knight, L. A. (1987). "Assessing computer anxiety: development and validation of the computer anxiety rating scale." Computers in Human Behavior, 3, 49-59.
Intel Corporation. (2008). "Moore's Law." Intel Corp. <http://www.intel.com/technology/mooreslaw/index.htm> (Jan 19, 2008).
Kingsford, P. W. (1964). Engineers, Inventors and Workers, St Martin's Press, New York.
Loyd, B. H., and Gressard, C. (1984). "Reliability and Factorial Validity of Computer Attitude Scales." Educational and Psychological Measurement, 44(2), 501-505.
Malouff, J. M., and Schutte, N. S. (1986). "Irrational Belief Scale." Sourcebook of Adult Assessment Strategies (1995), N. S. Schutte and J. M. Malouff, eds., Plenum Press, New York, 432-435.
Maurer, R. (1996). "Working with Resistance to Change: The Support for Change Questionnaire." The 1996 Annual: Volume 2, Consulting, J. W. Pfeiffer, Ph.D., J.D., ed., Pfeiffer & Co., San Diego, CA, 161-174.
Maurer, R. (1997). "Transforming resistance." HR Focus, 74(10), 9-10.
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.
Parsons, C. K., Liden, R. C., O'Connor, E. J., and Nagao, D. H. (1991). "Employee Responses to Technologically-Driven Change: The Implementation of Office Automation in a Service Organization." Human Relations, 44(12), 1331-1356.
Peansupap, V., and Walker, D. H. T. (2005). Factors Enabling Information and Communication Technology Diffusion and Actual Implementation in Construction Organisations, Journal of Information Technology in Construction, 10(14), 193-218, http://www.itcon.org/2005/14/
Rojas, E. M., and Locsin, S. (2007). "Integrated Practice: The Road Ahead." 2007 ASCE Construction Research Congress, Freeport, Bahamas, ASCE, Reston, VA, 77.1-77.8.
Rosenbaum, D. B., and Schriener, J. (2000). "Company Cultures Viewed as Threat to Web Collaboration." Engineering News Record, 244(19), 19.
Ruikar, K., Anumba, C. J., and Carrillo, P. M. (2005). "End-user perspectives on use of project extranets in construction organisations." Engineering Construction and Architectural Management, 12(3), 222-235.
Songer, A. D., Young, R. K., and Davis, K. A. (2001). "Social Architecture for Sustainable IT Implementation in AEC." CIB-W78 International Conference: IT in Construction in Africa, Mpumalanga, South Africa, CSIR, Pretoria, South Africa, 17.1-17.14.
Steier, L. P. (1989). "When technology meets people." Training and Development Journal, 43(8), 27-29.
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.
Trumbo, D. A. (1961). "Individual and Group Correlates of Attitudes Toward Work-Related Change." Journal of Applied Psychology, 45(5), 338-344.
U.S. Department of Labor. (1988). "Technological Change and Its Labor Impact on Four Industries: Contract construction/Railroad transportation/Air transportation/Petroleum pipeline transportation." Bulletin 2316, Bureau of Labor Statistics, U.S. Government Printing Office, Washington, D.C.