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Resistance to IT Change in the AEC Industry: An Individual Assessment Tool

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SUMMARY: *Numerous IT adoption studies within the AEC industry identify issues with individuals resisting IT changes. Current change models often only look at organizations and tasks and frequently neglect the individuals involved. The limitations in existing change models and the criticality of people issues in the successful implementation of change necessitates the investigation of individual resistance to IT change.*

Change management theory and attitude-behavior connections provide a framework to study variables associated with impeding/promoting the use of technologies. Data collected from a 50-person sample of the AEC population allowed reductions of the attitudes, fears, and beliefs variables. Reducing the variables indicative of resistance to information technology change facilitated the creation of a detailed social architecture factor model. Subsequently, 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.

The RTCI assists practitioners in developing new technology implementation plans. The RTCI also enables researchers to understand how individual participants resist and adapt to change allowing the development of enhanced organizational adoption models for new technology implementation within the building industry.

KEYWORDS: *Resistance, Change Management, Information Technology, Technology.*

1. INTRODUCTION

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. Work continues to support the idea that cultural (people) issues are a major barrier to IT implementation in the AEC industry (Rojas and Locsin, 2007, Ruikar et al., 2005). There are limitations in existing change models, 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.

People have a natural resistance to change, but not everyone reacts in a similar fashion, or for similar reasons (Coch and French, 1948). The amount of resistance also varies from person to person. These discrepancies may be the root of technology implementation problems. There is no visible consistency to resistance, making the implementation of technology change a very difficult goal to achieve.

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 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 documented.

The primary objectives of this research were: (1) to isolate attitudes, beliefs, and fears that are indicative of resistance to information technology change within 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. These estimates of intensity are not technology specific and are applicable to any information technology change that an individual might undergo.

This paper first reviews relevant theories connecting a person's attitudes with their likely behaviors. A social architecture factor model for investigating individual resistance to technology change is then introduced and the refinement of the model is discussed. Using the refined model, a Resistance to Change Index (RTCI) is created, enabling estimations of the intensity of resistance an individual is likely to exhibit using the personality traits and behavioral characteristics identified. The RTCI is an index created from nine variables that are indicative of resistance to change. Finally, the paper concludes with a discussion of the value of the RTCI, as well as some of its limitations.

2. THE ATTITUDE-BEHAVIOR CONNECTION

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 to forecast their intentions, and subsequently, to predict their behavior.

Three predominant theories relating attitudes and behavior are the Theory of Reasoned Action (TRA), the Theory of Planned Behavior (TPB), and the Technology Acceptance Model (TAM). A discussion of each theory is presented below.

2.1 The Theory of Reasoned Action (TRA)

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 (1975) proposed the Theory of Reasoned Action to support this idea (see Fig. 1). 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.

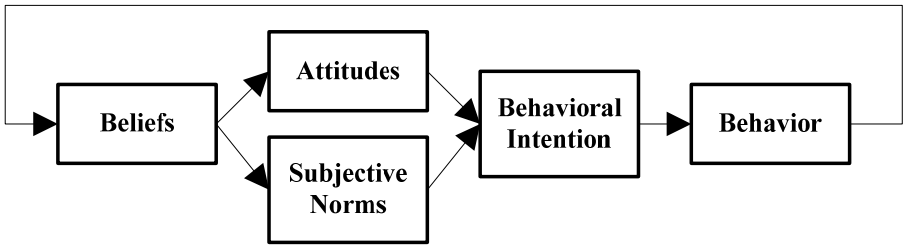

FIG. 1: Theory of Reasoned Action (Adapted from Fishbein and Ajzen, 1975)

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 (e.g. information technology), such as intentions to use it or avoid it. Subjective norms are those attitudes resulting from perceived social pressure from family, friends, and other important persons, and they also contribute to behavioral intentions. 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.

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. Another review (174 investigations), completed by Sheppard et al. (1988), supported the overall predictive abilities of the model even when used to evaluate situations beyond what the model intended.

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 this research, since the behavior of interest is the use (or lack thereof) 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.

2.2 The Theory of Planned Behavior (TPB)

The Theory of Planned Behavior (Ajzen, 1991) is an extension of the Theory of Reasoned Action (see Fig. 2). Attitudes and subjective norms are defined as they were in TRA. Perceived behavioral control reflects a person's confidence that they are capable of performing the behavior of interest. This perception, when combined with an individual's attitude toward the behavior and subjective norms, influences a person's intention to perform the behavior. Combining intention with a person's perceived ability to perform the behavior, will result in the behavior of interest.

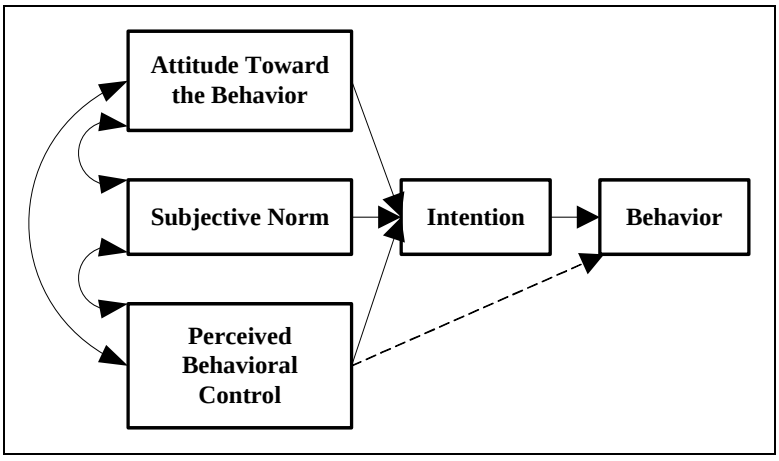

FIG. 2: Theory of Planned Behavior

Based on a review of 16 research studies using the Theory of Planned Behavior (Ajzen, 1991), the combination of attitude, perceived control over the behavior and subjective norms related to the behavior correctly predicted a majority of behavioral intentions. These intentions, when combined with perceived behavioral control, explain much of the variance in behaviour (exact amount varies with the study). Two other reviews (Conner and Armitage, 1998, Sutton, 1998) also conclude that the theory accounts for nearly half of the variance in intention, though it is somewhat less successful in accounting for behavior. The dominant criticism of this theory from both Conner and Armitage (1998) and Sutton (1998) is the need to expand the theory to include other factors.

Ajzen (1991) discusses in his Theory of Planned Behavior that a general attitude cannot be used to predict a specific behavior, but it can be used to predict aggregate behaviors. 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. This research employs Ajzen's aggregation principle and uses general attitudes and personality traits to predict the behavioral aggregate of an individual's likelihood to resist an information technology change.

2.3 The Technology Acceptance Model (TAM)

The Technology Acceptance Model (TAM) (Davis et al., 1989) and its revised version (TAM2) (Venkatesh and Davis, 2000) are extensions of TRA and TPB. TAM relies heavily on two beliefs, perceived usefulness and perceived ease of use, to determine behavioral intentions. Perceived usefulness is the individual's belief that the technology will increase their job performance. Perceived ease of use is the individual's belief that the technology will be easy to use. TAM2 expands the model by adding subjective norms. Both versions are criticized for lacking significant factors, such as variables reflecting the change process and cultural aspects (Legris et al., 2003). Both TAM and TAM2 require the individual to be aware of a change coming, as well as the specifics regarding what is being changed. These aspects alone makes TAM inappropriate for use in this work, as individuals participating in this research may not know that there is a technology change in their future. Additionally, this research focuses more on a person's willingness to change vs. resist technology and is not specific to a particular technology or information technology change process.

Therefore, only the Theories of Reasoned Action and Planned Behavior are used as a foundation for this research and provide the basis for the development of the Social Architecture Factor Model discussed in the next section. Specifically, these theories guide the inclusion of potentially influential attitudes, beliefs, and fears associated with impeding/promoting use of technologies. While the inclusion of emotional variables such as fear are limited in both TRA and TPB, fear does affect beliefs, attitudes, and perceived behavioral control and is appropriate for inclusion in this research. In combination, the theories provide the link in this research to use an individual's attitudes, beliefs, and fears to forecast their behavioral intentions, and in future research, to ultimately predict their behavior.

3. SOCIAL ARCHITECTURE FACTOR MODEL

As previously stated, this research investigates individuals' resistance to change brought about by new technology implementation in the AEC industry. The Social Architecture Factor Model illustrated in Fig. 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 boxes, 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.

This 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 (Fig. 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, but are downplayed here, as organizational aspects of technological change will be the focus of a subsequent research project.

The broad categorical groupings 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. Due to space limitations, a discussion of specific measures

within each grouping is not possible. The specific measures used in the *Attitudes, Beliefs and Fears of the Individual* portion of the model are presented in Table 1. The reader is directed to the references for additional information regarding each measure. This model serves as a framework for the larger investigation into individual resistance and was used to create a social architecture assessment instrument for measuring individual factors. The complete assessment instrument and information regarding measures used is available from the author.

This social architecture factor model is quite inclusive and extensive and consequently was too complex to allow adequate investigation of follow-on research. Therefore, a reduction in the scope of the model was needed. The following section details the reduction of the variables included in the model.

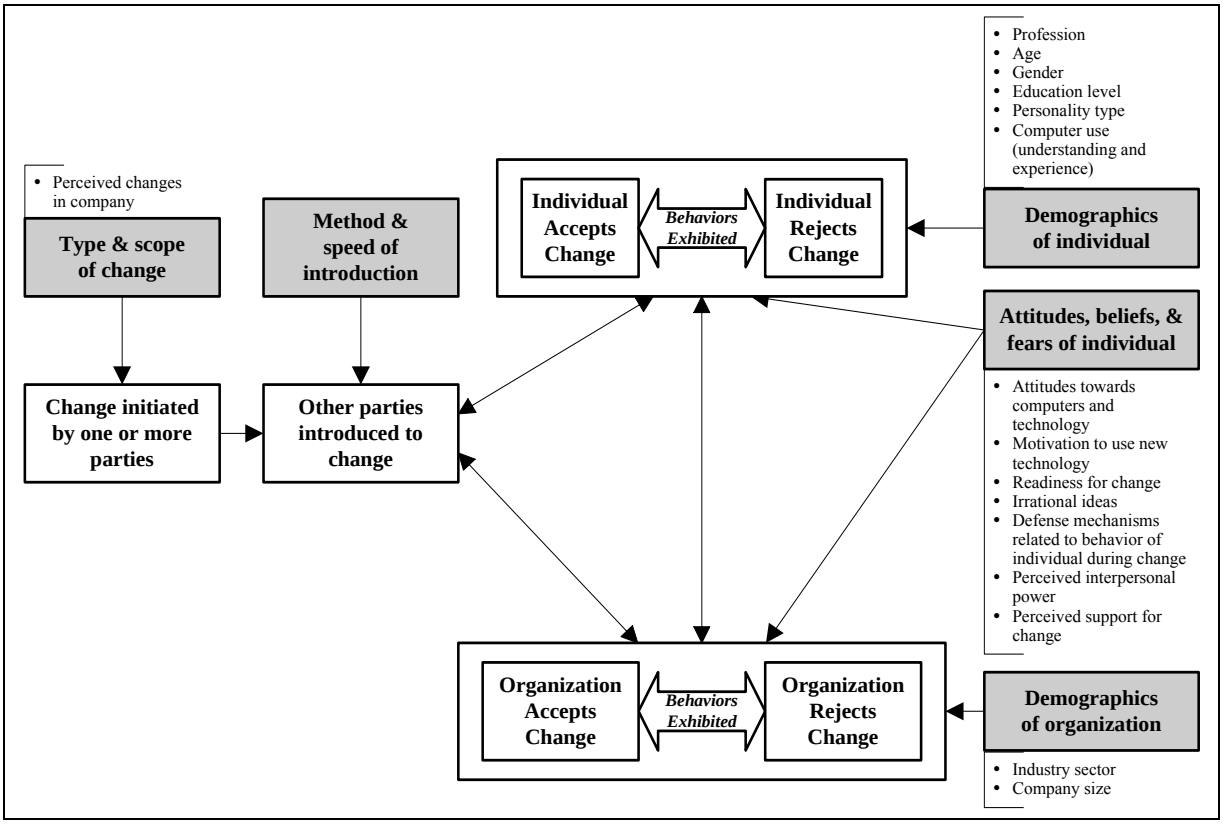

FIG. 3: Social Architecture Factor Model (shown with factors kept after Variable Reduction)

4. MODEL VARIABLE REDUCTION

The social architecture factor model identified 39 factors consisting of 76 variables associated with technological change from an individual's perspective within the AEC industry. The variable reduction effort collected data from a 50-person sample of the population to discover the most significant factors. The results of this effort provide patterns and relationships of the variables to determine whether the measures could be reduced to a smaller number of factors. A refined social architecture factor model and associated assessment survey for measuring individual factors were the products of this portion of the research.

4.1 Data Collection

Several methods were considered 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.

TABLE 1: Attitudes, Beliefs, and Fears of Individual: Factors and Measures in Original Survey

Factor	Measure	No. of Questions
Computer anxiety	Computer Anxiety Index (CAIN) (cited in Gardner et al., 1993, Maurer and Simonson, 1984)	26
	Computer Anxiety Rating Scale (CARS) (Heinssen et al., 1987)	18
Attitudes towards computers and technology	Attitudes to Computers (Todman and File, 1990)	15
	Human Fears of Technological Change (Cunningham et al., 1991)	1
	Computer Attitude Scale (CAS) (Gardner et al., 1993, used in Loyd and Gressard, 1984)	26
Computer confidence	Computer Confidence (Gardner et al., 1993)	4
Adaptability	Personal Rigidity (Rehfisch, 1958)	6
	Emotional Intelligence EQ Map Scale 9 – Resilience (Cooper and Sawaf, 1997)	13
Acceptance of uncertainty	Intolerance of Ambiguity (Budner, 1962, Robinson and Shaver, 1973a)	16
Readiness for change	The Change Seeker Index (CSI) (Garlington and Shimota, 1964)	92
	Reaction-to-Change Inventory (De Meuse and McDaris, 1994)	1
	The Change Scale (Trumbo, 1961)	9
	The Change Opinion Survey (Hultman, 1998)	40
Locus of control	Internal vs. External Control (Robinson and Shaver, 1973b)	23
Irrational ideas	Irrational Belief Scale (discussed in Bovey and Hede, 2001b, Malouff and Schutte, 1986)	20
Perceived interpersonal power	Emotional Intelligence EQ Map Scale 16 – Personal Power (Cooper and Sawaf, 1997)	13
	Researcher's questions	6
Previous positive or negative technological experiences	Researcher's questions	2
Motivation to use new technologies	Researcher's questions	2
Disposition to innovation	Researcher's questions	2
Perceived support for change	Support for Change Questionnaire (Maurer, 1996)	8
	Psychological Need Fulfillment Inventory (Hultman, 1998)	60
Defense mechanisms of the individual during change	Defence Mechanisms (Bovey and Hede, 2001a)	14
	Emotional Intelligence EQ Map Scale 11 – Constructive Discontent (Cooper and Sawaf, 1997)	13
	Job Investment (Trumbo, 1961)	4
	Researcher's questions	5

The sample population consisted of English-speaking architecture, engineering, contractor, and construction management organization employees in the US. The sample included 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 were included in the sample population because technological changes in the industry can affect all employees within an organization.

Employees working for companies with offices located in a 50-mile radius of Blacksburg, Virginia, USA were targeted for this survey. Companies were contacted by telephone or in person to request participation of some or all of their employees. Superintendents of local construction sites were also 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 8 weeks. Follow-up phone calls and office/site visits served as reminders for unreturned surveys. 89 surveys were distributed and 52 returned, resulting in a 58.4% response rate. The total sample size analyzed in this study was 50 individuals representing 31 companies. Two surveys were not included in analysis due to non-responsiveness.

Quota sampling ensured that enough data from each stratum of interest was obtained. Strata of interest included company size, industry sector, and profession, age, and gender of the individual. This non-probability sampling method is appropriate to determine whether a given factor warrants further study or not (Henry, 1990).

A majority of respondents answered all 554 questions on the survey (41 out of 52 respondents). One respondent answered only the first 100 questions, but the questions this respondent did answer were included in the data analysis. Two surveys were returned with no responses and were not included in the data analysis.

4.2 Data Analysis

After completion of the data collection, analysis identified patterns and relationships of the variables to determine whether the measures could be reduced to a smaller number of factors. A refined social architecture model and accompanying assessment survey for measuring individual factors were the products of this portion of the research. The remainder of this section describes the data analysis procedure for reducing the number of variables and the corresponding findings.

Reducing the number of variables in the model improved its manageability and comprehension. It also reduced the length of the survey to approximately 35% 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.

Correlation tests were performed on each pair of variables. The type of test chosen was based on the types of variables (i.e., continuous, normal, etc.). The tests used include Pearson correlations, Spearman correlations, ANOVA tests, Kruskal Wallis tests, and Chi-square tests (χ^2).

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 16 factors consisting of 34 variables. Six factors consisting of 18 variables [industry sector (12 variables), company size (2 variables), education, profession, age, and gender (1 variable each)] were omitted from analysis because they were to be kept in the assessment survey regardless of their correlations with other variables. The procedure used was an iterative process involving 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. For a complete discussion of the variable reduction process, including which correlation tests were applied to which pairs of variables, see Davis (2004).

Factor analysis is a possible data analysis technique for reducing the number of variables in the survey using an objective technique. Unfortunately, factor analysis is inappropriate for the task at hand – reducing the size of the survey to approximately 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 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.

4.3 Findings

As noted, analyzing the correlations between each of the variables in this manner reduced the survey from 39 factors consisting of 76 variables to 16 factors consisting of 34 variables. Fig. 3 identifies the remaining factors within the categories of the social architecture factor model. The model reduction allowed the number of questions in the survey to be 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 technology change, as well as reviewing the deleted variables to ensure that none were essential to accurately portraying resistance. A refined social architecture assessment survey for measuring individual factors was the product of this step of the research.

5. RESISTANCE TO CHANGE INDEX

Of the 16 remaining factors, seven factors (representing nine variables) represent the *Attitudes, beliefs, & fears of individual* block. The factors are: (1) Attitudes towards computers and technology; (2) Motivation to use new technology; (3) Readiness for change; (4) Irrational ideas; (5) Defense mechanisms related to behavior of individual during change; (6) Perceived interpersonal power; and (7) Perceived support for change. These seven factors were combined to create a Resistance to Change Index, representing the likelihood of an individual to accept or reject information technology change. The remainder of this section discusses the relevance of each factor included in the index, the measures used, and specifically how the index was created.

5.1 Relevance of Factors Included in Index

Attitudes towards computers and 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, 1984). This scale encompasses three types of attitudes: computer anxiety, computer liking, and computer confidence. A positive attitude towards computers is an indication of lower resistance towards technological change and vice-versa.

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 researchers 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).

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 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 (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, 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.

5.2 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 (after data collection) 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.

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 initial study data, had an approximately normal distribution with a mean of 4.23 and a standard deviation of 0.66. 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.

6. DISCUSSION OF THE RTCI

The RTCI adds value for both researchers and practitioners in the AEC industry. This work expands the view of resistance to change as represented in the literature. It also provides practitioners in the industry with a better way to identify those likely to resist an information technology change during implementation, allowing them to alter their change processes to adapt to these individuals. The following is a discussion of these values of the RTCI, as well as some of its limitations.

First, 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 RTCI provides the industry with a better perspective of which individuals are likely to resist information technology change. The RTCI provides an opportunity for AEC companies to identify potential resisters *prior* to an information technology implementation by relying only on questions regarding the attitudes, beliefs, and fears of the individual. This is in contrast to the work of other researchers that depends upon the specifics of an information technology and the workers perceptions about it during and after a change (Adams et al., 1992, Cooper and Zmud, 1990, Davis et al., 1989, Moore and Benbasat, 1991, Venkatesh and Davis, 2000, Venkatesh et al., 2003).

Early identification of individuals that are likely to resist a new information technology implementation allows businesses to alter their change processes before implementation begins to reflect the concerns of these individuals. When AEC businesses cannot identify these persons with any certainty, the change process tends to be hit or miss, as evidenced by the poor implementation rates within the AEC industry. This research provides a starting point for bettering this change process.

Some limitations of this research include not making a distinction between positive resistance and negative resistance, not addressing the cause of resistance, and not identifying 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 long-term case studies such as these, 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.

7. CONCLUSION

This paper describes initial research investigating the importance of behavioral characteristic measures indicative of resistance to change within the AEC industry. The social architecture factor model served as a framework for the creation of a refined social architecture assessment survey and, ultimately, for the creation of the Resistance to Change Index (RTCI). The RTCI estimates the intensity of resistance an individual is likely to exhibit using personality traits and behavioral characteristics.

The first objective of the research discussed in this paper was to reduce the number of variables in the social architecture factor model. By analyzing the correlations between each of the variables, the number of variables in the survey is reduced significantly. This reduces the number of questions needed in the assessment survey.

The second objective of this 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 is crucial to subsequent 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. Follow-on work investigates hypothesized relationships between the demographic variables and the Resistance to Change Index created.

The RTCI helps practitioners make decisions about how new technologies should be introduced to reduce the resistances present, as well as how to lessen their impact when they are unavoidable. The RTCI also enables researchers to understand how individual participants resist and adapt to change allowing the development of enhanced organizational adoption models for new technology implementation within the building industry.

Although the RTCI was developed for use in the AEC industry, it is a general tool that could be used to support new information technology implementation in other industries as well.

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