Towards Defining Categories of Innovativeness for the Construction Industry

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ABSTRACT

Innovation is a necessary part of construction business operations as a means to remain competitive in a dynamic environment, and yet, as a whole the construction industry continues to be labeled as laggard. Innovation and the processes surrounding innovation involve layers of complexity and are therefore often misunderstood. In order for industry stakeholders to better derive benefits from the innovation process, they must first understand the drivers of innovation within their own organizations, including relationships to other organizations and actions of contributing individuals. Utilizing a flexible design methodology of literature review, a modified Delphi technique and a survey instrument, this work aims to develop and present an initial validation of a framework of individual and organizational change by which such characteristics of innovativeness can be categorized. As a basis of this work, categories of innovativeness are those defined by Rogers (2003), and then expanded by parameters of innovativeness extracted from scholarly literature. The overarching goal of this research endeavor is to better understand the behavior of individual and organizational change through specific categories of innovativeness that can be used to build a tangible set of tools for use in the construction industry. However, ultimate validation and translation will be the effort of future work. In gaining innovativeness knowledge, industry stakeholders will understand their own strengths and weaknesses, better arming them with the tools to initiate and succeed at organizational change.

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Chapter 1: Introduction and Background

1.1 Introduction

The study of innovation has become a popular research topic, pioneered by E.M. Rogers (2003), comprising thousands of studies from most industries. It has been of particular interest in the construction industry due to increased competition through mechanisms such as globalization, increasing performance demands of the built environment and industry stakeholders faced with advances in technology that require significant changes in business operations. Additionally, innovation research in construction has been of interest because of the criticisms of the industry for its aversion to change and lack of innovation uptake (Winch 2003), despite innovation being cited in numerous publications as a necessary component of remaining competitive in a dynamic environment (Porter 1985; DETR 1998; Mitropoulos and Tatum 2000; NRC of Canada 2001; Serpell and Ocaranza 2001; Sexton and Barrett 2003).

The terms *change* and *innovation* are sometimes used interchangeably, though they contain significant differences. Organizational change and individual change is a process of adapting or transforming based on internal or external circumstances (Singh and Shoura 1999). Innovation is a type of change, defined as the implementation of a novel process, product or system that requires a significant adaptation or transformation of organizational or individual behavior (Slaughter 1998; McCoy 2009). Innovation is change, but change is not always innovation. This research effort focuses on innovation and specifically innovativeness, referring to the likelihood of an individual or organization to engage in innovation behaviors relative to other members of a social network (Rogers 2003; McCoy 2009). The term *change* is used in its more general version of organizational and individual characteristics and processes.

Many research efforts have focused on improving the adoption of innovation in construction through identifying industry barriers and accelerators to innovation diffusion, such as Holmen (2001) and BSRIA (2004). These studies often identify characteristics of the industry and characteristics of the innovations themselves. This type of information lends itself well to efforts of organizational innovation, successful policy improvement and commercialization.

Other AEC studies have focused on identifying characteristics of organizations and individuals based on adoption behavior (Kale and Arditi 2010; Blackley and Shepard 1996: Toole 1998), but are minimal in quantity. Research from various industries has shown that there are discernable differences between those that are more likely to adopt an innovation and those less likely (Ettlie et al. 1984; Dewar and Dutton 1986; Rogers 2003), with broad parameters that can be classified as a "kit of parts" (McCoy 2009). However, adoption studies in construction typically utilize broad categories to describe adopters, terms such as *more innovative* and *less innovative*. Though beneficial in distinguishing innovators versus non-innovators, conclusions drawn in broad terms inhibit the distinctions between specific adopter categories, such as those defined by Rogers (2003), thereby limiting the applicability of this information to the industry setting.

E.M. Rogers (2003) proposed five categories of innovativeness that comprise a social network and follow a standard bell-curve: 1) innovators (2.5%), 2) early adopters (13.5%), 3) early majority (34%), 4) late majority (34%), and 5) laggards (16%) (Figure 1.1). Within such social networks, behavioral styles are often used to create tangible tools that gauge prolonged behavior based on "an observable pattern of behaviors" (Effectiveness Institute 2004). In theory, behavioral profiling concepts could be applied to innovativeness categories to identify varying levels of innovativeness among and within innovation social networks.

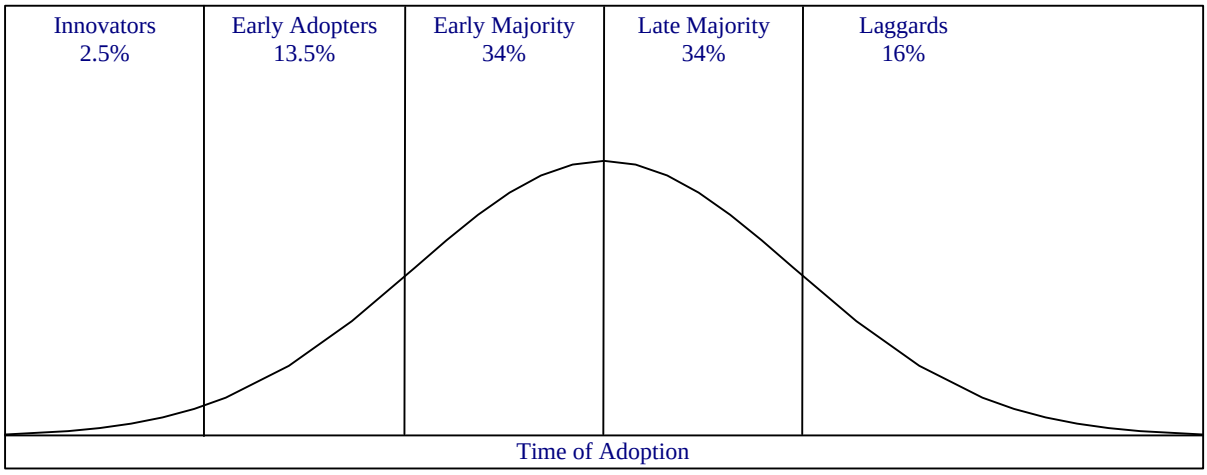


Figure 1.1: Adopter Categorization on the basis of Innovativeness (Rogers 2003)

However, construction complicates the matter through inherent, unique organizational and individual risks not faced in other industries. Examples include project site variability,

complexity of supply chain and comparatively longer product life-cycle requirements (McCoy 2009), all of which introduce obstacles specific to the construction industry (Koebel and McCoy 2006). It is, therefore, important to reduce uncertainty unique to the construction industry (Yisa 1996; McCoy 2009). This work attempts to reduce construction industry uncertainty through the following steps: 1) assessing characteristics, as obstacles and catalysts, of the change process for construction organizations and individuals; 2) conceptually clustering these characteristics, as a research team and through a pane of subject matter experts, into a simplified framework of change; and 3) validating the framework through stakeholder placement of the original characteristics back into the framework.

The overarching goal of this research endeavor is to better understand the behavior of individual and organizational change through innovativeness. Towards defining propensity towards or against innovation, the research is designed to develop a framework of innovativeness for the construction industry through a review of literature and a modified Delphi process. The framework will serve as a mechanism to define the parameters of innovativeness for construction organizations and the individuals within those organizations. The framework is organized as a conceptually clustered matrix. Through increasing understanding of innovativeness, industry members can better understand their own strengths and weaknesses in innovative endeavors, better arming them with the tools to initiate and succeed at organizational change. For instance, corporate culture is often cited as a factor of success of innovation efforts (Detert et al. 2000). Through defining corporate culture as a stand-alone element, and as a part of the innovativeness whole, this work provides a common language to define and discuss elements of innovativeness. Additionally, this work takes steps towards defining specific categories of innovativeness that can be used to build a tangible set of tools for use in the construction industry.

1.2 Background

1.2.1 Defining Terms of Innovation

It is important in discussing innovation to start on the same page. Innovation literature contains much variation in the definition of key terms (McCoy et al. 2008). Rogers (2003) defines innovation as a noun, while McCoy (2008) and Slaughter (1998) define innovation as a process. Section 1.2, therefore begins by defining terms that are common to innovation dialogue as follows:

Change – a transformative act whose occurrence owes to obstacles or catalysts. According to Edwards (2008), "since obstacles exist, change – and innovation – would be impossible without innovation."

Organizational Change – a process of adapting or transforming based on changing internal or external circumstances (Singh and Shoura 1999)

Invention – The process by which new ideas, products or processes are created and brought to a developable state (Koebel and McCoy 2006)

Innovation – the implementation of a novel process, product or system requiring a significant change in existing operational practices (Slaughter 1998; McCoy 2009)

Adoption – the act of an individual or group of individuals within an organization implementing an innovation into current daily operations (Zaltman et al. 1973; Damanpour and Schneider 2006; Hartmann et al. 2008). Adoption research focuses on characteristics and behaviors of the adopter (McCoy et al. 2008)

Diffusion – "the process by which an innovation is communicated through certain channels over time among the members of a social system." (Rogers 2003) Diffusion research focuses on accelerators or barriers to the spread of an innovation through a population (Rogers 2003)

Innovativeness – the likelihood of an individual or organization to engage in innovation activities relative to other members of a social network (Rogers 2003; McCoy 2009)

1.2.2 Innovation in Construction

In the construction industry there is a growing focus on organizational innovation (Kale and Arditi 2010) and its importance in better meeting the needs of clients and maintaining a strong competitive position among industry players (Porter 1985; Sexton and Barrett 2003; Manley et al. 2009). There is increasing support for the notion that innovation is a major factor in meeting

the dynamic and evolving demands of the industry (DETR 1998; NRC of Canada 2001; Serpell and Ocaranza 2001; Manley et al. 2009). Yet there remain significant gaps in the understanding of construction innovation and widespread acceptance of the assumption that the construction industry is generally averse to change (Winch 2003; Manseau and Shields; 2005; Koebel and McCoy 2006). Synthesis literature on innovation in construction firms concludes that the body of knowledge as a whole lacks direction, pointing to identifiable gaps in understanding (Manseau 2005; Sexton and Barrett 2003). When considering the great complexity inherent in the field of innovation and added complexities of the construction industry, gaps in understanding provide a significant barrier to effectively managing innovation within the construction industry (Manseau 2005; Sexton and Barrett 2003).

Innovation research efforts are aimed at better understanding the facets of innovation including adoption and diffusion theory, but there still exists a lack of consensus and often confusion of key terms (Koebel and McCoy 2006). Critical to a discussion of innovation is clarity of innovation terms (McCoy et al. 2008). Slaughter's (1998) definition of innovation is widely accepted in the construction industry: "Innovation is the actual use of a nontrivial change and improvement in a process, product, or system that is novel to the institution developing the change." This definition of innovation, unlike definitions presented by Thompson (1965) and Amabile et al. (1996), explicitly describe innovation as an improvement. Definitions that ignore the contribution of innovation, or "value-neutral" definitions, as Sexton and Barrett (2003) describe them, highlight a common assumption in innovation literature, that innovation is good (Sexton and Barrett 2003; Koebel and McCoy 2006). Koebel and McCoy (2006) proffer that pairing the assumption that the construction industry is laggard in nature with the assumption that innovation is generally good can lead to erroneous decision-making criteria in the efforts to increase innovation uptake in the industry. Additionally, Slaughter's (1998) definition of innovation implies that the use of a nontrivial change is innovation regardless of the timing of adoption. For instance, company A adopts technology A fifteen years after market introduction, but because technology A is new to company A it can be described as innovation. This work defines innovation as the implementation of a novel process, product or system requiring a significant change in existing operational practices (Slaughter 1998; McCoy 2009).

It is also important to understand the concepts of adoption and diffusion in innovation research. Adoption is the term used to describe the act of an individual or organization implementing an innovation into current daily operations (Zaltman et al. 1973; Damanpour and Schneider 2006; Hartmann et al. 2008). Adoption research focuses on the individual user and the factors therein that affect the uptake of innovation (Koebel and McCoy 2006). Diffusion, on the other hand, is the process by which the use of an innovation spreads through a social network (Rogers 2003). Diffusion research focuses on the factors that aid or hinder the spread of an innovation through a market, including communication and opinion leadership (Rogers 2003).

1.2.3 Innovativeness and Adopter Categories

An important aspect of adoption research is the concept of innovativeness. Innovativeness is defined as an organization or individual's likelihood of and propensity for adopting innovations earlier relative to other members of their social network (Rogers 2003, Rhee et al. 2010). This definition of innovativeness assumes a normal distribution of a population of adopters over time, implying that adopters of innovations within a population can be classified based on their earliness or lateness in adopting an innovation relative to other members of a given social network (Martinez and Polo 1996: Rogers 2003). However, Rogers (2003) points out that defining adopters based on timing of adoption is impractical and he therefore identifies five "adopter categories": 1) innovator; 2) early adopters; 3) early majority; 4) late majority; and 5) laggards, noting distinct characteristics as attributes of each category. Additional research efforts have attempted to draw distinction between innovative and non-innovative entities (Ettlie et al. 1984; Dewar and Dutton 1986; Subramanian 1996; Toole 1998). For instance, Subramanian (1996) found that stability in market conditions affected the innovativeness in a study of firms in the banking industry.

Many studies and reports have focused on characteristics of the industry and ways to accelerate diffusion through identification of barriers and accelerators of innovation inherent in the construction industry (BTI 2005; Holmen 2001; Hickling 1989). Few have attempted to define characteristics of adopters, but rather define characteristics of broad categories through correlation of various independent variables to adoption activities, such as Toole (1998) does. In general, the research subjects are broken down into broad innovativeness categories such as

earlier adopters, later adopters or non-adopters, or some such variant. In a study designed to define adopter categories for adopters of consumer durables, Martinez and Polo (1996) note that very few studies reviewed differentiate between two or more adopter categories. The author of the present work has come to the same conclusion in review of construction innovation literature. This study aims to aid diffusion of innovation in construction by focusing on the characteristics of the organizations that make up the industry and the individuals that drive these construction organizations. Identifying the characteristics of innovativeness displayed by an organization and the people that make up that organization provide a solid starting point for determining where an organization sits within its market and what changes can be made to meet its innovation goals. In an effort to clearly delineate between the different adopter categories this work seeks to define a framework of innovativeness, working towards the ability to assign specific characteristics of innovativeness to Rogers (2003) adopter categories, through a literature extraction and validation process.

An inherent assumption of this work is that the cumulative characteristics of the individuals that work within an organization affect the innovativeness of that organization. Thus to simply focus on the organization fails to get at the heart of an organization's innovative potential. Innovation processes in an organization involve multiple individuals that serve in varying roles in the innovation process (Koebel 2006; Koebel et al. 2003; Rogers 2003), therefore the innovativeness of the individuals will ultimately affect the innovation behaviors of the organization. In a study of resistance to IT change in the AEC industry, Davis and Songer (2008) stated that "current change models present processes and guidelines for changing organizations and tasks, with limited emphasis on individuals involved in change" despite the fact that many sources cite "people problems" as a barrier to successful IT implementation (Maurer 1997; Peansupap and Walker 2005; Rojas and Locsin 2007; Ruikar et al. 2005; Davis and Songer 2008). Ignoring the role of the individual in organizational innovation only serves to perpetuate an existing problem in current innovation knowledge. For this reason, this work sets about defining a construct of innovativeness for both individuals and organizations of the construction industry. Davis (2004) developed a behavioral tool for predicting the resistance an individual may display towards IT innovations in AEC organizations. While some of the characteristics of resistance identified by Davis (2004) are relevant to this research, the basic nature of the tool being developed differs.

The tool developed in this research is meant to be broadly applicable to all construction sectors, identifying a comprehensive set of innovativeness characteristics, whereas Davis (2004) focused on characteristics and traits of resistance to IT innovation.

1.2.4 Measuring Innovativeness

There are two major methods of measuring innovativeness, the propensity to adopt innovations relative to other members of a social network (Rogers 2003), identified in current innovation literature, along with a handful of miscellaneous methods developed by other works. All methods are post hoc. The first method was developed and reported by Rogers (2003). This is a timing-based approach, looking at a single innovation and plotting adopters based on time of adoption relative to other members of a population. The second measurement approach is the cross-sectional method, and differs from the previous method in that innovativeness is determined based on the number of innovations adopted, generally from a pre-selected list (Goldsmith and Hofacker 1991; Fell et al. 2003). Fell et al. (2003) developed a hybrid method of measuring innovativeness of single-family homebuilders, combining elements of Rogers (2003) timing-based method and the cross-sectional product-based method. The hybrid method accounts for both timing of adoption and number of products adopted, as well as degree of implementation.

While useful for market studies, these methods present three major problems for application by construction stakeholders: first, they do not offer a consistent means of measuring the innovativeness of individuals; second, they do not offer a feasible way for a change agent or firm leadership to quickly gauge individual and organizational innovativeness; and third, they do not attempt an ad hoc understanding of the organization and/or individuals involved. Traditional means of measuring innovativeness require labor intensive means of data collection and offer results that provide minimal tangible benefit for many members of the construction supply chain. Goldsmith and Hofacker (1991) summarize problems with the time-of-adoption method by stating: “Some methodological consequences of using the time-of-adoption method are that there is no way to evaluate its reliability and validity, findings cannot be compared across studies, and generalizability is limited to the individuals in a single study. Time-of adoption methods cannot be used to predict future behavior.” They go on to cite similar problems with the cross-sectional method and highlight the need for a standardized method that focuses on the “conceptual and

behavioral" nature of an innovativeness construct. The approach of this work will, in theory, provide a more practical and useful construct of innovativeness for members of the construction industry. This work does not dispute that innovativeness can be determined based on timing of adoption and/or quantity of innovations adopted, however it views it as less tangible for application in the construction industry context.

1.2.5 Behavioral Styles

Individuals and organizations cannot be characterized by one single action, but rather are made up of multiple characteristics and patterns of behavior that occur over time (McCoy 2009). Researchers and consultants have been challenged over the years to develop ways to predict prolonged patterns of behavior in a manner that is feasible, tangible and translatable. Profiling tools, such as those used by Myers-Briggs and The Effectiveness Institute, have been developed to determine a behavioral style based on a series of questions. A Behavioral Style is defined as "an observable pattern of behaviors" (Effectiveness Institute 2004). Cumulative responses to behavioral analysis questions can provide a reasonable snapshot of an individual or organization's behavioral style through recognition of observable characteristics (McCoy 2009). Anderson (2008), in describing how personality is measured, states that "personality cannot be measured directly due to its intangible nature". Anderson (2008) further describes the process of measuring personality as a series of questions about oneself with the answers corresponding to numerical values, ultimately providing a personality description of the person taking the test. While this research is not focused on measuring personality, the researchers see innovativeness as similar to personality or behavioral styles because it can be defined by observable characteristics and patterns of behavior. Similar to the work of Anderson (2008), the Effectiveness Institute (2004) created a 4-quadrant tool for developing a behavioral profile. This work seeks to set the foundation for the development of a similar tool that can be applied to both individuals and organizations in the construction industry.

1.3 Problem Statement and Objectives

A thorough review of innovation literature, specifically literature concerning construction, highlighted significant gaps in innovation knowledge. These gaps are discussed in detail below:

1. There is identifiable difficulty in correlating definable parameters to innovativeness within and among construction organizations (Rogers 2003, Mitropoulos and Tatum 2000), *and current literature tends to overlook the role of the individuals involved* (Judge et al. 1999; Davis and Songer 2008).

The availability of construction-based literature that attempts to identify the characteristics that define varying levels of innovativeness is limited (Mitropoulos and Tatum 2000) and often seeks to identify characteristics of broad categories of adopters, such as Toole (1998) does. In a study designed to define adopter categories for adopters of consumer durables, Martinez and Polo (1996) note that very few studies reviewed differentiate between two or more adopter categories. This holds true for construction literature. Furthermore, in the limited research efforts with the goal of identifying parameters of innovation adoption, there are inconsistent results in correlating independent variables to innovativeness, most likely due to vast complexity of innovation (Rogers 2003, Mitropoulos and Tatum 2000).

Additionally, there is unequal focus on organizations in construction innovation research. Although Baldridge and Burnham (1975) found that individual characteristics did not seem to be important factors of innovative behavior of individuals in large organizations, other research efforts emphasize the role of the individual in the success or failure of change initiatives (Judge et al. 1999; Davis and Songer 2008), specifically with respect to information technology change, within organizations. The characteristics of the individuals involved in an innovation-decision process have been found to affect the resulting innovation adoption decision (Toole 1998), highlighting the significance of profiling the individual as well as the organization. The sum of individual propensity towards innovation in a construction firm may not equal that firm's propensity toward innovation, but those individuals ultimately affect the ease and possibly the success of innovation implementation (Cameron and Green 2004).

2. Innovation is a very complex topic and there is no tangible tool that facilitates stakeholder change through an application of innovativeness research to their business operations.

Although there has been a great deal of research conducted in the field of innovation there is still much unknown about the facets of innovation (Kimberly and Evanisko 1981). The complex nature of innovation research leads to difficulties in defining and evaluating innovation behavior

in the construction industry (Koebel 2003). A means of classifying parameters of innovativeness that is tangible to industry is needed to more aptly understand the processes and behaviors surrounding innovation (Rankin and Luther 2006). Much like many innovation topics, there is confusion of what innovativeness is and how it is manifested through behaviors and characteristics of adopters. Subramanian (1996) states that determining the innovativeness of an organization or individual depends on the definition adopted by the researchers. Rogers (2003), Koebel (2003) and Mitropoulos and Tatum (2000) all identify different categories of innovativeness characteristics (categories of independent variables researchers have attempted to correlate to innovativeness), with the latter two being specific to the construction industry. Variation in the way that innovativeness is discussed increased the barriers to tangible application for industry stakeholders. What is needed is a simple, adaptable tool designed to measure innovativeness (Goldsmith and Hofacker 1991) based upon a standardized construct with commonly accepted definitions. At this point, there is no work that establishes such a tool or defines a construct of innovativeness.

As discussed in section 1.2.4, traditional methods of measuring innovativeness in literature yield results that lack tangible application for most construction stakeholders. Furthermore, these methods require labor intensive means of data collection. In order to increase the application of innovativeness research in the construction industry, there is a need for a standardized means of defining and measuring innovativeness.

This study aims to aid change in construction by focusing on the identification of characteristics that define adoption uncertainty for industry organizations and the individuals that drive these construction organizations. Identifying these characteristics of innovativeness provides a preliminary framework for determining where an organization sits within its market and what changes can be made to meet its innovation goals, through information about the organization's associates and the organization as a whole. In working towards the development of a tangible innovativeness profiling tool applicable to the construction industry, the researchers seek to develop a baseline framework of innovativeness through a flexible design methodology. The goals of this research are: 1) *to develop a framework of innovativeness based on current scholarly literature*; 2*) to modify and present a preliminary validation of the framework based on*

the opinion of construction innovation experts; and 3) *to populate the innovativeness framework with the original characteristics collected from literature to highlight consensus or divergence among current literature and expert opinion*. The framework of innovativeness, described herein, was developed to apply to both individuals and organizations of the construction industry, with some categories applying only to organizations. The process for achieving these goals is outlined in section 1.4 below.

1.4 Research Process

This research effort utilizes a flexible study design adopting multiple techniques for the collection and analysis of qualitative data. The research was conducted in 2 major phases (Figure 1.2). Phase 1 encompasses the construction of the initial "Innovativeness Framework". The framework is a conceptually clustered matrix, developed through subjecting the data, extracted from the literature, to a process of open coding. This process distills the data into categories and subcategories comprising the elements of innovativeness. The framework, developed in Phase 1, is carried into Phase 2, the validation of the initial framework. In Phase 2 a panel of experts was solicited to participate in a modified Delphi process, in order to gain consensus on the innovativeness construct

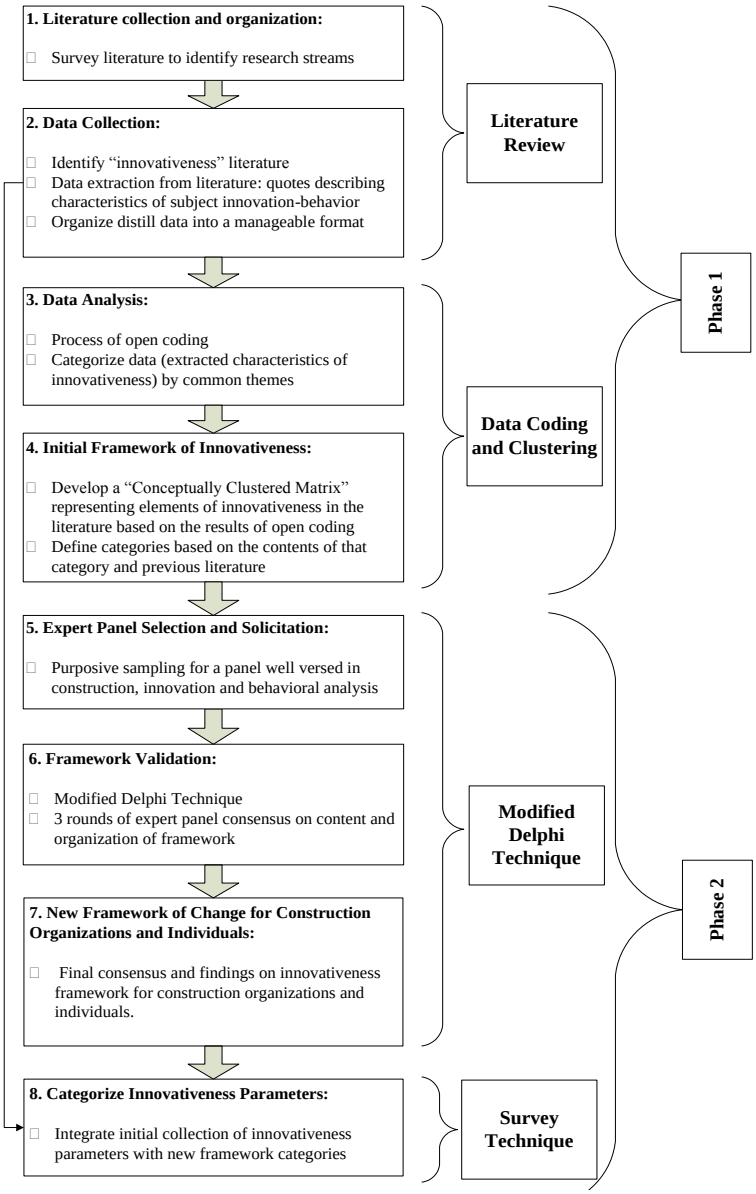


Figure 1.2: Research Process Map

developed in Phase 1. The Delphi technique is an accepted methodology for establishing consensus among experts and reducing group influence in the process. Still, such an elaborate process requires a small set of experts with overlapping subject matter expertise. This work began with 10 individuals with overlapping expertise in the following fields: Organizational Management (large and small), Organizational and Individual Leadership and Behavior, Construction innovation, Construction Risk, Construction-based Communication and Organizational Dynamics. The Delphi process herein consisted of three survey rounds with a data analysis and survey development period between each round, with the result being an updated innovativeness framework, termed the "Validated Innovativeness Framework". During these rounds of surveys, three members of the original team discontinued their involvement, limiting some industry-based responses on organizational dynamics and construction risk. The final step of this research effort was to ask the same expert panel to place the original characteristics of innovativeness back in the framework through the use of a survey tool. Through this process a comparison could be made between the original coding process and the opinion of the expert panel. In this way, areas of weakness and disagreement could be identified in the Innovativeness Framework, which become the subject of future research efforts. The final outcome of this thesis was a construct of innovativeness for organizations and individuals in the construction industry that can be used as a starting point for future innovativeness research in construction.

The three data collection methodologies utilized in this research were literature review, modified Delphi and survey instrument. Experts were solicited to participate in the survey and Delphi process for validation processes. Purposive sampling (Robson 2002) was utilized in the expert selection with an emphasis on expertise in areas of construction innovation, behavioral profiling, construction risk, organizational dynamics, construction communications and construction operations. The research process and methodology is discussed in greater detail in Chapters 2 and 3.

Chapters 2 and 3 provide a detailed description of the finding of this work and the research process used to make those findings. The findings include a construct of innovativeness based on current literature and a preliminarily validated framework based on the opinions of construction innovation experts. This concludes with findings of a re-categorization process of

the original data collected from the literature. Chapter 4 presents the discussions and conclusions based on the findings of this work, examined through the context of innovativeness established in previous work. This paper concludes with a discussion of the outcomes, limitations and impact of this work for the construction industry.

Chapter 2: Phase 1 – Innovativeness Framework Development

2.1 Methodology

This research was conducted in accordance with the regulations set forth by the Virginia Tech Institutional Review Board (IRB) for research involving human subjects under research protocol # 09-708. Appendix A provides copies of the initial approval letter from IRB along with three amendment application approvals. It is important to note that this research was originally titled "Toward Managing Agents of Change for U.S. Construction Organizations," but was modified to its current title as the project progressed.

This research effort utilizes a flexible study design adopting multiple techniques for the collection and analysis of qualitative data. The authors have adopted a flexible design methodology as a means to engage in an iterative process that is free of the constraints of predetermined hypotheses (Denton 1999). The authors believe this to be the most appropriate means of developing a construct within such a complex topic.

The research was conducted in 2 major phases (Figure 1.2). Phase 1 encompasses the construction of the initial *Innovativeness Framework*. The framework is a conceptually clustered matrix, developed through subjecting the data, extracted from the literature, to a process of open coding. Open coding is a method by which qualitative data is conceptually labeled to form categories and subcategories (Corbin and Strauss 1990; Crook and Kumar 1998; Robson 2002). The categories and subcategories are organized into a conceptually clustered matrix and form the structure of the Innovativeness Framework. A conceptually clustered matrix is developed through an iterative process of data coding, searching for common themes imbedded in the data. This method of analyzing qualitative data allows for uncertainties, as opposed to forcing the data into predetermined structures (Denton 1999). The framework, developed in Phase 1, is carried into Phase 2, the preliminary validation of the initial framework.

2.2 Innovation Literature Breakdown

This research began with a thorough review of innovation literature, with a focus on construction innovation. The literature was broken down into two major categories: literature "about" innovation and literature "for" innovation. Literature "about" innovation that focuses on the

construction industry is broken out into its own category as construction is the major focus of this work. A diagram of this literature breakdown is shown in Figure 2.1, below.

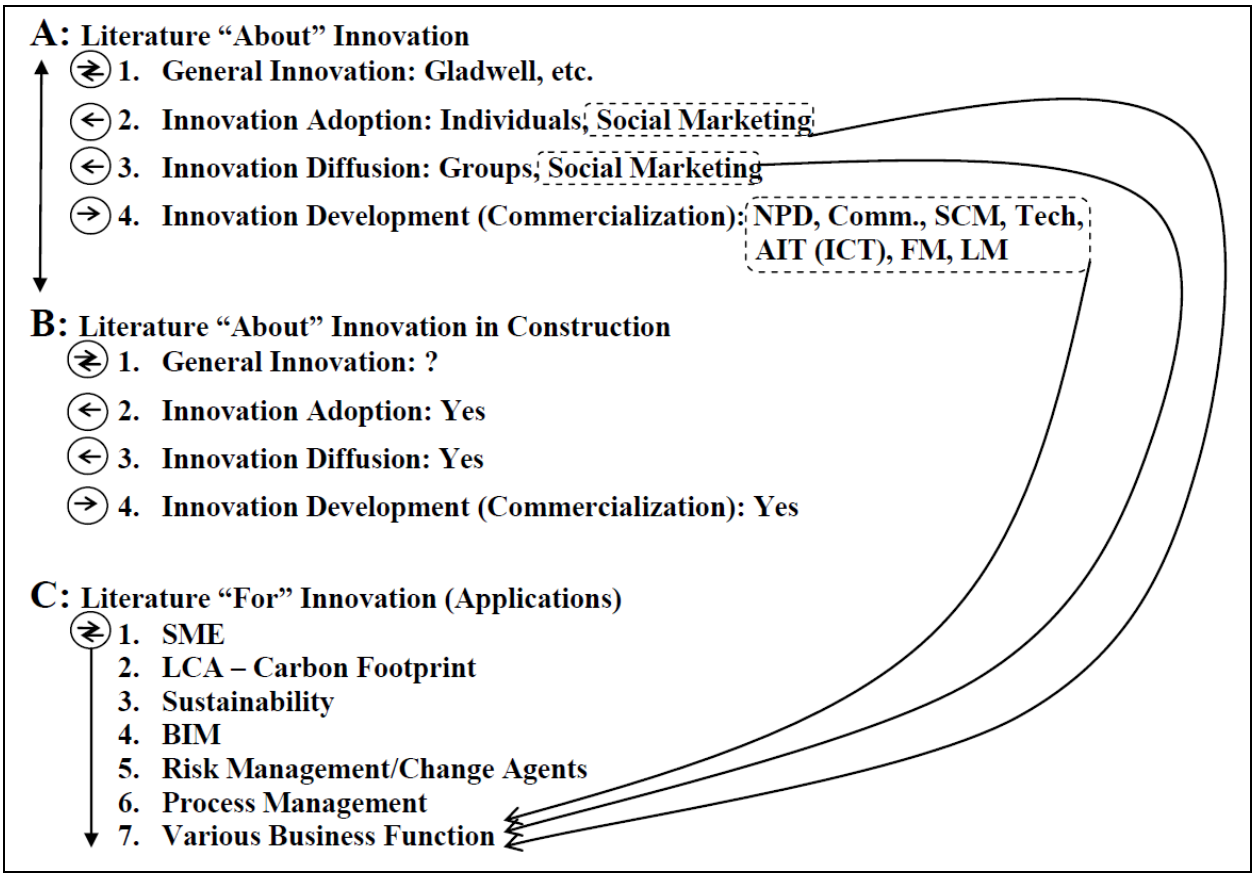


Figure 2.1: Innovation Literature Organization

Literature "about" innovation, indicated by letter "A" and "B" in Figure 2.1, includes general innovation literature, adoption literature, diffusion literature and innovation development literature. General innovation literature incorporates literature that discusses innovation topics not specific to adoption, diffusion or innovation development. Adoption literature, as described in section 1.2.2 above, focuses on the individual adopter unit (Koebel and McCoy 2006), whether that is an individual or an organization. Adoption topics include the innovation-decision process, adopter behavior and characteristics and innovativeness. Diffusion research, also described in section 1.2.2, focuses on the spread of innovation through a population (Rogers 2003). Diffusion topics include accelerators and barriers of innovation, rate of innovation uptake and innovation policy. Innovation development literature includes a range of topics from new product development to product market penetration (McCoy et al. 2008). As indicated by the circled arrows to the left, general innovation literature can include elements of end-user and

input (front-end) topics, while adoption and diffusion focus on the end-user and innovation development literature focuses on the front-end. The term end-user describes the innovation adopter and front-end refers to the process of commercialization of innovation.

The second major category of literature, indicated by the letter "C" in Figure 2.1 above, includes the applications for innovation knowledge. These topics, while not directly tied to innovation theory, are important correlates of innovation knowledge. Literature "about" innovation and literature "for" innovation both help in furthering the knowledge of the other. The encircled arrows to the left indicate that innovation applications include both input and end-user elements. This work concentrates on the concept of innovativeness, which falls into the category of adoption.

2.3 Literature Review Process: From Literature to Innovativeness Framework

2.3.1 Literature Review Process and Methodology

The major goal of this work is to develop a framework of innovativeness as a way to categorize the elements that make up an innovativeness profile, the parts of the whole, in other words. The first step of the process of developing such a framework is a review of the current literature. An in-depth review of construction innovation literature was performed to identify research articles, reports and books that identify adopters of innovations based on observable or quantifiable parameters. This process is diagrammed below in Figure 2.2, and will be described in detail in the sections following.

As a brief overview of this process, relevant literature was identified and descriptors of innovativeness were extracted from these sources and collected in a table. It is worth noting that the quantity of sources that attempt to do this are limited, especially with respect to organizations and individuals in construction. A distillation process was employed to eliminate repetition and to group the descriptors by common themes and subjects. Along with contributions of current literature, the themes identified through the distillation process became the shell of the initial framework.

The literature review began with a snowball sampling method and evolved into a purposive sampling. Once a clear picture of innovation literature was obtained (Figure 2.1), the authors targeted innovation literature that focused on describing characteristics of those involved in the innovation process. Purposive sampling allowed the research team to develop a literature base that aided the research goals. This is described further in section 2.3.2.

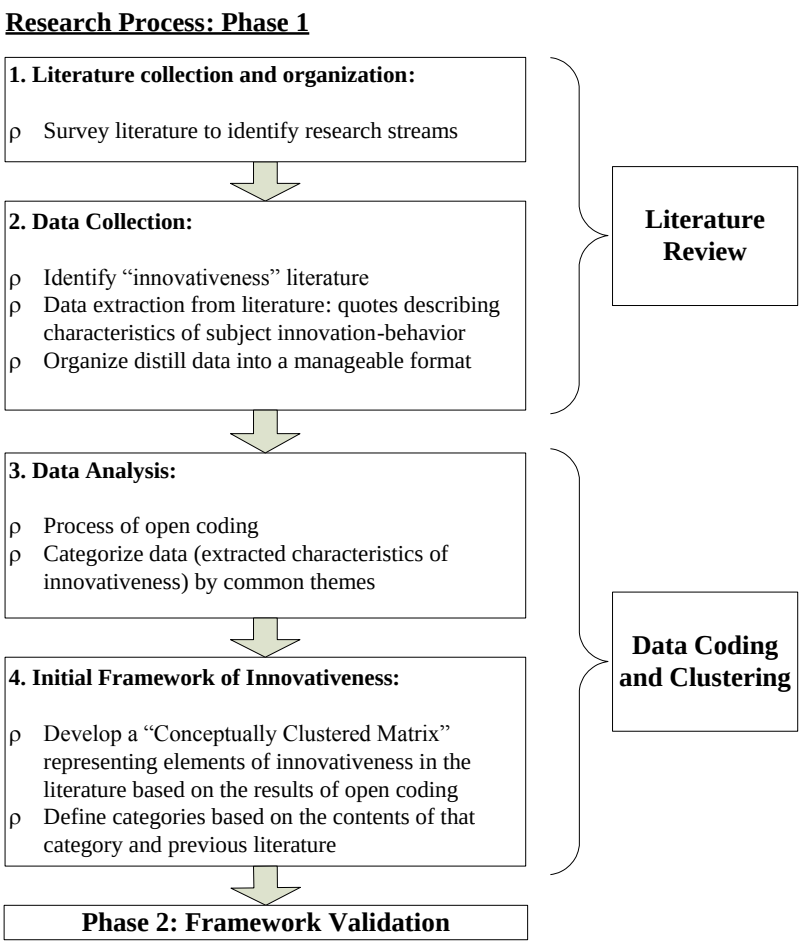


Figure 2.2: Research Process Phase 1

2.3.2 Identifying Literature Targets

Innovativeness is one stream of research that falls in the adoption category. There are minimal studies in the construction realm that deal specifically with innovativeness. Table 2.1, below, provides an outline of the most prominent sources from which characteristics of innovativeness were extracted, describing the studies purpose, the focus in construction and the terms of innovativeness used. Many studies avoid drawing distinction between specific categories of innovativeness, and rather use broad generic labels when describing innovativeness (Martinez and Polo 1996). For this reason, and because there is a lack of consensus on category titles, it is not possible to develop complete innovativeness profiles solely based on literature.

Publication	Objective	Construction Focus	Terms of Innovativeness
Holmen Enterprises, Ltd. (2001)	To identify actions that can be taken to foster more innovation in the housing industry.	Residential construction	Innovative, non-innovative
Davis (2004)	To develop an Resistance to Change Index to predict resistance of AEC professional to IT innovation	U.S. architecture, engineering, contractor and CM firms	None, describes characteristics of resistance to IT change, most aptly characterized as laggard.
J.F. Hickling (1989)	To identify measures that the Canadian government can take to encourage the uptake of innovation in residential construction.	Low-rise residential construction	Innovators and Early Adopters
Rogers (2003); Chapter 7	To identify and define innovativeness and adopter categories.	None, general resource on Innovation.	Innovator, Early Adopter, Early Majority, Late Majority, Laggard
BSRIA (2004)	To identify barriers to innovation in residential construction.	Residential construction	Innovators and Early Adopters
Building Technology Incorporated (2005	To make recommendations for overcoming barriers to innovation in U.S. housing.	Residential Construction	Adopters v. Non-adopters
Hartmann (2006)	To investigate the relationship between organizational culture and innovation in construction firms.	Case study of a Swiss contractor, focuses on organizational culture.	None (The researcher identifies cultural factors that generate an environment conducive to innovation.)
Moore (1999)	Discusses innovation in technology and presents the concept of "Crossing the Chasm"	None, focuses on technology.	Innovator, Early Adopter, Early Majority, Late Majority, Laggard
Toole (1998)	To increase understanding of home builders' behavior regarding technological innovations	Small and medium-sized homebuilding firms	More or less apt to adopt early.
Koebel et al. (2003)	To discover how and why housing innovations become standard.	Large homebuilding firms	More innovative, later adopters
Koebel and McCoy (2006)	To investigate the idea of innovation barriers through builder risk faced by early adopters of innovations.	Homebuilding	None, the authors list factors that influence adoption and diffusion of innovations.
Blackley and Shepard (1996)	To investigate the propensity for homebuilders to adopt innovative methods and materials.	Homebuilding	More or less propensity to adopt innovations.

Table 2.1: Major Sources of Innovativeness Characteristics

2.3.3 Innovativeness Parameter Extraction

When a relevant literature source was identified (those that identify adopter characteristics relative to the adoption-decision process/innovativeness), direct quotes were extracted and documented into a data table. Innovativeness refers to the likelihood of an individual or organization to engage in innovation adoption activities, and therefore quotes describing qualitative or quantitative attributes of organizations or individuals based on propensity towards innovation were deemed relevant. The information that was recorded along with the quote included the source, page number, whether or not it applied to an individual or organization and if the source described a specific adopter category that was being defined (adopter categories according to Rogers (2003)). Figure 2.3 shows a snapshot of a raw extraction as documented in the table. The underlined portion of the quote highlights the significant portion that describes a definable parameter of an adopter.

Quotation (direct excerpts from the listed source)	**P.**	**Source**	**Indiv./Org.?**	**Adopter Cat.**
Innovators normally play an important role, they perform the Economic, Social and Psychological risk assessment for the entire "Community".	20	J.F. Hickling (1989)	Both	Innovators

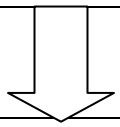
Figure 2.3: Format of Data Extracted from Literature

An innovativeness profiling tool must be adaptable to both large organizations and the individuals that comprise those organizations. It is therefore, imperative to draw early distinctions between appropriate descriptors for individuals, ones for organizations and ones for both. Therefore, "Indiv./Org.?" is used as a marker to track the extraction process and is used to sort innovativeness characteristics for application. Characteristics of individuals and organizations, as data, are managed independent of one another, and are brought back together through the process of conceptual clustering to form the framework presented in Table 2.2., on page 28.

While this work does not specifically develop profiles of innovativeness, this is a goal of future work. Those works that specifically state adopter categories, as in the example in Figure 2.3, were also recorded for use in future application.

The next step in the literature extraction process was to remove relevant innovativeness parameters from the extracted quotation. The result of this process is diagramed in Figure 2.4. This was done for ease of distillation and data management. This step put the data in a form in which the characteristic extracted was easily identified and could be handled independently.

Quotation (direct excerpts from the listed source)	**P.**	**Source**	**Indiv./Org.?**	**Adopter Cat.**
Innovators normally play an important role, they perform the Economic, Social and Psychological risk assessment for the entire "Community".	20	J.F. Hickling (1989)	Both	Innovators

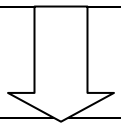


Quotation (direct excerpts from the listed source)	**P.**	**Source**	**Indiv./Org.?**	**Adopter Cat.**
Perform the Economic, Social and Psychological risk assessment	20	J.F. Hickling (1989)	Both	Innovators

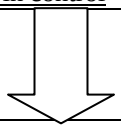
Figure 2.4: Progression of Data Format

Some quotations were extracted in a way that they incorporated multiple characteristics. Once the relevant portion of the quotation was clustered, the next step was to separate the characteristics. The result is a table with one characteristic occupying each line. This process, shown in Figure 2.5, below, allowed the extracted literature data to be clustered into a large list of innovativeness descriptors. The complete data set extracted from literature can be found in Appendix B. The data was then subjected to a process of distillation in order to condense the data and break it down into a manageable form, and is described in section 2.3.4.

Quotation (direct excerpts from the listed source)	**P.**	**Source**	**Indiv./Org.?**	**Adopter Cat.**
The issue gaining highest agreement is that early adopters tend to be "more open to new ideas". This is closely followed by: "they tend to have greater ability to understand innovation" and "they tend to be more positive/in control".	20	BSRIA (2005)	Indiv.	Early Adopter



Characteristic	**Pg.**	**Source**	**Indiv./Org.?**	**Adopter Cat.**
more open to new ideas; they tend to have greater ability to understand innovation"; they tend to be more positive/in control	20	BSRIA (2005)	Indiv.	Early Adopter



Characteristic	**Pg.**	**Source**	**Indiv./Org.?**	**Adopter Cat.**
more open to new ideas	20	BSRIA (2005)	Indiv.	Early Adopter
they tend to have greater ability to understand innovation	20	BSRIA (2005)	Indiv.	Early Adopter
they tend to be more positive/in control	20	BSRIA (2005)	Indiv.	Early Adopter

Figure 2.5: Data Progression for data points encompassing multiple characteristics

2.3.4 Innovativeness Parameter Distillation and Categorization

The extraction process was followed by a methodical distillation of the characteristics, which began by sorting the characteristic based on applicability to individuals or organizations. A line-by-line analysis was then conducted to assign a preliminary innovativeness category, if not already done by the source (based on the context of the source and Roger's (2003) definitions of each adopter category) and to eliminate repetition. The list of descriptive characteristics were then sorted into four separate tables based on the determined adopter category (Innovator, Early Adopter, Early Majority, and Late Majority/Laggard), resulting in eight separate tables (four each for characteristics of individuals and organizations). Because this work is intended to serve as the foundation for developing a 4-quadrant profiling tool, Late Majority and Laggard are combined into one category. This research does not incorporate the development of adopter category profiles or a profiling tool and therefore discussion of steps involving the division of data based on adopter categories is excluded from this paper. It is important to note that

preliminary adopter category assignments had no bearing on the results of the coding process or framework development.

A second line-by-line analysis was conducted on each of the eight tables (described above) and the data was subjected to a process of open coding. Open coding is a process by which qualitative data is conceptually labeled to form categories and subcategories (Corbin and Strauss 1990; Crook and Kumar 1998; Robson 2002). At this point the research team utilized the literature review results to develop a framework within which to categorize the individual and organizational characteristics of innovativeness extracted from research literature. Figure 2.6 shows the format in which the data was put during the categorization process. This is explained further below. Appendix C and D are the complete coding results broken apart by "Individual Characteristics" and "Organizational Characteristics".

Innovativeness Category	**Major Focus Areas of Change**	**Focus Strategy (within major areas)**	**Characteristic/trait**	**Source**	**P#**
Innovators	Communication	Stakeholder Resources	greater emphasis on subcontractor dependability	Koebel and McCoy (2006)	12
Innovators	Communication	Stakeholder Resources	not powerful enough to dictate the buying decisions of others	Moore (1999)	33

Figure 2.6: Data Format after Clustering and Coding

Rogers (2003) divides his discussion of innovativeness by individual innovativeness and organizational innovativeness. For individuals three major categories of innovativeness characteristics are identified: 1) "Socioeconomic Characteristics"; 2) "Personality Variables"; and 3) "Communications Behaviors" (Rogers 2003). Rogers (2003) presents three major categories of variables investigated in studies of organizational innovativeness. They are: 1) "Individual (Leader) Characteristics", including "attitude toward change"; 2) "Internal Characteristics of Organizational Structure", including "centralization, complexity, formalization, interconnectedness, organizational slack and size"; and 3) "External Characteristics of the Organization", including "system openness" (Rogers 2003). Koebel et al. (2003) placed the variables effecting adoption and diffusion of innovation in the homebuilding industry found in scholarly literature into the following categories:

- "The adopter's human resources
- Organizational structure
- Organizational culture and decision process
- Market context
- Industry characteristics
- Communication channels and social networks
- Technical attributes of the innovation
- Economic attributes of the innovation"

Furthermore, Mitropoulos and Tatum (2000) identified 5 organizational, characteristic-based focal points of innovativeness research, including: 1) "centralization of decision making"; 2) "technological capabilities"; 3) "organizational environment"; 4) "slack resources"; and 5) "external communication channels". BTI (2005) refers to four categories of barriers to innovation, namely fragmentation, risk, education and cultural values. This research found that the characteristics of innovativeness, describing members of the construction industry, extracted from the literature were closely in line with the categories identified by Rogers (2003), Koebel et al. (2003), Mitropoulos and Tatum (2000) and BTI (2005), and therefore utilized these categories as models in the development of the "Major Focus Areas", or the x-axis of the innovativeness framework. Each Major Focus Area was further broken down into what the researcher terms "Strategic Areas of Innovativeness", or the y-axis of the innovativeness framework. Strategic areas of innovativeness describe sub-categories within each Major Focus Area. Column 2 and 3 in Figure 2.6 above, contain the Major Focus Area and Strategic Areas of Innovativeness, respectively. Definitions were developed for each term incorporated into the innovativeness framework based on literature and the contents of the category being defined.

2.3.5 Initial Framework Development Findings

The initial framework development began with the distillation process described in section 2.3.4. The coding labels identified during the literature review and extraction process were incorporated into a conceptually clustered matrix framework. The intent of this framework is to clearly and succinctly define the elements of innovativeness as defined by the literature. Therefore, the next step was to define all the terms (Major Focus Areas and Strategic Areas of

Innovativeness) used to categorize characteristics of innovativeness. The definitions developed are listed below and summarized in Table 2.2 in a matrix format.

Major Focus Areas:

Demographics – Descriptive statistics (quantity) of individual or organizational Resources.

Communications – A stakeholder's ability and means of information exchange among individuals or among and within external organizations.

Culture – Functional attitudes through which individuals or organizations derive benefits (von Hippel).

Risk – The probability of an undesired event's occurrence and the significance of the consequence of that occurrence (Pritchard).

Strategic Areas of Innovativeness (by MFA):

Demographics:

Educational Statistics - Knowledge resources of the individual or organization, including:

- Education Level
- Training Level
-Technical Skills Level

Financial Statistics - Financial resources of the individual or organization, including:

- Income Level
- Earning Potential

Statistical Size (applies to organizations only) - Number of individuals within the firm or adopter category, including:

- 1-199 Small
- 200-499 Medium
- >499 Large (Rothwell)

Statistical Region (applies to organizations only) - The concentration of technical or business operations in one or more geographical areas, including:

- Local
- National
- International

Communications:

Transfer Processes – Capacity for transferring specific knowledge among individuals or organizations, including:

- Technical Information
- Tacit Knowledge
- Origins and Flow of information
- Other Transfer Capacity

Stakeholder Relationships – The position of the stakeholder among others, including:

- Supply Chain Location
- Relationship among other stakeholders

Culture:

Innovative - The activities and attitudes surrounding adoption of new products, processes, or systems, including:

- Innovation Decision Process
- Innovation Attitude
- Innovation Championing
- Attitude Towards Change

Corporate or Individual - The characteristics or behavior patterns of a specific population, including:

- Actions & practices (Indiv. & org.)
- Policies (org.)
- Norms (indiv.)

- Ethics (indiv. & org.)

Economic - The characteristics or behavior patterns towards commodities, including:

- Consumption
- Distribution
- Production

Creative - The ability for original acts and thoughts, including:

- Artistic Quality
- Imaginative Quality
- Intangibles(Johansen, Medici Effect)

Risk:

Mitigation - Management of the probability of occurrence, including:

- Management of: Materials (technical) & Timing
- Management through: Methods (programmatic) & Logical path
- Cost

Tolerance - Acceptance of the probability of occurrence, including:

- Reliability, Maintainability & Durability
- Affordability

Strategic Areas of Innovativeness	Major Focus Areas: Demographics	Communications	Culture	Risk
	Descriptive statistics (quantity) of individual or organizational Resources.	A stakeholder's ability and means of information exchange among individuals or among and within external organizations.	Functional attitudes through which individuals or organizations derive benefits (von Hippel).	The probability of an undesired event's occurrence and the significance of the consequence of that occurrence (Pritchard).
	1) Educational Statistics: Knowledge resources of the individual or organization, including: -Education Level -Training Level -Technical Skills Level	1) Transfer Processes: Capacity for transferring specific knowledge among individuals or organizations, including: -Technical Information -Tacit Knowledge -Origins and Flow of information -Other Transfer Capacity	1) Innovative: The activities and attitudes surrounding adoption of new products, processes, or systems, including: -Innovation Decision Process -Innovation Attitude -Innovation Championing -Attitude Towards Change	1) Mitigation: Management of the probability of occurrence, including: -Management of: Materials (technical) & Timing -Management through: Methods (programmatic) & Logical path -Cost
	2) Financial Statistics: Financial resources of the individual or organization, including -Income Level -Earning Potential	2) Stakeholder Relationships: The position of the stakeholder among others, including: -Supply Chain Location -Relationship among other stakeholders	2) Corporate or Individual: The characteristics or behavior patterns of a specific population, including: -Actions & practices (Indiv. & org.) -Policies (org.) -Norms (indiv.) -Ethics (indiv. & org.)	2)Tolerance: Acceptance of the probability of occurrence, including: -Reliability, Maintainability & Durability -Affordability
	3) Statistical Size: Number of individuals within the firm or adopter category, including: -1-199 Small -200-499 Medium ->499 Large (Rothwell) -Or Rogers' adopter categories		3) Economic: The characteristics or behavior patterns towards commodities, including: -Consumption -Distribution -Production	
	4) Statistical Region: The concentration of technical or business operations in one or more geographical areas, including: -Local -National -International		4) Creative: The ability for original acts and thoughts, including: -Artistic Quality -Imaginative Quality -Intangibles (Johansen, Medici Effect)	

Table 2.2: Initial Framework of Innovativeness (note: shaded areas apply to organizations only)

Chapter 3: Phase 2 - Innovativeness Framework Validation

3.1 Phase 2 Overview

The Phase 2 research process involves 4 distinct steps, including: 1) Expert panel selection and solicitation; 2) Framework validation; 3) Validated framework development; and 4) Categorization of innovativeness parameters, beginning with the framework developed in Phase 1 (described in Chapter 2). The process is diagrammed and outlined in Figure 3.1 and described in detail in the remainder of this chapter.

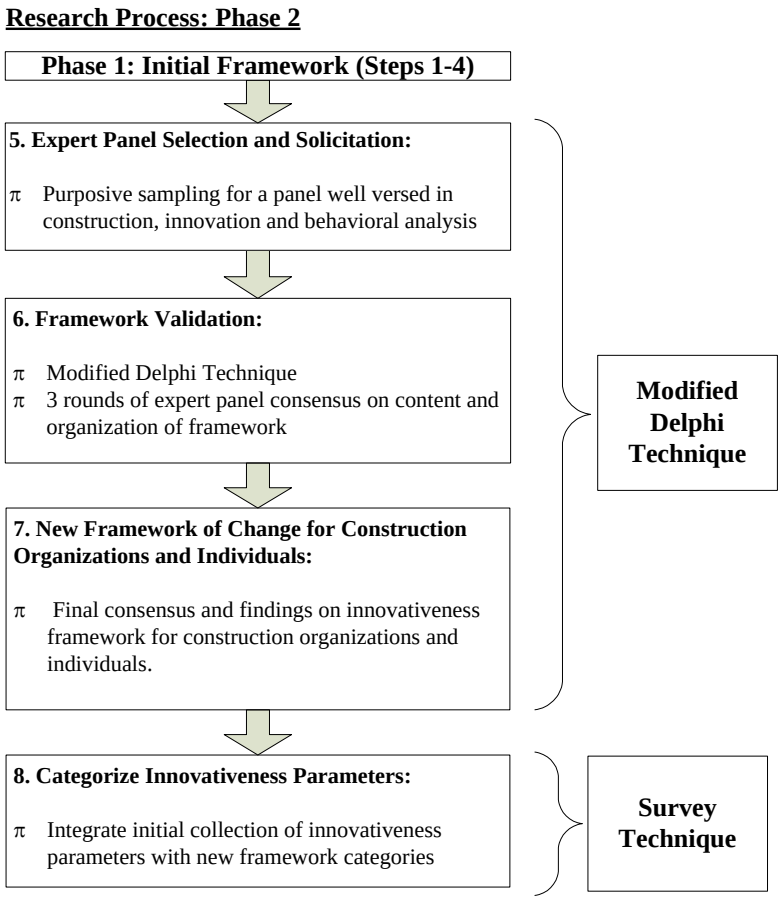


Figure 3.1: Phase 2 Research Process Map

3.2 Methodology

Phase 2 employed a modified Delphi process technique, which consisted of 3 survey rounds delivered to a panel of 7 experts. Experts were selected using a purposive sampling method (Robson 2002) to meet the rigors and complexities of innovation and construction. The research team identified experts that covered a range of topics in innovation and behavioral studies, which are outlined in section 3.3. The Delphi method is designed to harness the experiences of a panel

of experts to gain consensus on a given topic or series of topics in a structured and interactive way (Hallowell 2009). The Delphi method is appropriate for this research topic because complexities of innovation and construction research and the qualitative nature of innovativeness. Quantitative, objective data for this phase of the research is unrealistic (Hallowell 2009). A Delphi technique, in this setting, offers an opportunity to identify convergence or divergence between current literature and the opinion of field experts. This divergence then highlights areas of understanding that require emphasis in future research.

Historically, the Delphi process is conducted through paper-based means and face-to-face discussions of the results between rounds (Colton and Hatcher 2004). Colton and Hatcher (2004) utilized a web-based Delphi process in a study of adult education research. This research also adopted a web-based method for Delphi data collection in order to increase anonymity, reduce bias and bridge geographical barriers. A limitation of the process used is the lack of expert interaction, anonymous or otherwise. In eliminating expert interaction, true topic discussion is also eliminated. In order to minimize this limitation, all comments questioning aspects of the framework were included as changes or modifications in subsequent surveys and experts were encouraged to make comments.

3.3 Framework Validation through a modified Delphi Process

In order to validate the findings of the Phase 1, a modified Delphi process was adopted. A Delphi Process was selected because of its flexible nature in collecting and validating qualitative data in a complex field of study.

The process began by selection and solicitation of a panel of experts. A list of prospective experts was hand-selected by the research team based on expertise in various aspects of innovation, construction and behavioral analysis. The target fields of expertise include:

- Mgmt of large constr. Corp.;
- Mgmt of small constr. Corp.;
- Construction Risk ;
- Construction innovation;
- Organizational dynamics;
- Construction communications; and

- Individual leadership training and personal development.

These areas of expertise were dictated by the existing body of knowledge in the field of innovation. Industry professionals with management experience in small and large construction companies are needed because of their expertise in the daily operations in a construction organizations, as well as experience in organizational change. Innovation, by definition, implies inherent risk and the operation in the construction industry brings unique risks not faced in other industries (Koebel and McCoy 2006). Therefore, expertise in construction risk is critical to any discussion of innovation in construction. Obviously, expertise in construction innovation in research and practice is necessary for a well-rounded innovation expert panel. Organizational dynamics refers to the adaptive nature of the relationships within and among organizations. The dynamic environment of the construction industry demands change of the individuals and organizations that operate within it (Singh and Shoura 1999). Often times this change must be innovative in nature, and therefore becomes a necessary area of expertise. Communications refers to the channels and methods of knowledge transfer, as well as the role of individuals and organizations within the construction supply chain. The uptake of innovation can only happen when communication channels are present (Rogers 2003). Equally important are the roles that members of the supply chain play in the spread of innovation (Rogers 2003). For example, Hickling (1989) discusses the importance that "Innovators" play in the initial assessment of an innovation for the industry, although others point out the lack of opinion leadership that "Innovators" have in influencing the adoption decisions of other members of a social network (Moore 1999; Rogers 2003). It is, therefore, necessary to seek expertise in the area of construction communications. Individual leadership training and personal development is an important area of expertise because the framework is designed to be applicable to both individuals and organizations and also because of the goal of working towards a tangible profiling tool.

Identified potential experts were solicited via electronic mail for participation in a three-part Delphi process. Of the initial nine experts solicited, seven agreed to participate in the research. The expert panel was comprised of 3 current industry professionals, 3 members of construction

academia and 1 behavioral analysis expert. All panel members maintain a basis of expertise in one or more of the areas discussed above.

The validation process consisted of a modified Delphi process designed to validate the structure and definitions that constituted the initial innovativeness framework developed in Phase 1. The Delphi process was administered via online surveys (created and administered using survey.vt.edu, a tool offered and managed by Virginia Tech) and consisted of three survey rounds, one initial round and two consensus rounds, with data analysis and survey development periods after each round (three total). Initial round questions asked experts for agreement or disagreement on the structure of the framework as well as the definitions of the categories of innovativeness parameters. Because the methodology used eliminated expert interaction, experts were encouraged to write comments. The results of each round were analyzed by the research team to develop the subsequent round surveys and finally the updated framework of innovativeness.

The Round 1 survey of the Delphi process consisted of 34 questions relating to the structure and definitions of the framework. Experts were asked to agree or disagree with the categories within the framework and the corresponding definitions, and list any comments. Additionally, experts were asked to suggest Major Focus Areas or Strategic Areas of Innovativeness that were thought to be missing. In an effort to aid understanding and comprehension of the innovativeness construct and to preclude bias, the experts were provided with a copy of the initial framework in a matrix format, without any definitions. Of the seven surveys distributed all seven were returned. The complete Round 1 survey tool and results can be found in Appendix E and F.

The Round 2 survey consisted of 37 questions, comprised of non-consensus, dissent and proposed changes, as well as suggested additions recorded in the results of Round 1. Suggested changes and additions were presented to the experts as proposed changes, using wording such as "the following change has been proposed to the definition of…" so as to promote a form of dialogue between the experts. Of the seven surveys distributed five surveys were returned. The complete Round 2 survey tool and results can be found in Appendix G and H.

The Round 3 survey consisted of 12 questions, formulated the same way as Round 2. Of the seven surveys distributed three surveys were returned. Consensus was deemed to have been reached in all areas of question, and thus Round 3 was the final round of survey. The complete survey and results can be seen in Appendix I and J.

During the analysis period, consensus was deemed to have been reached when two-thirds or more of the respondents agreed and there were no dissenting comments. A dissenting comment was one in which the content or intent of the category or definition was questioned. Comments from the expert panel were a large part of the data collected for this portion of the Delphi process, and no comments were ignored. Comments for amendments and clarifications were incorporated into the matrix and then presented to the expert panel for consensus on the changes. Those questions that had a majority agreement with no comments were considered in consensus. Those without majority were modified based on comments and then put back to the expert panel as proposed changes in subsequent rounds. Therefore, the non-consensus round surveys were made up of questions in which there was no consensus or if a change was proposed. The results of the third survey round (2^{nd} consensus round) were analyzed and incorporated into the initial innovativeness framework to generate a validated framework.

3.4 Modified Delphi Finding

The resulting framework is presented in Figure 3.2, and summarized below. Notable major differences between the initial framework and the validated framework are the additions of two Major Focus Areas, *Market Conditions* and *Adaptability*. Also, the addition of the Strategic Area of Innovativeness, *Conflict Management*, to Culture and the addition of *Industry Sector* to Demographics. Below is a summary of the definitions that resulted from the Delphi process described above.

Major Focus Areas:

Demographics - Descriptive statistics (quantifiable) of individual or organizational resources

Market Conditions – The character of the market into which a firm is entering or is already a part of, including number of competitors, intensity of competition, complexity of challenges and the market's growth rate

Communications – The ability and means of information exchange

Culture – Functional attitudes through which individuals or organizations derive benefits (von Hippel).

Adaptability – Ability and willingness to fit changing circumstances

Risk – The probability of an undesired event's occurrence and the significance of the consequence of that occurrence (Pritchard).

Strategic Areas of Innovativeness (by MFA):

Demographics:

Educational Statistics – Knowledge resources of the individual or organization, including education level, training level, tenure and technical skills level.

Financial Statistics – Financial resources of the individual or organization, including

- Income Level
- Earning Potential

Statistical Size – Number of individuals within the firm, defined as:

- 1-99 Small
- 100-499 Medium
- >499 Large (Rothwell)

Statistical Region – The concentration of technical or business operations in one or more geographical areas, including:

- Local
- National
- International

Industry Sector – Industry specific products, services and systems of work

Market Conditions: No Strategic Areas of Innovativeness

Communications:

Transfer Processes – Capacity for transferring specific knowledge among individuals or organizations, including:

- Technical Information
- Tacit Knowledge
- Origins and Flow of information
- Other Transfer Capacity

Stakeholder Relationships – The role of an organization or individual among other supply chain members and/or project stakeholders

Culture:

Innovative – The activities and attitudes surrounding adoption of new products, processes, or systems, including:

- Innovation Decision Process
- Innovation Attitude
- Innovation Championing
- Attitude Towards Change

Corporate or Individual – The characteristics or behavior patterns of a specific population, including:

- Actions & practices (Indiv. & org.)
- Policies (org.)
- Norms (indiv.)
- Ethics (indiv. & org.)

Economic – Attitudes and behavior towards management of financial resources, goods and services

Creative – An emphasis on original thoughts and acts, including artistic quality, imaginative quality and intangibles (Johansen, Medici Effect)

Conflict Management – Ability and willingness to address disagreement

Risk:

Mitigation – Management of the probability and impact of an uncertain event's occurrence

Tolerance – The degree of uncertainty that an individual/organization can handle in regard to an uncertain event.

Strategies for focusing on individual and organizational change

STRATEGIC AREAS OF INNOVATIVENESS	MAJOR FOCUS AREAS (of individuals and organizations)					
	Demographics Descriptive statistics (quantity) of individual or organizational Resources.	**Market Conditions** The character of the market into which a firm is entering or is already a part of, including number of competitors, intensity of competition, complexity of challenges and the market's growth rate	**Communications** The ability and means of information exchange	**Culture** Functional attitudes through which individuals or organizations derive benefits (von Hippel).	**Adaptability** Ability and willingness to fit changing circumstances	**Risk** The probability of an undesired event's occurrence and the significance of the consequence of that occurrence (Pritchard).
	1) Educational Statistics: Knowledge resources of the individual or organization, including education level, training level, tenure and technical skills level.		1) Transfer Processes: Capacity for transferring specific knowledge among individuals or organizations, including: -Technical Information -Tacit Knowledge -Origins and Flow of information -Other Transfer Capacity	1) Innovative: The activities and attitudes surrounding adoption of new products, processes, or systems, including: -Innovation Decision Process -Innovation Attitude -Innovation Championing -Attitude Towards Change	1) Agility: The ability of an individual or organization to respond to market or circumstance changes to remain viable and profitable	1) Mitigation: Management of the probability and impact of an uncertain event's occurrence
	2) Financial Statistics: Financial resources of the individual or organization, including -Income Level -Earning Potential		2) Stakeholder Relationships: The role of an organization or individual among other supply chain members and/or project stakeholders	2) Corporate or Individual: The characteristics or behavior patterns of a specific population, including: -Actions & practices (Indiv. & org.) -Policies (org.) -Norms (indiv.) -Ethics (indiv. & org.)		2)Tolerance: The degree of uncertainty that an individual/organization can handle in regard to an uncertain event.
	3) Statistical Size: Number of individuals within the firm or adopter category, including: -1-99 Small -100-499 Medium ->499 Large (Rothwell)			3) Economic: Attitudes and behavior towards management of financial resources, goods and services		
	4) Statistical Region: The concentration of technical or business operations in one or more geographical areas, including: -Local -National -International			4) Creative: An emphasis on original thoughts and acts, including artistic quality, imaginative quality and intangibles (Johansen, Medici Effect)		
	5) Industry Sector Industry specific products, services and systems of work			5) Conflict Management Ability and willingness to address disagreement		

Figure 3.2: Innovativeness Framework updated through a modified Delphi technique (note: shaded areas apply to organizations only)

3.5 Innovativeness Parameter Re-Categorization

The final research step is a re-coding of the characteristics of innovativeness extracted from the literature through a survey technique. The survey tool was created in a Microsoft Excel worksheet with three tabs. The first tab gave instructions, the second tab listed all of the individual characteristics of innovativeness collected from literature and the third tab listed all of the organizational characteristics of innovativeness collected from literature.

The survey was distributed to the same expert panel that participated in the Delphi process used to validate the Innovativeness Framework (7 members). Expert panel members were asked to answer three questions for each characteristic listed on the tabs described above, only the first of which is utilized for this research. Experts were first asked to select the Major Focus Area (MFA)/Strategic Area of Innovativeness (SAoI) combination that the descriptor fit into. The MFA/SAoI combinations were based on the Innovativeness Framework developed during Phase 2. The experts were then asked to select an adopter category (based on Rogers' (2003) adopter categories) that the characteristic best described, and third they were asked to select a secondary category that the characteristic might also describe, if any at all. As mentioned above, the data collected from the second two questions has not been utilized as part of the research paper.

The researcher utilized a list/dropdown menu function in MS Excel and password protected the worksheets to eliminate the possibility of inadvertent tampering of the structure or content of the survey tool. This allowed the survey taker to only select pre-programmed responses, corresponding the MFAs and SAoIs defined in the previous research steps. The responses programmed for the "Major Focus & Strategic Areas" column (see Figure 3.3) are listed below:

- Demographics – Education;
- Demographics - Financial Stat.;
- Demographics – Size;
- Demographics – Region;
- Demographics - Industry Sector;
- Market Conditions;

- Communications - Transfer Processes;
- Communications - Stakeholder Relationships;
- Culture - Innovative;
- Culture - Individual/Corporate;
- Culture – Economic;
- Culture – Creative;
- Culture - Conflict Management;
- Adaptability – Agility;
- Risk – Mitigation; and
- Risk – Tolerance.

Figure 3.3 shows a snapshot of a returned survey, detailing the format and the questions asked of the expert panel. A complete version of the survey and a summary of results can be found in Appendix K and L. Of the 7 surveys distributed 5 surveys were returned, one of these being half completed.

#	Characteristic/trait	What Major Focus Area and Strategic Area of Change combination does this characteristic fit into? **Major Focus & Strategic Areas**	What Innovativeness Category does this characteristic describe (according to Rogers)? **Primary Innovativeness Category**	What other Innovativeness Category might this characteristic describe (according to Rogers)? **Secondary Innovativeness Category**
1	higher average levels of education and training	Demographics - Education	Early Adopters	Innovators
2	greater average technical knowledge	Demographics - Education	Innovators	Early Adopters
3	higher capacity for innovation	Culture - Innovative	Innovators	Early Adopters

Figure 3.3: Snapshot of a Returned Expert Survey

The Data collected in Step 8, described in this section above, is utilized to re-populate the validated framework. In other words, the experts performed an open coding operation, which served two purposes. The first is to code that data (innovativeness characteristics extracted from literature) based on the updated framework. This is necessary because the original code may or may not be valid based within the context of the restructured framework. The second purpose is to allow for the identification of patterns in the agreement or disagreement between current literature and expert opinion. These patterns can potentially highlight areas of weakness in the current framework that require additional investigation, as well as highlight gaps in the current innovation body of knowledge. The results of the survey are presented in the next section.

3.6 Survey Analysis and Findings

Data collected from the experts was aggregated into two separate MS Excel files, one for individual characteristics and one for organizational characteristics. The worksheet table lists three key pieces of information. The first is the characteristic extracted from the literature. The second is the original coding, assigned during Phase 1. The third is the coding (MFA-SAoI combination) selected by the survey respondents.

In order to more easily see patterns and make comparisons, a number system was employed to replace the MFA-SAoI coding, written out long-hand. Each MFA-SAoI combination was assigned a number with a whole number and one decimal place. The whole number represents the Major Focus Area and the decimal place represents the Strategic Area of Innovativeness. For instance Demographics is "1" and the first SAoI in Demographics (Educational Statistics) is ".1" and the second (Financial Statistics) is ".2", etc. This allowed for each MFA to have a single number assigned to it (1-6) while allowing for unique identification of the SAoI. The list of number assignments is provided in Table 3.1.

MFA-SAoI Combination	# Assignment
Demographics - Education	1.1
Demographics - Financial Stat.	1.2
Demographics - Size	1.3
Demographics - Region	1.4
Demographics - Industry Sector	1.5
Market Conditions	2.1
Communications - Transfer Processes	3.1
Communications - Stakeholder Relationships	3.2
Culture - Innovative	4.1
Culture - Individual/Corporate	4.2
Culture - Economic	4.3
Culture - Creative	4.4
Culture - Conflict Management	4.5
Adaptability - Agility	5.1
Risk - Mitigation	6.1
Risk - Tolerance	6.2

Table 3.1: Numbering Convention for Survey Data Analysis

The MFA-SAoI coding, based on the initial literature review and the expert's survey responses, were replaced with the corresponding number assignment, as listed in Table 3.1. Using the query function in MS Excel, the data was sorted based on the original Major Focus Area (first number) that was assigned during the development of the initial framework, yielding four

worksheet tabs for both the organizational characteristics and individual characteristics. This was done to break the data into a manageable format and to allow for ease of comparing the initial literature-based coding with expert opinion. Again, the data is managed in categories based on application to individuals or organizations, and results are summarized separately and cumulatively.

Once the data was sorted, a line-by-line comparative analysis was conducted. There are five questions that were asked for each data point. The questions are as follows:

1) Is there unanimous agreement between the literature MFA coding and all experts?
2) Is there majority (greater than 50%) agreement on the MFA coding? (excluding the original literature placement)
3) If there is majority agreement, does the expert majority agree with the literature coding or not?
4) Is there unanimous agreement on the MFA-SAoI coding between the literature and all experts?
5) Is there majority agreement on the MFA-SAoI coding amongst the experts?

The complete data analysis can be found in Appendix L and M. The results of this comparative analysis were tabulated and summarized in a summary table. These summary tables (one for individuals and one for organizations), provided in Table 3.2 and 3.3, list the percentage of either consensus or majority agreement for all of the data points, separated by the four original Major Focus Areas. The exception is column 4 in both Table 3.2 and 3.3. Column 4 lists the percentage of negative results found during the analysis. In other words, column 4 lists the percentage of majority expert disagreement with the original literature Major Focus Area coding. Two summary lines are also provided listing the cumulative results for Individual data points, Organizational data points and for all data points.

	MFA Consensus	MFA Majority	Expert disagreement with literature	SAoI Consensus	SAoI Majority
Demographics	11%	89%	11%	0%	78%
Communications	10%	48%	19%	5%	29%
Culture	6%	72%	19%	0%	28%
Risk	0%	100%	0%	0%	86%
Totals (Ind.)	7%	70%	16%	1%	41%
Totals for Ind. & Org.	18%	66%	12%	8%	40%

Table 3.2: Individual Characteristics of Innovativeness

	MFA Consensus	MFA Majority	Expert disagreement with literature	SAoI Consensus	SAoI Majority
Demographics	50%	83%	11%	44%	67%
Communications	9%	45%	9%	9%	23%
Culture	27%	64%	7%	4%	31%
Risk	10%	70%	10%	0%	70%
Totals (Org.)	25%	64%	8%	13%	40%
Totals for Ind. & Org.	18%	66%	12%	8%	40%

Table 3.3: Organizational Characteristics of Innovativeness

The implications of these data are discussed in Section 4.2

Chapter 4: Discussion and Conclusion

4.1 Defining Innovativeness through a Framework

As members of the U.S. construction industry continue to operate in a dynamic environment, innovation will remain an important tactic for gaining a competitive edge (Porter 1985; Mitropoulos and Tatum 2000). What remains clear is that innovation involves immensely complex topics of study (Sexton and Barrett 2003), highlighted by the great breadth of innovation research topics and often confusing intermingling of approaches and foci. In the construction industry the complexities surrounding mechanisms of innovation are further complicated by the unique attributes of the industry. Therefore, understanding the mechanisms that surround innovation and those parameters that define innovativeness, manifested through observable behaviors and characteristics of adopters, within and among construction firms will arm industry members with the information for more successful innovation initiatives. This work provides a preliminary construct for defining innovativeness for individuals and organizations in construction in a way that standardizes language and definitions, which is termed a *Framework of Innovativeness*.

The resulting framework, developed through a literature review and modified Delphi process, presented in this paper is a step towards developing an innovativeness profiling tool by providing a means to categorize and classify parameters of innovation. This is a necessary step in the efforts to develop such a tool because the tool must be founded in construction innovation literature. Furthermore, such a framework provides guidance in efforts aimed at increasing innovativeness. One cannot understand innovativeness without a means of defining and classifying its parts. This work establishes a context for defining innovativeness based on the observable behaviors and characteristics of adopters, similar to the measurement tool envisioned by Goldsmith and Hofacker (1991), rather than relying on data based on timing and quantity of innovation adoptions. Such methods, as discussed in section 1.2.4, involve labor intensive data collection methods and are impractical (Fell et al. 2003; Goldsmith and Hofacker 1991) for many members of the construction supply chain.

Traditional methods of measuring innovativeness provoke a discussion of convenience. To increase convenience in identifying adopter categories, Rogers (2003) introduces the concept of the *ideal type* through defining adopter categories (Innovators, Early Adopters, Early Majority, Late Majority and Laggards). These ideal types embody the defining characteristics of each category, but lack discrete beginnings and ends. This means that there is overlap between categories, and that an individual that is predominantly laggard may share some characteristics with the Late Majority, for example. This research was designed to develop a convenient means of defining innovativeness for construction and indicates that such ideal types are needed in defining categories of innovativeness in construction research. This is indicated by the variation in expert response in categorizing characteristics of innovativeness combined with previous difficulties in consistent correlation of independent variables to innovativeness. Characteristics of innovativeness may fall across more than one category, bringing into question the convenience of a framework, such as the framework presented in this work.

However, such a framework can increase the understanding of complex concepts, such as innovativeness. Innovativeness is an abstract concepts and when defined simply as *the likelihood of an individual or organization to engage in innovation activities relative to other members of a social network* (Rogers 2003; McCoy 2009), does little to describe what it means to the industry and the practical benefits that are possible through understanding it. Through the construct presented herein developed specifically for the construction industry, though refinement is still needed, members of the industry can begin to conceptualize innovativeness as a mechanism to promote change efforts, as opposed to a confusing, abstract concept. For instance, the Framework of Innovativeness identifies various elements that affect an organization's overall innovativeness, including communications structures and culture. Though this work does not advance to the point of measuring innovativeness through the developed construct, simply understanding that aspects of daily standard operating procedures affect innovativeness is a benefit not offered through conventional innovativeness measures.

The flexible design methodology used in this work was designed to extract characteristics of innovation adopters from current literature in order to build a fundamental construct of innovativeness. As the data was analyzed repetition of themes was present, and the researcher

began to assign categories to each data point. The data was divided into major category headings and subcategories, termed *Major Focus Areas* and *Strategic Areas of Innovativeness*, respectively. The terms *Major Focus Areas* and *Strategic Areas of Innovativeness* are used to identify the components of innovativeness in a way that highlights the operational nature of this framework.

Through the process of coding the literature data, it was found that propensity for innovation can be characterized by observable characteristics and patterns of behavior. The major categories identified in the literature include demographics, communication/knowledge flow (both internally and externally), organizational and individual culture and risk management. The modified Delphi technique, outlined in Chapter 3, identified two additional Major Focus Areas of innovativeness, namely Market Context and Adaptability.

Rogers (2003) divides his discussion of innovativeness by individual innovativeness and organizational innovativeness. For individuals three major categories innovativeness characteristics are identified: 1) "Socioeconomic Characteristics"; 2) "Personality Variables"; and 3) "Communications Behaviors" (Rogers 2003). Rogers (2003) presents three major categories of variables investigated in studies of organizational innovativeness. They are: 1) "Individual (Leader) Characteristics", including "attitude toward change"; 2) "Internal Characteristics of Organizational Structure", including "centralization, complexity, formalization, interconnectedness, organizational slack and size"; and 3) "External Characteristics of the Organization", including "system openness" (Rogers 2003). Koebel et al. (2003) placed the variables effecting adoption and diffusion of innovation in the homebuilding industry found in scholarly literature into the following categories:

- "The adopter's human resources
- Organizational structure
- Organizational culture and decision process
- Market context
- Industry characteristics
- Communication channels and social networks
- Technical attributes of the innovation

- Economic attributes of the innovation"

Furthermore, Mitropoulos and Tatum (2000) identified 5 organizational, characteristic-based focal points of innovativeness research, including: 1) "centralization of decision making"; 2) "technological capabilities"; 3) "organizational environment"; 4) "slack resources"; and 5) "external communication channels".

Syntheses of innovativeness research that identify categories of characteristics affecting innovation adoption decisions, such as those described above, were noted during the data collection of Phase 1. The data coding process, conducted during Phase 1, and the modified Delphi technique, of Phase 2, yielded a set of categories of similar character to these previous works. Table 4.1 plots the categories of previous works as they fit into the categories established in this work.

	Categories established in this work						
Research	**Demographics**	**Market Conditions**	**Communications**	**Culture**	**Adaptability**	**Risk**	**Categories identified in previous work**
Rogers (2003), Ind.	Socioeconomic characteristics	Does not apply	Communication behaviors	Personality variables	Personality variables	Personality variables	
Rogers (2003), Org.	Complexity, size, organizational slack	Ext. char. of the org. (System openness)	Centralization, interconnectedness	Individual leadership char. (attitudes toward change), formalization	No comparable category	Organizational slack	
Koebel (2003)	Human Resources, Industry characteristics	Market context	Org. structure, comm. channels and social networks	Organizational culture and decision process	No comparable category	Technical and economic attributes of innovation	
Mitropoulos and Tatum (2003)	Technological capabilities, slack resources	No comparable category	centralization of decision making, external comm. channels	Organizational environment	No comparable category	Slack resources	

Table 4.1: Innovativeness categories established in this work vs. those identified in previous work

First and foremost, this table highlights the variation present within innovation literature for a single concept and serves to reinforce the need for a standard construct of innovativeness for the construction industry. Variation among terms only serves to exacerbate the confusion that surrounds innovation. Rogers (2003) asserts that in general the concept of innovativeness is the most well developed of any in diffusion research. However, the results of this work show that,

specific to construction, there still exist significant gaps in the understanding of innovativeness, and may be a reason that construction has been labeled and criticized for being laggard. As a result of the knowledge gaps, there is a lack of consistency in the way that innovativeness is measured and defined for the construction industry. This supports the discussion by Mitropoulos and Tatum (2000) describing the inconsistency in innovativeness findings.

All four of the works, discussed above, stop short of developing a complete construct of innovativeness, which was not necessarily the intent of their work. These works serve as a point of departure for the work presented in this document. The Framework of Innovativeness developed during this research refines and modifies the categories identified in previous research towards a goal of creating a standard, comprehensive construct applicable to the construction industry. It provides an integrated view of the independent variables that effect innovativeness, which are typically investigated independent of one another. The results of this work may suggest that there is a holistic nature to innovativeness, requiring comprehensive consideration in research design that may lead to inconsistent findings when ignored.

As this work points out, innovation and more specifically, innovativeness is a complex topic, and as a result construction researchers have encountered difficulty in generating consistent innovativeness findings. A quantitative research effort, which describes many of the existing construction innovativeness studies, is unable to completely capture the complex nature of innovativeness. This works shows that qualitative methods are valid approaches to corralling a topic such as innovativeness. However, to generate the most apt construct of innovativeness both qualitative and quantitative research methods are needed.

4.2 Framework Refinement

Characteristics of innovativeness play a vital role in working towards the ability to accurately identify adopter categories, and as such were a vital piece in developing the Innovativeness Framework. It is important that the framework allows for quick, clear assessment and categorization of a category through comprehensiveness and conciseness. The re-coding process was intended to highlight the ease with which characteristics of innovativeness can be coded within the framework. The findings of the re-coding survey indicate refinement may be needed to develop a sound framework. For all of the characteristics coded by the experts, majority

consensus was reached for the Major Focus Area for 66% of them, while a majority consensus was reached for Major Focus Areas and Strategic Areas of Innovativeness for 40%.

This indicates a couple of discussion points. The first is that clarity may be lacked in the construct of the framework, which requires refinement of categories and definitions, or that current literature has done a poor job of identifying clear characteristics of innovativeness. Secondly, this may indicate that characteristics of innovativeness are difficult to categorize, and may span multiple categories. For instance the behavior "conduct initial assessment of innovation" was coded twice as *Communications* and three times as *Culture*. Perhaps this behavior is rooted in both knowledge transfer as a stakeholder role and the culture of an individual or organization.

The areas of *Demographics* and *Risk* had the greatest percentage of majority consensus for both individual and organizational characteristics, indicating that these Major Focus Areas require minimal refinement. However, the areas of *Communications* and *Culture* had the least majority consensus, with *Communications* being the most discrepant category. This indicates that clarity is needed in the application of these definitions as well as the need for clarity in the literature on the effect of these two categories on innovativeness. *Communications* was developed to encompass a wide range of descriptors including organizational structure, internal knowledge flow, knowledge management and stakeholder interactions. This breadth of category may be confusing and require the separation of some of the elements into unique categories, in other words increasing the Strategic Areas of Innovativeness falling under communications.

There was minimal majority consensus reached when selecting a MFA-SAoI combination for those characteristics originally coded as *Culture* and *Communications* (for individuals 28% and 29% respectively, and for organizations 23% and 31% respectively). This raises the issue of clarity in the way that the SAoIs are defined and whether or not sub-categories are needed at all. What is the need to further breakdown the categories from the MFA level? Because these characteristics are the manifestation of such a complex concept, defining categories for them becomes very tedious and difficult and can lead to the type of confusion highlighted by the

survey data. However, failure to sub-divide the major categories leaves the information in a form that is difficult to apply in an industry setting.

There were two Major Focus Areas that were added during the modified Delphi process, namely *Adaptability* and *Market Conditions*. Market conditions is discussed independently in section 4.3. Adaptability was used to describe 22 characteristics of the total 164 presented to the experts. Based on this, it would appear that the addition of a category based on adaptability is justified. Of the 22 characteristics, 13 of those were originally coded as culture. This data does not question the validity of including Adaptability in the framework, but it does question the addition of Adaptability as a Major Focus Area. Based on the discrepancy between the original coding, it would be necessary to explore the need for Adaptability to become a Strategic Area of Innovativeness under Culture. While this framework must be clear and comprehensive, it must also be simple to use and apply. Expanding to many Major Focus Areas may detract from the meaning and impact as well as turn off potential users through over complication.

4.3 Market Conditions as an External Factor of Innovativeness

The Major Focus Area of *Market Conditions* was added as a result of the modified Delphi process, based on the discussion of the expert panel. This category may have been omitted in the initial framework because market conditions deal with external factors that affect innovation activities. When considering the development of a profiling tool similar to a behavioral analysis tool, only elements considered internal to the subject, organization or individual, appear relevant. However, the question arises; do the behaviors of an innovator, for instance, change significantly when environmental conditions change? Subramanian (1996) raises this issue in an innovativeness study in the banking industry, finding that "firms in less stable environments were significantly more innovative than their counterparts in more stable environments." The author goes on to discuss the implications of this finding, stating that previous research may have erroneously labeled subjects as not innovative, when they did not innovate because the environment did not demand it. In the construction industry this line of thought may be challengeable. McCoy (2009) highlights uncertainties unique to the industry, including site variability, one-off nature, supply chain management and product durability and Mitropoulos and Tatum (2000) describe a dynamic industry. These descriptions of the construction industry paint the picture of what can be concluded as a generally unstable environment, and yet many still

criticize the industry for lagging behind other industries in the uptake of innovation. Based on the findings by Subramanian (1996), the construction industry should be innovative. This leads to yet another question: can external factors in a domain-specific measure of innovativeness be assumed the same for all members of the construction industry, or do different environmental factors need to be considered for different sectors, regions, specialties, etc.? This work finds that the market conditions of the industry must be considered when determining innovativeness. However, the specificity of this finding is not clear and requires further investigation.

Chapter 5: Limitations, Impacts and Future Research

This chapter discusses the limitations of the work, the impacts that this work makes and areas for future research.

5.1 Limitations

As with any work there are limitations and it is important to the validity of the work to discuss these limitations. The limitations identified in this work are discussed below.

1. The initial framework was developed based on current scholarly literature that fit the criteria necessary for inclusion into this work. Therefore, the initial framework is limited not only by current available literature, but also by the researcher's ability to locate and obtain literature. Having said this, the researcher believes that the body of literature surveyed is sufficient to support the discussion presented in this paper, however it is important to consider that an important work may have been inadvertently omitted.
2. The expert panel, described in section 3.3, served a central role in this work. The modified Delphi process and survey that the experts participated in took place over an extended period of time (September 2009 to February 2010). This is due to the need for data analysis and survey development time and the need for 3 Delphi rounds. Additionally, data collection periods were extended to accommodate experts that were unable to meet the original timelines. With such a long timeline, expert panel member fatigue must be considered when drawing conclusions from the results. Desire to get the process over with may have led to experts rushing through data collection tools.
3. The modified Delphi technique adapted for this research restricted the interaction between experts, limiting inter-expert dialogue concerning topics. This was due to geographical and funding limitations. In order to minimize this limitation, all comments were considered and proposed to other experts as suggestions in order to simulate dialogue.
4. The researcher acknowledges that there is a heavy emphasis on residential construction pieces represented in the development of the initial framework. This work is intended to be a general piece on innovativeness for the entire construction industry. Future work

must be aimed at validating the use of such a framework for all sectors of the industry, or identify the need for adaptation to fit the needs of individual sectors.

5.2 Impacts

The results of the data collection done as a part of this research have been leveraged to develop a framework of innovativeness. This framework is a necessary piece in the effort to develop an innovativeness profiling tool for individuals and organizations in the construction industry because it provides a mechanism by which parameters of innovativeness can be classified. Categorization provides a basis for comparison as well as a common language for discussing innovativeness. This is comparable to the Construction Specifications Institute's Master Format for division of labor for a construction project. Innovativeness is complex, much like a construction project, and construction stakeholders need a common standard for defining innovativeness. The Framework of Innovativeness offers the industry a meaningful way to think about and discuss innovativeness that will allow industry stakeholders to identify ways to improve their innovation initiatives.

Though the ultimate goal is to develop a reliable, simple to use, innovativeness profiling tool, which this work does not, the work does provide the first step in creating such a tool. Provided in this work is a list of characteristics that research has found to be manifestations of innovativeness in the construction industry. Also provided is a means of classifying these categories within a construct of innovativeness. These pieces are important to the development of a profiling tool because, along with determining the proper innovativeness/adopter categories, a profiling tool needs a way to describe the categories (the characteristics) and a means of organizing the information so that the user has a clear picture of innovativeness strengths and weaknesses (the framework). It is acknowledged, however, that refinement of the framework may be necessary.

5.3 Future Research

This work highlights the need for further research in various areas of innovativeness. These are discussed below.

1. The first area of future research identified is the need for further framework validation. Discrepancies identified during the re-coding process done by the expert panel highlight a

need for refinement and clarification. Additional research is also required to investigate the inclusion of external parameters of innovativeness into such a framework, designed to support development of a profiling tool, but also intended to serve as an innovativeness reference for the industry as a whole.

2. Along the same line as the first research area discussed, the second area of future research is the investigation of the applicability of the developed framework to specific market segments. Large population survey data paired with detailed case studies may be the best approach for such a task.
3. The third research task set up by this work is the development of an innovativeness profiling tool specific to the construction industry based on observable behaviors and characteristics. This requires that profiles of adopter categories be developed from which to build a testing mechanism, much like a behavioral profiling test. A means of validating the adopter profiles will be necessary, such as comparing the results of traditional innovativeness measures with the developed adopter profiles.
4. Finally, because this framework is designed to serve as a general construct for construction, it is necessary to investigate the applicability of this framework across multiple platforms of innovation. Can innovativeness be defined by the same construct for building information modeling innovation versus management process innovations?

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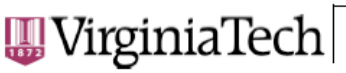
Appendix A: IRB Approval Letters



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FWA00000572(expires 1/20/2010)
IRB # is IRB00000667

DATE: September 3, 2009

MEMORANDUM

TO: Andrew McCoy
Justin Gore

FROM: Carmen Green

SUBJECT: **IRB Exempt Approval:** "Towards Managing Agents of Change for US Construction Organizations" , IRB # 09-708

I have reviewed your request to the IRB for exemption for the above referenced project. The research falls within the exempt status. Approval is granted effective as of September 3, 2009.

As an investigator of human subjects, your responsibilities include the following:

1. Report promptly proposed changes in the research protocol. The proposed changes must not be initiated without IRB review and approval, except where necessary to eliminate apparent immediate hazards to the subjects.

2. Report promptly to the IRB any injuries or other unanticipated or adverse events involving risks or harms to human research subjects or others.

cc: File

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IRB # is IRB00000667

DATE: October 22, 2009

MEMORANDUM

TO: Andrew McCoy
Justin Gore

FROM: Carmen Green

SUBJECT: **IRB Amendment 1 Approval:** "Towards Managing Agents of Change for US Construction Organizations" , IRB # 09-708

This memo is regarding the above referenced protocol which was previously granted approval by the IRB on September 3, 2009. You subsequently requested permission to amend your IRB application. Approval has been granted for the requested protocol amendment, effective as of October 22, 2009.

As an investigator of human subjects, your responsibilities include the following:

1. Report promptly proposed changes in the research proposal. The proposed changes must not be initiated without IRB review and approval, except where necessary to eliminate apparent immediate hazards to the subjects.
2. Report promptly to the IRB any injuries or other unanticipated or adverse events involving risks or harms to human research subjects or others.

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IRB # is IRB00000667

DATE: December 4, 2009

MEMORANDUM

TO: Andrew McCoy
Justin Gore

FROM: Carmen Green

SUBJECT: **IRB Amendment 2 Approval:** "Towards Managing Agents of Change for US Construction Organizations" , IRB # 09-708

This memo is regarding the above referenced protocol which was previously granted approval by the IRB on September 3, 2009. You subsequently requested permission to amend your IRB application. Approval has been granted for the requested protocol amendment, effective as of December 4, 2009.

As an investigator of human subjects, your responsibilities include the following:

1. Report promptly proposed changes in the research proposal. The proposed changes must not be initiated without IRB review and approval, except where necessary to eliminate apparent immediate hazards to the subjects.
2. Report promptly to the IRB any injuries or other unanticipated or adverse events involving risks or harms to human research subjects or others.

cc: File

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IRB # is IRB00000667

DATE: January 19, 2010

MEMORANDUM

TO: Andrew McCoy
Justin Gore

FROM: David M. Moore

SUBJECT: **IRB Amendment 3 Approval:** "Towards Managing Agents of Change for US Construction Organizations" , IRB # 09-708

This memo is regarding the above referenced protocol which was previously granted approval by the IRB on September 3, 2009. You subsequently requested permission to amend your IRB application. Approval has been granted for the requested protocol amendment, effective as of January 15, 2010.

As an investigator of human subjects, your responsibilities include the following:

1. Report promptly proposed changes in the research protocol. The proposed changes must not be initiated without IRB review and approval, except where necessary to eliminate apparent immediate hazards to the subjects.
2. Report promptly to the IRB any injuries or other unanticipated or adverse events involving risks or harms to human research subjects or others.

cc: File

Appendix B: Literature Data

Source	P.	Quotation (direct excerpts from the listed source)	Characteristic/trait	Indiv./Org.?	Adopter Cat.
Holmen Enterprises, Ltd. (2001)	ii	A key strategic perspective for innovators to understand is the innovations must meet the objectives and interests of the users of their innovation.	innovations must meet the objectives and interests of the users of their innovation	Both	Early Adopters
Holmen Enterprises, Ltd. (2001)	iii	In the construction industry, little innovation occurs as a result of research. The main driving forces are the ideas of other people, i.e., customers, management, marketing personnel and production personnel as they focus on fixing problems and developing new ideas.	main driving forces are the ideas of other people	Org.	Innovators, Early Adopters
Holmen Enterprises, Ltd. (2001)	iii		focus on fixing problems and developing new ideas	Org.	Innovators
Holmen Enterprises, Ltd. (2001)	iv	Some members of the industry, such as manufacturers and developers, are large, have substantial resources and carry out extensive amounts of research, development and innovation.	large	Org.	
Holmen Enterprises, Ltd. (2001)	iv		have substantial resources	Org.	Early Adopters
Holmen Enterprises, Ltd. (2001)	iv		carry out extensive amounts of research, development	Org.	Innovators
Holmen Enterprises, Ltd. (2001)	iv	Strategies to foster innovation generally consist of actions that reinforce or strengthen accelerators, offset or remove barriers and establish conditions for the contingent factors to be supportive of innovation…	reinforce or strengthen accelerators	Org.	Early Adopters
Holmen Enterprises, Ltd. (2001)	iv		offset or remove barriers	Org.	Early Adopters
Holmen Enterprises, Ltd. (2001)	iv		establish conditions for the contingent factors to be supportive of innovation	Org.	Innovators
Holmen Enterprises, Ltd. (2001)	iv, 14	Effective information transfer is critical to promote the adoption of the new products, processes, services and equipment that are continually being introduced to the housing industry.	Effective information transfer	Org.	Early Adopters
Holmen Enterprises, Ltd. (2001)	v	A key motivator for innovators is to garner benefits from their innovations.	key motivator is to garner benefits from their innovations	Indiv.	Innovator
Holmen Enterprises, Ltd. (2001)	v	Building and trades usually have difficulty obtaining benefits from their innovations due to copying by their competitors, and this disinclines some of them from innovating.	to copying by their competitors, and this disinclines some of them from innovating	Org.	Early Majority

Holmen Enterprises, Ltd. (2001)	v	Some members of the industry regard the benefit of innovation as getting the job (as opposed to receiving payment for an innovation). This attitude flows from a perspective of continuous innovation as a normal part of business operations.	continuous innovation as a normal part of business operations	Org.	Innovators
Holmen Enterprises, Ltd. (2001)	v	All of these risks mean risk of financial loss, and the trend is toward increasing risk, particularly risk of liability.	risk of financial loss - Degree to which risk can be tolerated or is feared.	Org.	All
Holmen Enterprises, Ltd. (2001)	v		risk of liability - Degree to which risk can be tolerated or is feared.	Org.	All
Holmen Enterprises, Ltd. (2001)	vi	Innovative companies are more successful than non-innovative companies and have the following attributes: their managements instill a culture of innovation, they emphasize human resource development and marketing, and their personnel tend to have higher levels of education, more central positions in a communications network and stronger linkages to business resources than those in less innovative companies have.	their managements instill a culture of innovation	Org.	Innovators, Early Adopters
Holmen Enterprises, Ltd. (2001)	vi		emphasize human resource development and marketing	Org.	Innovators, Early Adopters
Holmen Enterprises, Ltd. (2001)	vi		personnel tend to have higher levels of education	Org.	Innovators, Early Adopters
Holmen Enterprises, Ltd. (2001)	vi		more central positions in a communications network	Org.	Innovators, Early Adopters
Holmen Enterprises, Ltd. (2001)	vi		stronger linkages to business resources	Org.	Innovators, Early Adopters
Holmen Enterprises, Ltd. (2001)	vi	Attributes of innovations affect their rate of adoption. Innovation developers who wish to achieve rapid diffusion of their innovations should ensure that they 1) provide significant economic advantage over competitive products or processes, 2) are simple to use, 3) are compatible with existing practices and products, 4) are easy to try and 5) are easy to explain.	look for innovations that provide significant economic advantage over competitive products or processes	Both	Late Majority, Laggards
Holmen Enterprises, Ltd. (2001)	vi		look for innovations that are simple to use	Both	Late Majority, Laggards
Holmen Enterprises, Ltd. (2001)	vi		look for innovations that are compatible with existing practices and products	Both	Late Majority, Laggards
Holmen Enterprises, Ltd. (2001)	vi		look for innovations that are easy to try	Both	Late Majority, Laggards
Holmen Enterprises, Ltd. (2001)	vi		look for innovations that are easy to explain	Both	Late Majority, Laggards

Holmen Enterprises, Ltd. (2001)	vi	The main reason for innovating is economic benefit.	economic benefit	Both	Early Adopters
Holmen Enterprises, Ltd. (2001)	3	Another reason for innovation is remedying problems.	remedying problems/ problem solver	Indiv.	Innovators
Holmen Enterprises, Ltd. (2001)	5	A more accurate and helpful perspective is to acknowledge that innovation occurs – and should occur – due to a composite set of forces – market and economic opportunities and technical abilities. Accordingly, innovation should be accomplished using multiple methods and approaches.	innovation should be accomplished using multiple methods and approaches	Both	Early Adopters
Holmen Enterprises, Ltd. (2001)	9	Most housing companies have variable sales and low profits: Both factors constrain research and development and other innovation activities. Low profit tares make such investments impossible and cyclical profits make them inefficient, i.e., stop-start actions are not efficient and "stop periods" result in staff departures and long "re-learn" times.	variable sales	Org.	Late Majority, Laggards
Holmen Enterprises, Ltd. (2001)	9		low profits	Org.	Late Majority, Laggards
Holmen Enterprises, Ltd. (2001)	9	The industry is mostly comprised of smaller firms that have limited financial ability to carry out R&D and to participate in other innovation activities.	smaller firms	Org.	
Holmen Enterprises, Ltd. (2001)	9	Housing companies have small number of management staff that do not have the time to devote to research.	small number of management staff	Org.	Late Majority, Laggards
Holmen Enterprises, Ltd. (2001)	9	Most housing companies have low investment in capital equipment and specialized labour.	low investment in capital equipment and specialized labour	Org.	Late Majority, Laggards
Holmen Enterprises, Ltd. (2001)	10	The industry is dispersed: this characteristic refers to the industry being geographically spread. The implications include a limited ability to generate the benefits of "clustering", e.g., networking, information transfer, and a requirement to diffuse innovations repeatedly.	geographically spread	Org.	
Holmen Enterprises, Ltd. (2001)	10	Construction companies' adoption of innovation generally varies with their characteristics, i.e., adoption varies positively with their size and the extent to which they build manufactured or multiple-unit projects…	adoption varies positively with their size	Org.	
Holmen Enterprises, Ltd. (2001)	10		the extent to which they build manufactured or multiple-unit projects	Org.	Innovators, Early Adopters
Holmen Enterprises, Ltd. (2001)	10	Adoption varies negatively with the extent to which construction companies subcontract work.	extent to which construction companies subcontract work	Org.	Late Majority, Laggards

Holmen Enterprises, Ltd. (2001)	10	The practice of making operation as standardized as possible may not encourage innovation but it contributes to a very efficient construction process which lowers housing costs and improves housing affordability.	making operation as standardized as possible	Org.	Late Majority, Laggards
Holmen Enterprises, Ltd. (2001)	15	Information learned by word-of-mouth, and comments from respected peers are reportedly very effective information transfer techniques, especially for the evaluation of new products by potential adopters.	Information learned by word-of-mouth	Indiv.	Early Majority
Holmen Enterprises, Ltd. (2001)	15		comments from respected peers are very effective information transfer techniques	Indiv.	Early Majority
Holmen Enterprises, Ltd. (2001)	21	The management of innovative firms have explicit strategies that included innovation as one area of emphasis. They create a culture of innovation and work constantly at searching and testing new ideas.	have explicit strategies that included innovation as one area of emphasis	Org.	Early Adopters
Holmen Enterprises, Ltd. (2001)	21		create a culture of innovation	Org.	Innovators, Early Adopters
Holmen Enterprises, Ltd. (2001)	21		work constantly at searching and testing new ideas	Org.	Innovators
Holmen Enterprises, Ltd. (2001)	21	The management of innovative firms places more emphasis on 1) human resource development, 2) training, 3) financing, 4) marketing, and 5) production economics than do the management of non-innovative firms.	management places more emphasis on human resource development	Org.	Innovators, Early Adopters
Holmen Enterprises, Ltd. (2001)	21		management places more emphasis on training	Org.	Innovators, Early Adopters
Holmen Enterprises, Ltd. (2001)	21		management places more emphasis on financing	Org.	Innovators, Early Adopters
Holmen Enterprises, Ltd. (2001)	21		management places more emphasis on marketing	Org.	Innovators, Early Adopters
Holmen Enterprises, Ltd. (2001)	21		management places more emphasis on production economics	Org.	Early Adopters
Davis (2004)	2	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).	usually preoccupied with the technical aspects of implementing a new technology	Org.	Innovators
Davis (2004)	2		ensuring that it meets the organizational needs	Org.	Early Adopters
Davis (2004)	2		worker-related issues are regularly neglected	Org.	
Davis (2004)	13	Resistance to change has many advantageous aspects. For example, it is "better than apathy, it avoids group-think, it provides alternative	Resistance to change help to avoid group-think	Indiv.	Late Majority, Laggards

Davis (2004)	13	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 evaluation properly enough alternatives" (Mabin et al. 2001, p. 170).	provide alternative ideas for consideration	Indiv.	Late Majority
Davis (2004)	13		failing to consider or evaluation properly enough alternatives	Indiv.	Innovators
Davis (2004)	13	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.	resistance is an alarm signal warning that more evaluation of the possible consequences of the innovation adoption need to take place	Indiv.	Late Majority, Laggards
Davis (2004)	13	"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." (Klein 1973, p. 432)	consider the costs of ignoring, overriding, or dismissing as irrational those who emerge as their opponents	Indiv.	Innovators, Early Adopters
Davis (2004)	15	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).	active displays of resistance, such as sabotaging or arguing	Indiv.	Laggards
Davis (2004)	15		passive, like procrastinating or withholding information	Indiv.	Laggards
Davis (2004)	25-26	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).	if an individual participates as a decision-maker in the change process, resistance to the change is much less likely to occur	Indiv.	
Davis (2004)	25-27	The resources available to an employee during a technological change can affect their reaction.	have resources available	Org.	Early Adopters
Davis (2004)	30	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	Indiv.	Laggards
Davis (2004)	31	As an individual's control of change increases, resistance decreases (Kyle 1993).	control of change increases, resistance decreases	Indiv.	
Davis (2004)	31, 63	Individuals often have irrational ideas about change and they create their own interpretations of how the change will occur. The level of irrational ideas has shown a positive correlation to resistance to change (Bovey and Hede 2001b).	irrational ideas about change	Indiv.	Laggards
Davis (2004)	32-33	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.	low disposition to innovation	Indiv.	Early Majority
Davis (2004)	62	A positive attitude towards computers is an indication of lower resistance towards technological change and vice-versa.	positive attitude towards computers	Indiv.	Innovators, Early Adopters
Davis (2004)	62	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.	strong motivation to use the new technology	Indiv.	Innovators
Davis (2004)	62		strong motivation not to use the technology	Indiv.	Laggards
Davis (2004)	62	The Change Scale indicates that "individual differences in attitudes toward change may reflect differences in the capacity to adjust to change situations" (Trumbo 1961).	individual differences in attitudes toward change may reflect differences in the capacity to adjust to change situations	Indiv.	All
Davis (2004)	63	A higher level of referent power indicates a lower level of resistance to change. An individual with higher level in their organization will	higher level of referent power	Indiv.	

Davis (2004)	63	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.	higher level in their organization	Indiv.	
Davis (2004)	76	"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). 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.	the relative positions they occupy in the organizational hierarchy	Indiv.	
Davis (2004)	76		top management is likely to have a low resistance to the change because they are in control and were the decision-makers	Org.	
Davis (2004)	76	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.	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.	Indiv.	Laggards
Davis (2004)	82	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 ad Chakrabarti 1990; Levine and Donitsa-Schmidt 1997; Loyd and Gressard 1984a).	good understanding of computer technologies	Indiv.	Innovators
Davis (2004)	82		high amount of experience with the technologies	Indiv.	Innovators
Davis (2004)	83	Additionally, participation in a decision has also been found to improve individual's response to change (Burdett 1999; Coch and French 1948; Lawrence 1973; Trist and Bamforth 1951).	participation in a decision	Indiv.	
Davis (2004)	108	…indicating that there is a negative linear relationship between Resistance to Change Index 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.	high computer understanding and experience	Indiv.	Innovators, Early Majority
Davis (2004)	108		low computer understanding and experience	Indiv.	Late Majority, Laggards
Davis (2004)	109	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 and information technology change.	perceive an information technology change	Indiv.	
Davis (2004)	126	These findings imply that although a linear relationship between age and RTCI was not found, there is a relationship between age and Variable 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.	younger workers being more receptive to and knowledgeable about computer technologies than older workers	Indiv.	
Davis (2004)	129	…there is a positive correlation between computer understanding and experience and education level, 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, indicating that a person with more education has more favorable attitudes regarding computers.	positive correlation between computer understanding and experience and education level	Indiv.	
Davis (2004)	129		computer attitudes and education level	Indiv.	

Davis (2004)	130	…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.	computer understanding and experience	Indiv.	
Davis (2004)	131	Those that perceive a future change have a lower mean RTCI value than individuals that do not perceive a future change.	perceive a future change	Indiv.	
J.F. Hickling (1989)	6	The industry is adversely affected by time, vertical and lateral discontinuities.	vertical and lateral discontinuities	Both	Late Majority, Laggards
J.F. Hickling (1989)	7	Isolation, lack of communications, risk avoidance, discontinuity and low levels of formal education are generally reliable indicators of an industry structure with low permeability to innovations.	Isolation	Both	Late Majority, Laggards
J.F. Hickling (1989)	7		lack of communication	Both	Late Majority, Laggards
J.F. Hickling (1989)	7		risk avoidance	Both	Late Majority, Laggards
J.F. Hickling (1989)	7		discontinuity	Org.	Late Majority, Laggards
J.F. Hickling (1989)	7		low levels of formal education	Indiv.	Late Majority, Laggards
J.F. Hickling (1989)	14	Effective communication for the purpose of diffusion requires that information be first given to the prospective adopter by a credible source.	Effective communication	Indiv.	Early Adopters
J.F. Hickling (1989)	14		credible source	Indiv.	Early Adopters
J.F. Hickling (1989)	15	For instance, during periods of low construction activity, tradespeople tend to put a lower value on their time and are less likely to adopt time-saving innovations.	put a lower value on their time	Both	Laggards
J.F. Hickling (1989)	20	The L.R.R.C.I. is not homogenous. Despite it local, regional and national industry organizations, it remains fragmented and locally focused. The industry lacks opinion leaders with national impact.	not homogenous	Org.	Late Majority, Laggards
J.F. Hickling (1989)	20		fragmented and locally focused	Org.	Late Majority, Laggards
J.F. Hickling (1989)	20		lacks opinion leaders with national impact	Org.	Innovators
J.F. Hickling (1989)	20, 25	Innovators normally play an important role, they perform the Economic, Social and Psychological risk assessment for the entire "Community".	Conduct Economic, Social and Psychological risk assessment	Both	Innovators
J.F. Hickling (1989)	20	The case studies also confirm that the L.R.R.C.I. is compartmentalized by function which further hinders diffusion.	compartmentalized	Org.	Late Majority, Laggards
J.F. Hickling (1989)	20	The higher the risk bearing capabilities (high capitalization, high education, high stability,), the higher the capacity (and generally willingness) to adopt innovations.	high risk bearing capabilities	Org.	Early Adopters
J.F. Hickling (1989)	20		high capitalization	Org.	Early Adopters
J.F. Hickling (1989)	20		high education	Org.	Early Adopters
J.F. Hickling	20		high stability	Org.	Early Adopters

(1989)					
J.F. Hickling (1989)	20	Reasons for this type of behaviour include lack of a capital which heightens financial risks, the lack of formal education which increases the apparent complexity of innovations and the lack of pressure for change.	lack of a capital	Org.	Late Majority, Laggards
J.F. Hickling (1989)	20		inability to bear financial risks	Org.	Late Majority, Laggards
J.F. Hickling (1989)	20		lack of formal education	Org.	Late Majority, Laggards
J.F. Hickling (1989)	20		lack of pressure for change	Org.	Late Majority, Laggards
J.F. Hickling (1989)	21	In addition, there exists a fear of liabilities which is perhaps one of the greatest deterrents to innovations in the industry.	fear of liabilities	Org.	Late Majority, Laggards
J.F. Hickling (1989)	21	Small builders, contractors and sub-trades do not include long term contingencies in their costs and for them the trend of enforcing greater liability for work and materials is a disincentive to innovate.	do not include long term contingencies	Org.	Late Majority, Laggards
J.F. Hickling (1989)	21		trend of enforcing greater liability for work and materials		Late Majority, Laggards
J.F. Hickling (1989)	26	The high communicability of Visible Cosmetics is a key to their diffusion because producers must take over the communication "networking" role normally fulfilled by innovators and early adopters.	high communicability	Indiv.	Early Adopters
J.F. Hickling (1989)	26		"networking" role		Early Adopters
J.F. Hickling (1989)	29	In terms of Diffusion Process, the degree of perceived Relative Advantage impacts directly on the economic, social and psychological risk assessment. As such it is the major barrier to diffusion between Innovators and Early Adopters.	determine adoption decisions by perceived Relative Advantage	Both	Early Adopters
J.F. Hickling (1989)	29	A tradesperson is not interested in adopting an innovation which either forces him to change working habits or which threatens his livelihood.	not interested in adopting an innovation which either forces him to change working habits or which threatens his livelihood.	Both	Laggards
J.F. Hickling (1989)	30	Members of the L.R.R.C.I have a low tolerance for risk. They will stay away from any innovation which carries a market risk, a competitive risk and especially a financial risk. This is due to their low level of capitalization which does not allow them to use a product before it is well accepted by the market, even if the product has proven itself in another area nor if it may increase costs without "adding value" (competitive risk).	low tolerance for risk	Org.	Late Majority, Laggards
J.F. Hickling (1989)	30		low level of capitalization	Org.	Late Majority, Laggards
J.F. Hickling (1989)	30		avoid innovations that are perceived to possibly increase costs without "adding value" (competitive risk)	Org.	Late Majority, Laggards
J.F. Hickling (1989)	32	The high fear of liabilities is not being checked by the communication network and this is resulting in builders and sub-trades people rejecting innovations for fear that they may lead to unforeseen liabilities down the road.	fear of liabilities	Org.	Late Majority, Laggards
J.F. Hickling (1989)	271	Builders by and large are risk averse and resist incorporating innovations into their building processes unless there are well proven and demonstrated advantages.	risk averse	Org.	Late Majority, Laggards
J.F. Hickling (1989)	271		resist incorporating innovations into their building processes unless there are well proven and demonstrated advantages	Org.	Early Majority, Late Majority
Rogers (2003)	271	Although exposure to mass media in Saucio was very limited, innovators had much higher exposure than did laggards, averaging a	high exposure to mass media	Indiv.	Innovators

Rogers (2003)	271	mass media exposure score (composed of radio, newspapers, and books) of 26, while laggards averaged only 4. Innovators were more likely than laggards to utilize mass media sources or channels at the knowledge stage, 11 percent to 2 percent.	low exposure to mass media	Indiv.	Late Majority, Laggards
Rogers (2003)	271		utilize mass media sources or channels at the knowledge stage	Indiv.	Innovators
Rogers (2003)	271	Innovators were also more cosmopolite at the knowledge stage, using sources or channels from outside the village, 33 percent to 17 percent.	cosmopolite	Indiv.	Innovators
Rogers (2003)	282	Venturesomeness is almost an obsession with innovators.	Venturesomeness	Both	Innovators
Rogers (2003)	282	Their interest in new ideas leads them out of a local circle of peer networks and into more cosmopolite social relationships.	interest in new idea	Indiv.	Innovators
Rogers (2003)	282		out of a local circle of peer networks	Indiv.	Innovators
Rogers (2003)	282		more cosmopolite social relationships	Indiv.	Innovators
Rogers (2003)	282	Control of substantial financial resources is helpful in absorbing the possible losses from an unprofitable innovation.	Control of substantial financial resources	Both	Innovators
Rogers (2003)	282	The ability to understand and apply complex technical knowledge is also needed.	ability to understand and apply complex technical knowledge	Both	Innovators
Rogers (2003)	282	The innovator must be able to cope with a high degree of uncertainty about an innovation at the time he or she adopts.	cope with a high degree of uncertainty	Both	Innovators
Rogers (2003)	283	While an innovator may not be respected by other members of a local system, the innovator plays an important role in the diffusion process: that of launching the new idea in the system by importing the innovation from outside of the system's boundaries. Thus, the innovator plays a gatekeeping role in the flow of new ideas into a system.	not respected by other members of a local system	Both	Innovators
Rogers (2003)	283		important role of launching the new idea in the system	Both	Innovators
Rogers (2003)	283	Early adopters are a more integrated part of the local social system than are innovators. Where as innovators are cosmopolites, early adopters are localites.	integrated part of the local social system/ localite	Indiv.	Early Adopters
Rogers (2003)	283	This adopter category, more than any other, has the highest degree of opinion leadership in most systems. Potential adopters look to early adopters for advice and information about an innovation.	degree of opinion leadership in most systems	Both	Early Adopters
Rogers (2003)	283		look to early adopters for advice	Both	Early Adopters
Rogers (2003)	283	The early adopter decreases uncertainty about a new idea by adopting it, and then conveying a subjective evaluation of the innovation to near peers through interpersonal networks.	decreases uncertainty about a new idea by adopting it	Both	Early Adopters
Rogers (2003)	283		conveying a subjective evaluation	Both	Early Adopters
Rogers (2003)	283	The early majority interact frequently with their peers but seldom hold positions of opinion leadership in a system.	interact frequently with their peers	Indiv.	Early Majority
Rogers (2003)	283		seldom hold positions of opinion leadership	Indiv.	Early Majority
Rogers (2003)	284	They provide interconnectedness in the system's interpersonal networks.	provide interconnectedness in the system's interpersonal networks	Both	Early Majority
Rogers (2003)	284	The early majority may deliberate for some time before completely adopting a new idea.	may deliberate for some time before completely adopting a new idea	Both	Early Majority
Rogers (2003)	284	Their innovation-decision period is relatively longer than that of the innovators and the early adopters.	innovation-decision period is relatively longer	Both	Early Majority
Rogers (2003)	284	They follow with deliberate willingness in adopting innovations but seldom lead.	follow with deliberate willingness in adopting innovations	Both	Early Majority
Rogers (2003)	284		seldom lead	Both	Early Majority
Rogers (2003)	284	Adoption may be both an economic necessity for the late majority and	economic necessity	Both	Late Majority

Rogers (2003)	284	the result of increasing peer pressures.	result of increasing peer pressures	Both	Late Majority
Rogers (2003)	284	Innovations are approached with a skeptical and cautious air, and the late majority do not adopt until most others in their system have already done so. The weight of system norms must definitely favor an innovation before the late majority are convinced to adopt. The pressure of peers is necessary to motivate adoption.	approached with a skeptical and cautious air	Both	Late Majority
Rogers (2003)	284		do not adopt until most others in their system have already done so	Both	Late Majority
Rogers (2003)	284		weight of system norms must definitely favor an innovation	Both	Late Majority
Rogers (2003)	284		pressure of peers is necessary to motivate adoption	Both	Late Majority
Rogers (2003)	284	Their relatively scarce resources mean that most of the uncertainty about a new idea must be removed before the late majority feel that it is safe to adopt.	relatively scarce resources	Both	Late Majority
Rogers (2003)	284		most of the uncertainty about a new idea must be removed	Both	Late Majority
Rogers (2003)	284	Laggards are the last in a social system to adopt an innovation. They possess almost no opinion leadership. Laggards are the most localite of all adopter categories in their outlook. Many are near isolates in the social networks of their system.	last in a social system to adopt an innovation	Both	Laggards
Rogers (2003)	284		no opinion leadership	Both	Laggards
Rogers (2003)	284		the most localite	Both	Laggards
Rogers (2003)	284		Many are near isolates	Both	Laggards
Rogers (2003)	284	The point of reference for the laggard is the past. Decisions are often made in terms of what has been done previously, and these individuals interact primarily with others who also have relatively traditional values.	The point of reference is the past	Both	Laggards
Rogers (2003)	284		interact primarily with others who also have relatively traditional values	Both	Laggards
Rogers (2003)	284	Laggards tend to be suspicious of innovations and of change agents.	suspicious of innovations and of change agents	Indiv.	Laggards
Rogers (2003)	284-285	Resistance to innovations on the part of laggards may be entirely rational from the laggards' viewpoint, as their resources are limited and they must be certain that a new idea will not fail before they can adopt. The laggard's precarious economic position forces the individual to be extremely cautious in adopting innovations.	Resistance may be entirely rational	Both	Laggards
Rogers (2003)	284-286		resources are limited	Both	Laggards
Rogers (2003)	284-287		extremely cautious in adopting innovations	Both	Laggards
BSRIA (2005)	sum.	Roger's model of innovation shows that the role of the early adopter is crucial to get an innovation through to market.	role of the early adopter is crucial to get an innovation through to market	Both	Early Adopter
BSRIA (2005)	3	If such incentives were directly related to the removal of planning uncertainty, then it was believed that this would be a positive encouragement to adopting sustainable construction techniques and specification.	remove planning uncertainty of innovations	Org.	Early Majority
BSRIA (2005)	4	Lack of skills and training has been highlighted in recent research from both the SBTG and the Barker report.	Lack skills and training	Indiv.	Late Majority, Laggards
BSRIA (2005)	10	The research showed that trade shows are currently the most popular way of reaching early adopters (88%), followed by trade press (78%) and recommendations from friends (63%).	way of reaching early adopters	Indiv.	Early Adopters
BSRIA (2005)	14	The single highest enabler overall is that there is a forward-thinking board/management team. This issue is borne out by the case studies report which clearly showed that commitment to innovation is essential at board level.	forward-thinking board/management team	Org.	Innovators, Early Adopters
BSRIA (2005)	15		commitment to innovation		Innovators
BSRIA (2005)	20	Open minded	Open minded	Indiv.	Early Adopter
BSRIA (2005)	20	Ambitious	Ambitious	Indiv.	Early Adopter
BSRIA	20	Well Read	Well Read	Indiv.	Early Adopter

(2005)					
BSRIA (2005)	20	Professional Status	Professional Status	Both	Early Adopter
BSRIA (2005)	20	Formal Education	Formal Education	Indiv.	Early Adopter
BSRIA (2005)	20	Bigger Company	Bigger Company	Org.	Early Adopter
BSRIA (2005)	20	The issue gaining highest agreement is that early adopters tend to be "more open to new ideas". This is closely followed by: "they tend to have greater ability to understand innovation" and "they tend to be more positive/in control".	more open to new ideas	Indiv.	Early Adopter
BSRIA (2005)	20		they tend to have greater ability to understand innovation	Indiv.	Early Adopter
BSRIA (2005)	20		they tend to be more positive/in control	Indiv.	Early Adopter
BSRIA (2005)	20	Such early adopters are critical to getting an innovation to market, since further down the innovation chain (i.e. early majority and skeptics) will not adopt new ideas/innovations unless the much respected peer group of early adopters has first taken the plunge.	critical to getting an innovation to market	Both	Early Adopters
BSRIA (2005)	20		early majority and skeptics will not adopt new ideas/innovations unless the much respected peer group of early adopters has first taken the plunge	Both	Early Majority
BSRIA (2005)	37	Our greatest single barrier to innovation is our risk-averse culture.	risk-averse culture	Org.	Late Majority, Laggards
BSRIA (2005)	43	Innovative firms belong to major groups.	belong to major groups	Org.	Innovators, Early Adopters
Building Technology Incorporated (2005)	5	In explaining the effect of management intensity on propensity to adopt innovation, this paper seems to support Slaughter's theory that builders with workers participating in both management and construction are likely to adopt and adapt innovations.	management intensity	Org.	Innovators, Early Adopters
Building Technology Incorporated (2005)	5		builders with workers participating in both management and construction	Org.	Early Adopters, Early Majority
Building Technology Incorporated (2005)	6	Two variables that correlate with builder's propensity to adopt innovation are the size of the firm and the operation in multiple markets.	size of the firm	Org.	
Building Technology Incorporated (2005)	6		operation in multiple markets	Org.	Innovators, Early Adopters
Building Technology Incorporated (2005)	7	As discussed in a number of references, the ability of builders to experiment and adapt new ideas in the field is an excellent source of evolutionary improvements to innovations, as they diffuse within the industry and over time.	ability to experiment and adapt new ideas	Both	Innovators

Hartmann (2006)	159	Essential tasks of managing innovation involve the capitalization and reinforcement of the ability and willingness of an organization to innovate (Trommsdorf, 1990). Ability refers to the reservoir of physical and mental resources to be allocated for innovative activities (Erez, 1997), and creativity is seen to be the key resource in this regard (Wang and Horng, 2002)	capitalization and reinforcement of the ability and willingness of an organization to innovate	Both	Early Adopters
Hartmann (2006)	159		Ability	Both	Innovators, Early Adopters
Hartmann (2006)	159		Creativity	Both	Innovators
Hartmann (2006)	159	Willingness, on the other hand, refers to the forces that energize and regulate the allocation of resources to innovation-related activities (Erez, 1997).	Willingness	Org.	Innovators
Hartmann (2006)	160	Employees are only motivated to go beyond their designated role and get involved in spontaneous and innovative activities if they experience this behavior as being personally satisfying (Locke and Latham, 1990).	experience innovative activities as being personally satisfying	Indiv.	Innovators
Hartmann (2006)	160	…organizational culture seems to play a critical role in developing and maintaining involvement in and dedication to innovation (Meglino et al., 1989; O'Reilly, 1989).	organizational culture	Org.	
Hartmann (2006)	160	Egbu et al. (1998) also found that the four innovative organizations they investigated showed certain culture characteristics including risk tolerance, communications flexibility and willingness to share knowledge.	risk tolerance	Org.	Early Adopters
Hartmann (2006)	160		communications flexibility	Org.	Innovators, Early Adopters
Hartmann (2006)	160		willingness to share knowledge	Org.	Innovators, Early Adopters
Hartmann (2006)	162	In innovative organizations people widely share that expectations that (O'Reilly, 1989; Martins and Terblanche, 2003): • Challenging the status quo is part of the job; • Focusing on the long term ensures the survival of the organization; • Risks are inevitable and are taken; • Failures are acceptable and represent chances for learning; • Information is shared between all levels and units of the organization without being hampered; • People are treated as the most valuable capital of the organization.	Challenge the status quo	Both	Early Adopters
Hartmann (2006)	162		Focus on the long term	Both	Early Adopters
Hartmann (2006)	162		understand risks are inevitable and are taken	Both	Innovators,Early Adopters
Hartmann (2006)	162		Failures are acceptable and represent chances for learning	Org.	Early Adopters
Hartmann (2006)	162		Information is shared between all levels and units of the organization	Org.	Early Adopters
Hartmann (2006)	162		People are treated as the most valuable capital	Org.	Early Adopters
Hartmann (2006)	168	Employees will not be motivated to behave innovatively until they recognize clear and consistent signals and behavior on the part of management that communicate the importance of innovation.	clear and consistent signals and behavior on the part of management	Org.	Early Adopters
Moore (1999)	12	Innovators pursue new technology products aggressively. They sometimes seek them out even before a formal marketing program has been launched.	pursue new technology products aggressively	Both	Innovators
Moore (1999)	12	This is because technology is a central interest in their life, regardless of what function it is performing.	technology is a central interest in their life	Indiv.	Innovators
Moore (1999)	12	At root they are intrigued with any fundamental advance and often make a technology purchase simply for the pleasure of exploring the new device's properties.	intrigued with any fundamental advance	Both	Innovators

Moore (1999)	12	Early adopters buy into new product concepts very early in their life cycle, but they are not technologists.	buy into new product concepts very early in their life cycle	Indiv.	Early Adopters
Moore (1999)	12	Rather they are people who find it easy to imagine, understand and appreciate the benefits of a new technology, and to relate these potential benefits to their other concerns. Whenever they find a strong match, early adopters are willing to base their buying decisions upon it.	find it easy to imagine, understand and appreciate the benefits of a new technology	Indiv.	Early Adopters
Moore (1999)	12		relate these potential benefits to their other concerns	Indiv.	Early Adopters
Moore (1999)	12	Because early adopters do not rely on well-established references in making these buying decisions, preferring instead to rely on their own intuition and vision, they are key to opening up any high-tech market segment.	do not rely on well-established references	Org.	Early Adopters
Moore (1999)	12		rely on their own intuition and vision	Org.	Early Adopters
Moore (1999)	12-13	The early majority share some of the early adopter's ability to relate to technology, but ultimately they are driven by a strong sense of practicality.	driven by a strong sense of practicality	Indiv.	Early Majority
Moore (1999)	13	They know that many of these newfangled inventions end up as passing fads, so they are content to wait and see how other people are making out before they buy in themselves.	are content to wait and see how other people are making out	Both	Early Majority
Moore (1999)	13	They want to see well-established references before investing substantially.	want to see well-established references	Both	Early Majority
Moore (1999)	13	The late majority shares all the concerns of the early majority, plus one major additional one: Whereas people in the early majority are comfortable with their ability to handle a technology product, should they finally decide to purchase it, members of the late majority are not.	not comfortable with their ability to handle a technology product	Both	Late Majority
Moore (1999)	13	As a result, they wait until something has become an established standard, and even then they want to see lots of support and tend to buy, therefore, from large, well-established companies.	wait until something has become an established standard	Both	Late Majority
Moore (1999)	13		see lots of support	Both	Late Majority
Moore (1999)	13	These people simply don't want anything to do with new technology.	don't want anything to do with new technology	Both	Laggards
Moore (1999)	18	Simply put, the early majority is willing and able to become technologically competent, where necessary;	willing and able to become technologically competent, where necessary	Indiv.	Early Majority
Moore (1999)	18	…; the late majority, much less so (see above quotation).	late majority, much less so (see above quotation)	Indiv.	Late Majority
Moore (1999)	22	In sum, when promoters of high-tech products try to make the transition from a market base made up of visionary early adopters…	visionary	Both	Early Adopters
Moore (1999)	22	… to penetrate the next adoption segment the pragmatist early majority, they are effectively operating without a reference base and without a support base within a market that is highly reference oriented and highly support oriented.	pragmatist	Indiv.	Early Majority
Moore (1999)	22		highly reference oriented	Indiv.	Early Majority
Moore (1999)	22		highly support oriented	Indiv.	Early Majority
Moore (1999)	30	In the high-tech industry, the innovators are better know as technology enthusiasts or just techies…	technology enthusiasts	Indiv.	Innovators
Moore (1999)	30	…whereas the early adopters are the visionaries.	visionaries	Indiv.	Early Adopters
Moore (1999)	30	Classically, the first people to adopt any new technology are those who appreciate the technology for its own sake.	those who appreciate the technology for its own sake	Indiv.	Innovators

Moore(1999)	31	They are the ones who first appreciate the architecture of your product and why it therefore has a competitive advantage over the current crop of products established in the marketplace.	appreciate the architecture of your product	Both	Innovators
Moore (1999)	31	They will forgive ghastly documentation, horrendously slow performance, ludicrous omissions in functionality and bizarrely obtuse methods of invoking some needed function.	forgive ghastly documentation, horrendously slow performance, ludicrous omissions in functionality and bizarrely obtuse methods of invoking some needed function	Both	Innovators
Moore (1999)	31	They make great critics because they truly care.	great critics	Indiv.	Innovators
Moore (1999)	32	In business, technology enthusiasts are the gatekeepers for any new technology. They are the ones who have the interest to learn about it and the ones everyone else deems competent to do the early evaluation.	the gatekeepers	Both	Innovators
Moore (1999)	32		competent to do the early evaluation	Both	Innovators
Moore (1999)	32	As a buying population, or as key influences in corporate buying decisions, technology enthusiasts pose fewer requirements than any other group in the adoption profile.	pose fewer requirements	Both	Innovators
Moore (1999)	33	For the most part, these people are not powerful enough to dictate the buying decisions of others, nor do they represent a significant market in themselves.	not powerful enough to dictate the buying decisions of others	Both	Innovators
Moore (1999)	34	Visionaries are that rare breed of people who have the insight to match an emerging technology to a strategic opportunity, the temperament to translate that insight into a high-visibility, high-risk project, and the charisma to get the rest of their organization to buy into that project.	the insight to match an emerging technology to a strategic opportunity	Indiv.	Early Adopters
Moore (1999)	34		the temperament to translate that insight into a high-visibility, high-risk project	Indiv.	Early Adopters
Moore (1999)	34		charisma to get the rest of their organization to buy into that project	Indiv.	Early Adopters
Moore (1999)	34	Visionaries are not looking for an improvement; they are looking for a breakthrough.	looking for a breakthrough	Indiv.	Early Adopters
Moore (1999)	35	Visionaries drive the high-tech industry because they see the potential for an "order-of-magnitude" return on investment and willingly take high risks to pursue that goal.	willingly take high risks	Indiv.	Early Adopters
Moore (1999)	35	Because they see such vast potential for the technology they have in mind, they are the least price-sensitive of any segment of the technology adoption profile.	the least price-sensitive of any segment	Both	Early Adopters
Moore (1999)	35	Finally, beyond fueling the industry with dollars, visionaries are also effective at alerting the business community to pertinent technology advances.	fueling the industry with dollars	Org.	Early Adopters
Moore (1999)	35		effective at alerting the business community to pertinent technology advances	Org.	Early Adopters
Moore (1999)	35	Outgoing and ambitious as a group, they are usually more than willing to serve as highly visible references, thereby drawing the attention of the business press and additional customers to small fledgling enterprises.	Outgoing and ambitious as a group	Org.	Early Adopters
Moore (1999)	35		serve as highly visible references	Org.	Early Adopters
Moore (1999)	35	As a buying group, visionaries are easy to sell but very hard to please.	easy to sell but very hard to please	Org.	Early Adopters
Moore (1999)	36	First, visionaries like a project orientation. They want to start out with a pilot project…	like a project orientation	Org.	Early Adopters
Moore (1999)	37	The other key quality of visionaries is that they are in a hurry. They see the future in terms of windows of opportunity, and they see those windows closing. As a result, they tend to exert deadline pressures to drive the project faster.	in a hurry	Org.	Early Adopters
Moore (1999)	37		tend to exert deadline pressures to drive the project faster	Org.	Early Adopters

Moore (1999)	41	They are dominated by the early majority, who in high tech are best understood as pragmatists.	pragmatists	Both	Early Majority
Moore (1999)	41-42	Instead those funds are in the hands of more prudent souls who do not want to be pioneers…	more prudent souls who do not want to be pioneers	Both	Early Majority
Moore (1999)	42	Actually, important as they are, they are hard to characterize because they do not have the visionary's penchant for drawing attention to themselves.	they are hard to characterize	Both	Early Majority
Moore (1999)	42		do not have the visionary's penchant for drawing attention to themselves	Both	Early Majority
Moore (1999)	42	…the goal of pragmatists is to make a percentage improvement—incremental, measureable, predictable progress.	the goal; is to make a percentage improvement	Org.	Early Majority
Moore (1999)	42	If they are installing a new product, they want to know how other people have faired with it.	they want to know how other people have faired with it	Org.	Early Majority
Moore (1999)	42	They will undertake risk when required, but they first will put in place safety nets and manage the risks very closely.	first will put in place safety nets	Org.	Early Majority
Moore (1999)	42		manage the risks very closely	Org.	Early Majority
Moore (1999)	44	Pragmatists tend to be "vertically" oriented, meaning that they communicate more with others like themselves within their own industry than do technology enthusiasts and early adopters…	"vertically" oriented	Org.	Early Majority
Moore (1999)	46	Conservatives, in essence, are against discontinuous innovations.	Conservatives	Both	Late Majority
Moore (1999)	46		against discontinuous innovations	Both	Late Majority
Moore (1999)	46	They believe far more in tradition than in process. And when they find something that works, they like to stick with it.	believe far more in tradition than in process	Both	Late Majority
Moore (1999)	46	The truth is, conservatives often fear high tech a little bit.	fear high tech a little bit	Both	Late Majority
Moore (1999)	46	Therefore, they tend to invest only at the end of a technology life cycle, when products are extremely mature, market-share competition is driving low prices, and the product themselves can be treated as commodities. P. 46	invest only at the end of a technology life cycle	Both	Late Majority
Moore (1999)	55	Ultimately the service that skeptics provide to high-tech marketers is to point continually to the discrepancies between the sales claims and the delivered product.	point continually to the discrepancies between the sales claims and the delivered product	Both	Laggards
Toole (1998)	323	One explanation that remains popular for what is perceived as slow diffusion of building innovations is that home builders are excessively conservative and do not appreciate the benefits of technological innovation.	excessively conservative	Both	Late Majority
Toole (1998)	323		do not appreciate the benefits of technological innovation	Both	Late Majority
Toole (1998)	323	…home builders who are more apt to adopt non-diffused innovations are those who have superior abilities to gather and process information about innovations and higher tolerances of uncertainty.	superior abilities to gather and process information about innovations	Org.	Early Adopters
Toole (1998)	323		higher tolerances of uncertainty	Org.	Early Adopters
Toole (1998)	324	The variations in size, layout, materials, living spaces, and style of houses around the country due to local tastes, climate, and regulations are tremendous. Since the concrete benefits of an innovation depend on the characteristics of the house in which it is used, weighing the expected benefits versus the switching or fixed costs associated with adopting the innovation can be difficult.	high variation in product delivered	Org.	Late Majority

Toole (1998)	325	Low munificence results in very few home building firms having sufficient resources to invest in generating or adopting innovations while also ensuring organizational slack to survive drastic drops in demand.	have sufficient resources to invest in generating or adopting innovations	Org.	Early Adopters
Toole (1998)	325	The more inputs required for an organization's operations, the more outputs it produces, the more organizations and industries that it interacts with, or the more regulated it is, the higher the complexity of an organization's environment. Complexity contributes to the perceived uncertainty by increasing the number of variables that managers must take into account when making decisions about organizational actions.	higher the complexity of an organization's environment	Org.	Late Majority
Toole (1998)	325	…the vast majority of builders seek convincing proof that a new building product will provide significant advantages over an existing product.	seek convincing proof that a new building product will provide significant advantages over an existing product	Both	Early Majority
Toole (1998)	325	As such, we would expect to find that home builders who are early adopters of innovations have superior abilities to effectively gather missing information for their adoption decisions.	have superior abilities to effectively gather missing information for their adoption decisions	Both	Early Adopters
Toole (1998)	326	In addition, these relatively early adopters are also expected to have higher tolerances of uncertainty.	have higher tolerances of uncertainty	Org.	Early Adopters
Toole (1998)	328	Table 1 indicates that the relationship between the number of information sources about innovations that builders considered important and the number of non-diffused innovations adopted is positive and significant for both high and low uncertainty innovations. Builders more apt to adopt both high and low uncertainty, non-diffused innovations tap into more sources of information about innovations than do non-adopters.	tap into more sources of information about innovations	Both	Innovators, Early Adopters
Toole (1998)	329	As shown in Table 1, the relationship between the number of functions involved in making adoption decisions and adoption of high uncertainty, non-diffused innovations was found to be positively and significantly related, whereas no significant relationship was found with adoption of low uncertainty, non-diffused innovations.	high number of functions involved in making adoption decisions	Org.	Early Adopters
Toole (1998)	329	Having at least one individual with a building trades background involved in innovation-related activities was found to positively and significantly relate to adoption of high uncertainty, non-diffused innovations.	Having a building trades background involved in innovation-related activities	Org.	Early Adopters
Toole (1998)	329	Having at least one individual with an architectural or engineering (AE) background involved in innovation-related activities was found to be positively and significantly related to adoption of low uncertainty, non-diffused innovations.	Having at least one individual with an architectural or engineering (AE) background involved in innovation-related activities	Org.	Early Adopters
Toole (1998)	330	The relationship between attitude and adoption of low uncertainty, non-diffused innovations, however, is positive and highly significant.	attitude toward innovation and change	Indiv.	

Toole (1998)	331	While having at least one individual with an AE background involved in innovation-related activities facilitates adoption of low uncertainty innovations, it does not facilitate adoption of high uncertainty innovations, because such individuals are apparently less tolerant of and cannot reduce high uncertainty related to market acceptance. Adoption of high uncertainty non-diffused innovation is, however, facilitated by having someone with a building trades background to help evaluate how the innovation would fit with the company's house designs and subcontracting procedures.	less tolerant of high uncertainty related to market acceptance	Org.	Late Majority, Laggards
Toole (1998)	331	Adoption of high uncertainty, non-diffused innovations also requires intimate knowledge of multiple sectors of the environment, which is provided by having multiple functions involved in adoption decisions.	intimate knowledge of multiple sectors of the environment;	Org.	Early Adopters
Koebel et al. (2003)	ix	Nonetheless, middle-stage adopters warrant greater research attention, as they are the lynchpin to significant market penetration.	middle-stage adopters are the lynchpin to significant market penetration.	Both	Early Adopters
Koebel et al. (2003)	ix	Late-stage adopters are heavily influenced by the "bandwagon" effect and pressure to adopt products, materials, and practices that are rapidly becoming industry standards.	influenced by the "bandwagon" effect and pressure to adopt innovations becoming industry standards.	Org.	Late Majority
Koebel et al. (2003)	x	At the early stage of diffusion, national and regional firms, multifamily and modular builders, and custom builders are more likely to adopt innovation than are single-family production builders.	national and regional firms, multifamily and modular builders, and custom builders	Org.	Innovators, Early Majority
Koebel et al. (2003)	x	…early-stage adopters rely on technology transfer programs and universities more than middle or late-stage adopters do.	rely on technology transfer programs and universities	Org.	Innovators, Early Majority
Koebel et al. (2003)	x	…residential building construction relies heavily on established manufacturers who stand behind their products. This behavior likely reflects the substantial financial and market risks associated with innovation in residential building.	relies heavily on established manufacturers	Org.	Early Majority
Koebel et al. (2003)	x	The types of home building firms most likely to be early adopters were: Modular builders and multifamily builders	Modular builders and multifamily builders	Org.	Early Adopters
Koebel et al. (2003)	x	The types of home building firms most likely to be early adopters were: Single-family custom home builders	Single-family custom home builders;	Org.	Early Adopters
Koebel et al. (2003)	x	The types of home building firms most likely to be early adopters were: National and regional builders	National and regional builders.	Org.	Early Adopters
Koebel et al. (2003)	x	These more innovative firms were also more likely to : Have a technology advocate within the building firm	Have a technology advocate within the building firm;	Org.	Early Adopters
Koebel et al. (2003)	x	These more innovative firms were also more likely to : Stress the importance of being creative and the first to use new products	Stress the importance of being creative and the first to use new products;	Org.	Early Adopters
Koebel et al. (2003)	x	These more innovative firms were also more likely to : Use technology transfer programs like the Partnership for Advancing Technology in Housing (PATH) and universities	Use technology transfer programs	Org.	Early Adopters
Koebel et al. (2003)	x	These firms also stressed the importance of : Reliance on established manufacturers standing behind their building and construction products.	Reliance on established manufacturers	Org.	Early Majority

Koebel et al. (2003)	x	The types of home building firms that wait until new products, materials, and practices have been around much longer were more likely to be local firms and single-family production builders.	wait until new products, materials, and practices have been around much longer	Org.	Late Majority
Koebel et al. (2003)	x		local firms and single-family production builders	Org.	Late Majority
Koebel et al. (2003)	x	These later adopters were more likely to: Emphasize marketability and profit	Emphasize marketability and profit	Org.	Late Majority
Koebel et al. (2003)	x	These later adopters were more likely to: Associate the firm's success with land development	Associate the firm's success with land development;	Org.	Late Majority
Koebel et al. (2003)	x	These later adopters were more likely to: Emphasize the "tried and true" and the risks of new materials and products	Emphasize the "tried and true"	Org.	Late Majority
Koebel et al. (2003)	x		the risks of new materials and products	Org.	Late Majority
Koebel et al. (2003)	xi	They are also less likely to be innovative if their business strategy emphasizes acquiring and developing land with better locations than that of their competitors.	business strategy emphasizes acquiring and developing land	Org.	Late Majority
Koebel et al. (2003)	xi	Innovative builders, by contrast, emphasize educating their customers about new technologies.	emphasize educating their customers about new technologies	Org.	Innovators, Early Adopters
Koebel et al. (2003)	xi	Additionally, innovation among home builders is associated with firms that establish innovation and creativity as part of their corporate culture.	establish innovation and creativity as part of their corporate culture	Org.	Innovators, Early Adopters
Koebel et al. (2003)	xi	Some firms, probably as a result of their owners' advocacy of innovation, see themselves as creative and innovative.	owners' advocacy of innovation	Org.	Innovators, Early Adopters
Koebel et al. (2003)	xi	They are less concerned about the immediate impact of innovation on profits and stress the contributions of innovation to productivity.	less concerned about the immediate impact of innovation on profits	Org.	Innovators
Koebel et al. (2003)	xi		stress the contributions of innovation to productivity	Org.	Innovators
Koebel et al. (2003)	xi	They do not look to their competitors or to market trends before deciding to innovate.	do not look to their competitors or to market trends before deciding to innovate	Org.	Innovators
Koebel et al. (2003)	xi	They learn about technology from the government (through programs like PATH), the National Associating of Home Builders (NAHB) seminars, universities, and the Internet.	learn about technology from the government, universities, and the Internet.	Org.	Innovators, Early Adopters
Koebel et al. (2003)	xi	Middle- and Late-stage adopters are more likely to learn about new technologies from other builders and trade shows.	more likely to learn about new technologies from other builders and trade shows	Org.	Early Majority, Late Majority
Koebel et al. (2003)	xi	Late-stage adopters are inappropriate targets for technology diffusion programs. They are too risk-adverse and will wait for other to show that the benefits and costs of new technologies are proven. By that time competitive bandwagon effects are sufficiently powerful to bring them along.	risk-adverse	Org.	Late Majority, Laggards
Koebel et al. (2003)	xi		wait for other to show that the benefits and costs of new technologies are proven	Org.	Late Majority, Laggards
Koebel et al. (2003)	xi	..and the tendency of innovative builders to be less concerned about competitive advantage related to factors other than price might explain the greater acceptance by small builders of new technologies that cost more than alternatives.	less concerned about competitive advantage related to factors other than price	Org.	Innovators
Koebel et al. (2003)	8	Lack of integration of the industry, particularly the heavy reliance on subcontractors.	Lack of integration of the industry	Org.	Late Majority

Koebel et al. (2003)	8		heavy reliance on subcontractors	Org.	Late Majority
Koebel et al. (2003)	8	Lack of access to information about new products.	Lack of access to information about new products	Org.	Late Majority, Laggards
Koebel et al. (2003)	8	Inadequate education and training on products and materials, installation techniques, and methods of operation and maintenance.	Inadequate education and training on products and materials, installation techniques	Org.	Late Majority, Laggards
Koebel et al. (2003)	8		inadequate methods of operation and maintenance	Org.	Late Majority, Laggards
Koebel et al. (2003)	8	Limited funding for research.	Limited funding for research	Org.	Late Majority, Laggards
Koebel et al. (2003)	9	Poorly developed links between universities and the construction industry.	Poorly developed links between universities and the construction industry	Org.	Early Majority, Late Majority, Laggards
Koebel and McCoy (2006)	6	Established firms typically resist innovations that require significant rethinking of systems or business models, which probably reflects the greater risks associated with major changes.	resist innovations that require significant rethinking of systems or business models	Org.	Late Majority, Laggards
Koebel and McCoy (2006)	6	Scarbough (1998) warns that the knowledge resources of the firm are not readily appropriable from individuals to central administrators, which suggest that the top-down mandated changes of any significant sort are likely to have a high risk of failure without understanding and addressing the social and inter-organizational networks and knowledge depositories that contribute to the firm's success.	without understanding and addressing the social and inter-organizational networks and knowledge depositories that contribute to the firm's success	Org.	All
Koebel and McCoy (2006)	10	resources and business strategies, and ability to implement (Sexton and Barrett, 2003b)	resources and business strategies	Org.	Early Adopters
Koebel and McCoy (2006)	10		ability to implement	Org.	Early Adopters
Koebel and McCoy (2006)	10	embedded knowledge regarding technology, including tacit or explicit knowledge (Mitropoulos and Tatum, 1999)	embedded knowledge regarding technology, including tacit or explicit knowledge	Org.	Innovators, Early Adopters
Koebel and McCoy (2006)	10	roles of champion, integrator and innovation broker (Gann, 2001)	roles of champion, integrator and innovation broker	Org.	Innovators, Early Adopters
Koebel and McCoy (2006)	10	technology watch done infrequently (Davidson, 2001)	technology watch done infrequently	Org.	Late Majority, Laggards
Koebel and McCoy (2006)	10	corporate culture, culture of innovation and culture of collaboration (Barlow, 2000; Love et al., 2002; Blayse and Manley, 2004; Cousins, 1998);	corporate culture, culture of innovation and culture of collaboration	Org.	Innovators, Early Adopters
Koebel and McCoy (2006)	10	capacity for innovation based on submarket served, inter-firm network, business strategy, market position, knowledge of technology and ease of adoption, imbedded knowledge, and organization (Sexton and Barrett, 2004)	capacity for innovation	Org.	Innovators, Early Adopters

Koebel and McCoy (2006)	10	cognitive capabilities; ability to innovate; use of IT and knowledge management to support innovation (Sexton and Barrett, 2003b)	use of IT and knowledge management to support innovation	Org.	Early Adopters
Koebel and McCoy (2006)	10	lack resources—U-shaped relationship with innovation (Sexton and Barrett, 2003a);	lack resources	Org.	Late Majority, Laggards
Koebel and McCoy (2006)	10	experimentation and willingness to fail (Sexton and Barrett, 2003a);	experimentation and willingness to fail	Both	Innovators
Koebel and McCoy (2006)	10	management support for implementation (Sexton Barrett, 2003a);	management support for implementation	Org.	Innovators, Early Adopters
Koebel and McCoy (2006)	10	senior executive involvement (Mitropoulos and Tatum, 1999);	senior executive involvement	Org.	Innovators, Early Adopters
Koebel and McCoy (2006)	10	balance of rational analysis and intuitive synthesis (Mitropoulos and Tatum, 1999)	balance of rational analysis and intuitive synthesis	Both	Early Adopters
Koebel and McCoy (2006)	10	small firms concentrate on survival, stability and limiting exposure to costs and risks (Sexton and Barrett, 2003b)	small firms concentrate on survival, stability and limiting exposure to costs and risks	Org.	Late Majority, Laggards
Koebel and McCoy (2006)	10	path dependency; day-to-day competitive pressure (Sexton and Barrett, 2003b; Macomber, 2004)	path dependency; day-to-day competitive pressure	Org.	Late Majority, Laggards
Koebel and McCoy (2006)	11	institutional attitudes; resistance to change; lack of confidence in outputs;	institutional attitudes	Both	Late Majority, Laggards
Koebel and McCoy (2006)	11		resistance to change	Both	Late Majority, Laggards
Koebel and McCoy (2006)	11	liability concerns (Flood et al., 2003);	liability concerns	Both	Early Majority, Late Majority
Koebel and McCoy (2006)	12	larger firms have greater capacity to innovate (Blackley and Shepard; Oster and Quigley, 1977; Koebel, 2003);	larger firms	Org.	Innovators, Early Adopters
Koebel and McCoy (2006)	12	operating in multiple markets reduces risks and increases opportunities for regulatory acceptance (Blackley and Shepard)	operating in multiple markets	Org.	Early Adopters
Koebel and McCoy (2006)	12	small firms lack capital for innovation including costs of implementation and require returns more quickly (Slaughter, 1993a);	small firms	Org.	Late Majority
Koebel and McCoy (2006)	12		require returns more quickly	Org.	Late Majority
Koebel and McCoy (2006)	12	owner/president most influential followed by project manager in influencing decisions about new products/materials, and owner/president almost exclusively responsible for final decisions about new products/materials (Koebel 2003);	owner/president almost exclusively responsible for final decisions about new products/materials	Org.	All

Koebel and McCoy (2006)	12	small firms are risk adverse (Slaughter, 1993a, Toole, 1998)	small firms are risk adverse	Org.	Late Majority, Laggards
Koebel and McCoy (2006)	12	inadequate knowledge management and technology scanning (Slaughter, 1993a, Toole, 1998);	inadequate knowledge management and technology scanning	Org.	Late Majority, Laggards
Koebel and McCoy (2006)	12	30% have no plan for growth in profits or plan to downsize (Koebel, 2003);	no plan for growth in profits	Org.	Late Majority, Laggards
Koebel and McCoy (2006)	12	one-third hold positive attitudes about innovation and one-sixth hold negative or conservative attitudes (Koebel, 2003);	positive attitudes about innovation	Both	Innovators, Early Adopters
Koebel and McCoy (2006)	12		negative or conservative attitudes	Both	Late Majority, Laggards
Koebel and McCoy (2006)	12	greater emphasis on aesthetic improvements, total quality practices, subcontractor dependability, marketability and reducing call-backs than on reducing costs and liabilities through investment in innovative products (Koebel, 2003);12	greater emphasis on aesthetic improvements	Org.	Innovators, Early Adopters
Koebel and McCoy (2006)	12		greater emphasis on total quality practices	Org.	Innovators, Early Adopters
Koebel and McCoy (2006)	12		greater emphasis on subcontractor dependability	Org.	Innovators, Early Adopters
Koebel and McCoy (2006)	12		greater emphasis on marketability	Org.	Innovators, Early Adopters
Koebel and McCoy (2006)	12		greater emphasis on reducing call-backs	Org.	Innovators, Early Adopters
Koebel and McCoy (2006)	12		greater emphasis on reducing costs and liabilities through investment in innovative products	Org.	Early Majority
Koebel and McCoy (2006)	12	pro-innovation business strategy, technology champion and emphasis on cooperation associated with higher innovation (Koebel 2003);	pro-innovation business strategy	Org.	Innovators, Early Adopters
Koebel and McCoy (2006)	12		technology champion	Org.	Innovators, Early Adopters
Koebel and McCoy (2006)	12	emphasis on land development associated with lower innovativeness (Koebel 2003);	emphasis on land development	Org.	Late Majority, Laggards
Koebel and McCoy (2006)	13	reliance on established companies that stand behind their products (Koebel, 2003);	reliance on established companies	Both	Early Majority
Koebel and McCoy (2006)	13	having a greater number of information sources reduces uncertainty associated with innovation (Toole, 1998)	greater number of information sources	Both	Innovators, Early Adopters

Blackley and Shepard (1996)	305	The relatively low rate of profits and small average size implies that firms generally will often not have the resources available to fund activities required to evaluate potentially profitable innovations.	low rate of profits	Org.	Late Majority, Laggards
Blackley and Shepard (1996)	305		small average size	Org.	Late Majority, Laggards
Blackley and Shepard (1996)	306	Larger or more diversified firms are generally believed to be more likely to undertake the risks involved with innovation or diffusion.	Larger or more diversified firms	Org.	Early Adopters
Blackley and Shepard (1996)	306	In general, studies have shown that those of higher socioeconomic status, higher income, and greater education and training are more willing to accept the risks of developing or adopting innovations.	higher socioeconomic status	Org.	Innovators, Early Adopters
Blackley and Shepard (1996)	306		higher income,	Org.	Innovators, Early Adopters
Blackley and Shepard (1996)	306		greater education and training	Org.	Innovators, Early Adopters
Blackley and Shepard (1996)	306		more willing to accept the risks	Org.	Innovators, Early Adopters
Blackley and Shepard (1996)	317	The probability of using no innovation and one innovation falls by about 0.005 and 0.002, and the probability of using two, three, and four or more innovations rises by 0.003, 0.002, and 0.002 for each $1 million increase in construction revenues, all else equal.	$1 million increase in construction revenues	Org.	Innovators, Early Adopters

Appendix C: Coding Results for Individual Characteristics of Innovativeness

Major Focus Areas of Change	Focus Strategy (within major areas)	Characteristic/trait	Source
Demographic	Education	High level of education	Rogers (2003)
Demographic	Education	Strong technological background	Davis (2004); Rogers (2003)
Demographic	Financial Statistics	High level of financial resources	Rogers (2003)
Communication	Stakeholder Relationships	Do not command high levels of opinion leadership in the industry	Rogers (2003); Moore (1999)
Communication	Stakeholder Relationships	Introduce innovation into the industry	Moore (1999); Rogers (2003)
Communication	Stakeholder Relationships	Conduct Initial assessment of innovation	J.F. Hickling (1989)
Communication	Stakeholder Relationships	cosmopolite	Rogers (2003)
Communication	Transfer Processes	Are able to fill innovation information gaps	Building Technology Incorporated (2005); Moore (1999)
Communication	Transfer Processes	Utilize mass media as an information source	Rogers (2003)
Communication	Transfer Processes	Maintain more information sources than other members of the construction industry	Koebel and McCoy (2006); Toole (1998)
Culture	Creative	Exhibit intangible creativity and daring to pursue innovation	Hartmann (2006); Rogers (2003); Koebel and McCoy (2006); Moore (1999)
Culture	Economic	See innovation as a chance to derive economic benefit	Holmen Enterprises, Ltd. (2001)
Culture	Individual	Actively seek innovation	Moore (1999)
Culture	Individual	May fail to consider enough alternatives due to intense focus on innovation	Davis (2004)

Culture	Individual	Problem solvers	Holmen Enterprises (2001)
Culture	Individual	Forgiving in nature and initially require less of an innovation	Moore (1999)
Culture	Innovative	Technically capable of implementing innovations	Hartmann (2006)
Culture	Innovative	Able to critique innovations new to the industry	Moore (1999)
Culture	Innovative	Favorable attitudes toward innovation and technology	Moore (1999); Koebel and McCoy (2006); Moore (1999); Davis (2004); Hartmann (2006); Rogers (2003)
Risk	Tolerance	Willingly engage in high-risk endeavors	Hartmann (2006)
Risk	Tolerance	High risk tolerance	Rogers (2003)
Demographic	Education	Value formal education and technical knowledge	BSRIA (2005)
Demographic	Education	Value experience with technology	Davis (2004)
Demographic	Financial Statistics	Not as price sensitive as other industry members	Moore (1999)
Communication	Stakeholder Relationships	Looked up to in the industry as opinion leaders and serve as references for others that adopt after them	Rogers (2003); J.F. Hickling (1989); BSRIA (2005); Koebel et al. (2003)
Communication	Stakeholder Relationships	Exhibit effective communication	J.F. Hickling (1989)
Communication	Transfer Processes	Able to effectively gather innovation information	Toole (1998); Koebel and McCoy (2006)
Communication	Transfer Processes	maintain a high number of sources	Toole (1998); Koebel and McCoy (2006)
Culture	Creative	Able to match attributes of innovation to tangible organizational benefits	BSRIA (2005); Koeble and McCoy (2006); Moore (1999)
Culture	Economic	Seek economic benefit from innovation	Holmen Enterprises, Ltd. (2001)
Culture	Individual	Open-minded individuals looking to improve upon daily operations	BSRIA (2005); Hartmann (2006)
Culture	Innovative	Willing to pursue innovations	Hartmann (2006); Koebel and McCoy (2006); Davis (2004); BSRIA (2005); Hartmann (2006)

Culture	Innovative	Capable of matching innovations to organizational goals to forward the organization	BSRIA (2005); J.F. Hickling (1989); Moore (1999)
Risk	Tolerance	Able to engage in high-risk endeavors	Hartmann (2006); Moore (1999)
Communication	Stakeholder Relationships	lack opinion leadership in the industry	Rogers (2003); BSRIA (2005)
Communication	Stakeholder Relationships	look to Early Adopters for leadership	BSRIA (2005)
Communication	Stakeholder Relationships	provide a link later adopters to earlier adopters	Rogers (2003); BSRIA (2005)
Communication	Transfer Processes	Require high levels of information	Rogers (2003); Moore (1999)
Communication	Transfer Processes	frequently gather word-of-mouth information	Holmen Enterprises, Ltd. (2001)
Culture	Creative	Avoid being on the leading edge of innovation	Moore (1999)
Culture	Individual	Discrete	Moore (1999)
Culture	Individual	Practical by nature, they are interested in the consequences of innovation	Moore (1999)
Culture	Innovative	Capable of technological competency	Moore (1999)
Culture	Innovative	Will innovate only after a longer innovation-decision periods	Rogers (2003); Davis (2004)
Risk	Mitigation	Use well-established companies and references to reduce innovation risk	Koebel and McCoy (2006); Moore (1999); Toole (1998)
Demographic	Education	Low average level of formal education and training	BSRIA (2005); J.F. Hickling (1989)
Demographic	Education	Minimal technological experience	Davis (2004)
Demographic	Financial Statistics	Limited financial resources	Rogers (2003)
Demographic	Stakeholder Relationships	Resistant to change	Davis (2004); Rogers (2003)
Demographic	Stakeholder Relationships	play a devil's advocate role in a group setting	Davis (2004)

Communication	Stakeholder Relationships	Hold no opinion leadership in the industry	Rogers (2003)
Communication	Stakeholder Relationships	maintain relationships with those who have shared values	Rogers (2003); J.F. Hickling (1989)
Communication	Transfer Processes	Sparse connections to mass media	Rogers (2003)
Communication	Transfer Processes	ineffective communication	J.F. Hickling (1989)
Culture	Economic	Innovate out of necessity	Holmen Enterprises, Ltd. (2001); Rogers (2003)
Culture	Economic	publicly identify innovations flaws	Moore (1999)
Culture	Economic	Last in the industry to adopt innovations	J.F. Hickling (1989); Moore (1999)
Culture	Individual	Very conservative attitudes toward innovation	Moore (1999); Koebel and McCoy (2006); Rogers (2003); Toole (1998)
Culture	Individual	unwilling to increase technological competence	Moore (1999)
Culture	Innovative	Resist innovation	Moore (1999); Davis (2004); Koebel and McCoy (2006);
Culture	Innovative	have negative ideas and fears of change and innovation	Davis (2004); Rogers (2004)
Culture	Innovative	fail to recognize the benefits of technology	Toole (1998)
Culture	Innovative	Require innovations that do not demand high levels of technical knowledge	J.F. Hickling (1989); Holmen Enterprises, Ltd. (2001)
Culture	Innovative	Require innovations that do not demand significant changes in business practice	Holmen Enterprises, Ltd. (2001)
Culture	Innovative	draw attention to uncertainty of innovations	Davis (2004)
Culture	Innovative	Innovate as a result peer-pressure	Rogers (2003)
Culture	Innovative	Innovate as a result of a swing in industry standards	Rogers (2003)

Risk	Mitigation	Mitigate risk by avoiding it or significantly reducing uncertainty	Rogers (2003); J.F. Hickling (1989)
Risk	Tolerance	Very cautious about innovation due to inability to tolerate high levels of risk	Moore (1999); Rogers (2003)
Risk	Tolerance	Inability to tolerate high levels of risk	Koebel and McCoy (2006)

Appendix D: Coding Results for Organizational Characteristics of Innovativeness

Major Focus Areas of Change	Focus Strategy (within major areas)	Characteristic/trait	Source
Demographic	Education	higher average levels of education and training	Blackley and Shepard (1996); Holmen Enterprises, Ltd. (2001)
Demographic	Education	greater average technical knowledge	Rogers (2003)
Demographic	Education	higher capacity for innovation	Koebel and McCoy (2006); Hartmann (2006)
Demographic	Education	greater ability to evaluate innovations new to the industry	Moore (1999)
Demographic	Financial Statistics	Higher average socioeconomic status and income potential, including high financial resources	Rogers (2003); Blackley and Shepard (1996)
Demographic	Statistical Region	Conduct business operations in multiple geographic markets	Building Technology Incorporated (2005); Koebel et al. (2003)
Demographic	Statistical Size	Large Firms	Koebel and McCoy (2006)
Communication	Stakeholder Relationships	Focus on strong business relationships within the industry supply chain	Holmen Enterprises, Ltd. (2001); Koebel and McCoy (2006); BSRIA (2005)
Communication	Stakeholder Relationships	Serve to introduce innovations to the industry and conduct an early evaluation	Moore (1999); J.F. Hickling (1989); Rogers (2003); Hartmann (2006)
Communication	Stakeholder Relationships	lack the respect and industry leadership to strongly influence the purchasing decisions of other industry members	J.F. Hickling (1989); Moore (1999); Rogers (2003)
Communication	Transfer Processes	Utilize many innovation information sources, including government and university sources	Koebel et al. (2003); Toole (1998); Koebel and McCoy (2006); Hartmann (2006)

Communication	Transfer Processes	emphasize information transfer	Koebel et al. (2003)
Culture	Corporate	establish innovation as a part of corporate culture and business strategy	Holmen Enterprises, Ltd. (2001); BSRIA (2005); Koebel and McCoy (2006); Building Technology Incorporated (2005); Koebel et al. (2003)
Demographic	Education	High average levels of education and training	Holmen Enterprises, Ltd. (2001); Blackley and Shepard (1996)
Demographic	Education	Associates have the ability to seek and apply innovation information	Toole (1998); Koebel and McCoy (2006)
Demographic	Education	Diverse backgrounds of those involved in innovation-decisions	Toole (1998)
Demographic	Financial Statistics	Control significant financial resources	Toole (1998); Davis (2004); Holmen Enterprises, Ltd. (2001); Blackley and Shepard (1996); J.F. Hickling (1989);
Demographic	Financial Statistics	Display willingness to invest financial resources into innovation	Moore (1999)
Demographic	Statistical Region	Operate in multiple geographic markets, usually on a regional or national level	Koebel et al. (2003); Building Technology Incorporated (2005); Koebel and McCoy (2006)
Demographic	Statistical Size	Larger firms	BSRIA (2005); Blackley and Shepard (1996); Koebel and McCoy (2006); Koebel et al. (2003)
Communication	Stakeholders Relationships	Are central in the communication network	Holmen Enterprises, Ltd. (2001); BSRIA (2005)

Communication	Stakeholders Relationships	Hold high degrees of opinion leadership in the industry	Rogers (2003); Koebel et. Al. (2003); BSRIA (2005)
Communication	Stakeholders Relationships	Serve as references for risk reduction to those who adopt after them	Rogers (2003); Koebel et. Al. (2003)
Communication	Stakeholder Relationships	Form strong business relationship within the supply chain	Toole (1998); Holmen Enterprises, Ltd. (2001); BSRIA (2005); Koebel and McCoy (2006)
Communication	Stakeholder Relationships	Maintain a knowledge of many market sectors	Toole (1998); Holmen Enterprises, Ltd. (2001)
Communication	Transfer Processes	Willingly and effectively share innovation information within the organization and the supply chain	Moore (1999); Holmen Enterprises, Ltd. (2001); Rogers (2003); Hartmann (2006)
Communication	Transfer Processes	Utilize a high number of information sources including technology transfer programs	Koebel et al. (2003); Toole (1998); Koebel and McCoy (2006)
Culture	Corporate	Management support and promote a culture that emphasizes innovation and factors that support innovation	Holmen Enterprises, Ltd. (2001); Hartmann (2006); Koebel and McCoy (2006); Koebel et al. (2003); Building Technology Incorporated (2005); BSRIA (2005)
Culture	Corporate	Realize and focus on the value of human capital	Hartmann (2006); Holmen Enterprises, Ltd. (2001)
Culture	Corporate	Seek results and benefits quickly	Moore (1999)
Culture	Corporate	Focus on quality	Koebel and McCoy (2006)
Culture	Corporate	Able to see the value of an innovation in meeting the needs of the organization	Hartman (2006); Davis (2004)

Culture	Creative	Have an innate capacity for innovation that is balanced with rational analysis	Koebel and McCoy (2006); Hartman (2006)
Culture	Creative	Demonstrate idealistic foresight focusing on the ideas of people	Moore (1999); Holmen Enterprises, Ltd. (2001)
Culture	Economic	Emphasize marketability	Koebel and McCoy (2006)
Culture	Economic	Seek economic benefit from innovation	Holmen Enterprises (2001)
Culture	Innovative	Have innovation champions	Koebel and McCoy (2006); Koebel et al. (2003)
Culture	Innovative	Work to strengthen innovation accelerators	Koebel and McCoy (2006); Holmen Enterprises, Ltd. (2001)
Culture	Innovative	Implement innovation using multiple approaches including project orientations; they have high standards for innovation, but view failures as a learning opportunity	Koebel and McCoy (2006); Toole (1998); Holmen Enterprises, Ltd. (2001); Hartmann (2006); Moore (1999)
Culture	Innovative	Positive and ambitious attitudes toward innovation	Koebel et al. (2003); Koebel and McCoy (2006); Moore (1999)
Culture	Innovative	Hold high standards when evaluating innovation	Holmen Enterprises, Ltd. (2001); J.F. Hickling (1989); Koebel and McCoy (2006)
Risk	Mitigation	Seek to stem down-stream costs	Koeble and McCoy (2006)
Risk	Mitigation	Able to face high risks	J.F. Hickling (1989)
Risk	Tolerance	Ability to tolerate high innovation risk without well-established references	Moore (1999); Hartmann (2006); Toole (1998); Blackley and Shepard (1996); J.F. Hickling (1989)
Communication	Stakeholder Relationships	Serve as a link between earlier and later adopters	Rogers (2003)

Communication	Stakeholder Relationships	Are not on the leading edge of innovation adoption	BSRIA (2005); Rogers (2003)
Communication	Stakeholder Relationships	Rely on the experiences of others as references for innovation information	BSRIA (2005); Rogers (2003); Moore (1999); Koebel et al. (2003)
Communication	Transfer Processes	Lack of information transfer with those outside the industry	Koebel et al. (2003)
Communication	Transfer Processes	rather rely on information from peer organizations	Koebel et al. (2003)
Culture	Corporate	Have dual-role associates participating in management and daily construction activities	Building Technology Incorporated (2005); Moore (1999)
Culture	Corporate	Tend to be more discrete	Moore (1999)
Culture	Innovative	Capable of technical competence	Moore (1999)
Culture	Innovative	Generally engage in a longer innovation-decision process	Moore (1999); Rogers (2003); Toole (1998); J.F. Hickling (1989)
Culture	Innovative	Seek to make incremental improvements	Moore (1999)
Culture	Innovative	Fear losing competitive advantage through competitor copying	Holment Enterprises, Ltd. (2001)
Risk	Mitigation	Need reliable innovation information prior to adopting	Koebel and McCoy (2006); Moore (1999)
Risk	Mitigation	Emphasize managing risk involved with innovation adoption	BSRIA (2005); Koebel and McCoy (2006); Moore (1999)
Demographic	Education	Lower average level of education and technical knowledge	Koebel et al. (2003); J.F. Hickling (1989)
Demographic	Education	Lower average income and lack of financial resources	Rogers (2003); J.F. Hickling (1989); Koebel and McCoy (2006); Holmen Enterprises, Ltd. (2001); Blackley and Shepard (1996)

Demographic	Statistical Region	Tend to have locally focused operations	Koebel et al. (2003); Rogers (2003)
Demographic	Statistical Size	Small firm size	Koebel and McCoy (2006); Blackley and Shepard (1996)
Communication	Stakeholder Relationships	Characterized by fragmented relationships and subcontractor dependence (high level of subcontracted work)	J.F. Hickling (1989); Koebel et al. (2003); Holmen Enterprises, Ltd. (2001)
Communication	Stakeholder Relationships	Lack opinion leadership in the industry and typically are subject to pressure from other industry stakeholders	Rogers (2003)
Communication	Stakeholder Relationships	tend to relate to those of similar standing	Rogers (2003)
Communication	Transfer Processes	Do no seek sources of innovation information outside of their circle of peers	Koebel and McCoy (2006); Koebel et al. (2003); J.F. Hickling (1989)
Communication	Transfer Processes	Exhibit poor innovation information management	Koebel and McCoy (2006); Koebel et al. (2003)
Culture	Corporate	Form and maintain discontinuous relationships with limited focus on integration	J.F. Hickling (1989); Koebel et al. (2003); Holmen Enterprises, Ltd. (2001)
Culture	Corporate	Overly conservative attitudes toward innovation with a tendency to avoid change	J.F. Hickling (1989); Koebel and McCoy (2006); Moore (1999); Toole (1998)
Culture	Corporate	Focus on the past	Koebel et al. (2003); Koebel and McCoy (2006); Holmen Enterprises, Ltd. (2001)
Culture	Corporate	Focus on land development with minimal long-term contingencies	Koebel et al. (2003); J.F. Hickling (1989); Koebel and McCoy (2006)

Culture	Economic	Minimal investment in innovation activities, focusing on maintaining the status quo	Koebel et al. (2003); Holmen Enterprises, Ltd. (2001); Koebel and McCoy (2006)
Culture	Economic	Generally innovate only out of economic necessity	Rogers (2003); Holmen Enterprises, Ltd. (2001)
Culture	Innovative	Loyal to tradition, opposing change and innovation out of fear and distaste	Rogers (2003); Koebel and McCoy (2006); J.F. Hickling (1989); Moore (1999); Koebel et al. (2003); Toole (1998)
Culture	Innovative	Require innovations that do not require high degrees of technical ability/knowledge	Holmen Enterprises, Ltd. (2001)
Culture	Innovative	Last in the industry to innovate, waiting until innovation becomes standard and succumbing to peer-pressure	Moore (1999); Rogers (2003); Koebel et al. (2003)
Risk	Mitigation	Mitigate risk by delaying adoption until the innovation has been thoroughly proven	Rogers (2003); Koebel et al. (2003); Moore (1999); J.F. Hickling (1989)
Risk	Mitigation	Seek non-discontinuous innovations, those that do not require significant changes in day-to-day operations	Holmen Enterprises, Ltd. (2001); Koebel and McCoy (2006)
Risk	Mitigation	Try to avoid risk associated with innovation, and are very cautious of innovation	Rogers (2003); Koebel and McCoy (2006); Koebel et al. (2003); J.F. Hickling (1989)
Risk	Tolerance	Risk-averse	Koebel and McCoy (2006); Rogers (2003); Koebel et al. (2003); J.F. Hickling (1989); BSRIA (2005); Toole (1998)

Appendix E: Modified Delphi initial round survey tool

Part 1: Matrix Definitions

Dear Expert Panel Member,

Thank you very much for taking the time to participate in a process for defining categories of individual and organizational innovativeness in construction literature. Part 1 establishes four separate, major categories, termed "Major Focus Areas." These four categories are then further divided into sub-categories, termed "Strategic Areas for Change," within the Major Focus Areas. The Major Focus Areas of literature on innovativeness are: Organizational and individual Demographics, Communication, Culture and Risk. Please refer to the literature organizational matrix email to you when answering the survey questions.

The initial portion of this survey is designed to determine if you concur with Major Focus Area and sub-category definitions developed by the research team.

Major Focus Areas:

Do you agree with Demographics as a Major Focus Area?

Yes

No

If no, please explain.

Do you agree with Communication as a Major Focus Area?

Yes

No

If no, please explain.

Do you agree with Culture as a Major Focus Area?

Yes

No

If no, please explain.

Do you agree with Risk as a Major Focus Area?

Yes

No

If no, please explain.

Please list Major Focus Areas you would add to the innovativeness literaure matrix and explain:

Strategic Areas for Change:
The sub-categories of the Major Focus Areas, or "Strategic Areas of Change," in the literature pertaining to innovativeness are: Educational, Financial, Statistical Size and Statistical Region demographics; Transfer Process and Stakeholder Relationship Communications; Innovative, Corporate and Individual, Economic and Creative Cultures; and Tolerance of and Mitigation of Risks. Again, please refer to the literature organizational matrix email to you when answering the survey questions.

The remaining portion of this survey is designed to determine if you concur with sub-category definitions developed by the research team.

Within the major focus area of Demographics we define Educational Statistics as "knowledge resources of the individual or organization, including education level, training level and technical skill level. Do you agree with this definition?

Yes

No

If no, please explain.

Within the major focus area of Demographics we define Financial Statistics as "financial resources of the individual or organization, including income level and earning potential". Do you agree with this definition?

Yes

No

If no, please explain.

Within the major focus area of Demographics we define Statistical Size as "Number of individuals within the firm or adopter category (1-199 = small; 200-499 = medium; >499 = Large). Do you agree with this definition?

Yes

No

If no, please explain.

Within the major focus area of Demographics we define Statistical Region as "The concentration of technical or business operation in one or more geographical areas, including local, national, and international. Do you agree with this definition?

Yes

No

If no, please explain.

Within the major focus area of Communications we define Transfer Processes as "capacity for transferring specific knowledge among individuals or organizations, including, technical information, tacit knowledge, origins and flow of information". Do you agree with this definition?

Yes

No

If no, please explain.

Within the major focus area of Communications we define Stakeholder Relationships as "the position of the stakeholder among others, including supply chain location, and relationships among other stakeholders". Do you agree with this definition?

Yes

No

If no, please explain.

Within the major focus area of Culture we define Innovative Culture as "the activities and attitudes

surrounding adoption of new products, processes, or systems, including, innovation decision process, innovation attitude, innovation championing and attitudes toward change". Do you agree with this definition?

Yes

No

If no, please explain.

Within the major focus area of Culture we define Corporate of Individual Culture as "the characteristics or behavior patterns of a specific population, including actions and practices, policies, norms and ethics". Do you agree with this definition?

Yes

No

If no, please explain.

Within the major focus area of Culture we define Economic Culture as "The characteristics or behavior patterns towards commodities, including consumption, distribution, and production". Do you agree with this definition?

Yes

No

If no, please explain.

Within the major focus area of Culture we define Creative Culture as "the ability for original acts and thoughts, including artistic quality, imaginative quality, and intangibles". Do you agree with this definition?

Yes

No

In no, please explain.

Within the major focus area of Risk we define Mitigation as "management of the probability of occurrence, including, management of materials and timing, management throuh methods and logical path, and cost". Do you agree with this definition?

Yes

No

If no, please explain.

Within the major focus area of Risk we define Tolerance as "acceptance of the probability of occurrence, including reliability, maintainability, durability and affordability". Do you agree with this definition?

Yes

No

If no, please explain.

Please list Strategic Areas of Change you would add to the innovativeness literaure matrix, list the major Focus Area to which it/ they belong(s) and explain:

You have completed Part 1. Thank you very much for your time and input.
Sincerely,
The Change Agents Research Team

Appendix F: modified Delphi initial round results

Do you agree with Demographics as a Major Focus Area?	7	0	I agree with Organizational Demographics. Individual Demographics should only be used in the case that a construction related organization is operated as a Sole Proprietorship, or all decisions rest in the hands of one individual.					
Do you agree with Communication as a Major Focus Area?	6	1	I agree to an extent, just not sure if Communication is the appropriate terminology. I sense that you are attempting to asses how and who is in the communication loop and by what mechanisms?					
Do you agree with Culture as a Major Focus Area?	7	0	I am unsure of how you are framing "culture." If you mean it to describe the culture of an organization, then that makes sense. Remember that organizational cultures are often rooted in organizational myths and advertising, and can sometimes be less than clearly reflective of an organizations decision making structures.					

Do you agree with Risk as a Major Focus Area?	7	0	Yes, if you mean to determine the level of risk aversion in each organization by use of a reliable tool.					
Please list Major Focus Areas you would add to the innovativeness literature matrix and explain:			Adaptability - Consider the extent to which there is room for meaningful innovation. For example, what is the breadth of possibilities in tile setting?	Current market conditions should be measured and attempted to be correlated with an organizations innovativeness trends. this might help correlate risk (or perceived risk) with innovation.	I agree with the listed areas. My experience tells me that inability and/or willingness to address conflict is a major factor. In the absence of skills, mandate is used which has a direct impact on willingness to risk. I did not see where conflict was part of the sub-categories...I think this has a huge impact...e.g. "I don't want to get in trouble" or "I am not authorized..." Innovation and change require risk taking that is different than Mitigation and Tolerance. It is about risk taking in personal relationships. If this is included in one of the other categories or sub-categories (I did not see it) then I am okay.	Possibly the characteristics of the industry sector-mature industry, the novelty and complexity of problems, etc. For example, companies in hi-tech industries may be more innovative etc. I suggest that the major focus areas include a category related to the context of the individual/organization. This may "force" innovativeness.		
Within the major focus area of Demographics we define Educational Statistics as "knowledge resources of the individual or organization, including education level, training level and technical skill level. Do you agree with this definition?	6	0	Consider as well the dimension of tenure. How long has the company been in business? How long has the individual been at it?	Also consider if there is in-house training at the organizational level. That may be encompassed in the "training level" already, not sure.				

Within the major focus area of Demographics we define Financial Statistics as "financial resources of the individual or organization, including income level and earning potential". Do you agree with this definition?	7	0	Consider as well the level of sophistication in tracking job costs. If you have a good system, you can identify areas needing improvement. If you don't recognize where there's a problem, you cannot.					
Within the major focus area of Demographics we define Statistical Size as "Number of individuals within the firm or adopter category (1-199 = small, 200-499 = medium, >499 = Large). Do you agree with this definition?	6	1	No, the headcounts are too high.	Might want to align small business definition with those used by the Federal Government.				
Within the major focus area of Demographics we define Statistical Region as "the concentration of technical or business operation in one or more geographical areas, including local, national, and international. Do you agree with this definition?	7	0	Consider as well the potential effect of industry clusters. Could it be that contractors are driven to be more innovative in areas where they have the benefit of competitive interplay to a greater extent than those who are dominant local companies in small markets?	Consider also adding to that the industry sector served or the type of work they put into place or manage.				

Within the major focus area of Communications we define Transfer Processes as "capacity for transferring specific knowledge among individuals or organizations, including, technical information, tacit knowledge, origins and flow of information". Do you agree with this definition?	7	0	Suggest describing the organizations as more or less vertical or horizontal in its communications.					
Within the major focus area of Communications we define Stakeholder Relationships as "the position of the stakeholder among others, including supply chain location, and relationships among other stakeholders". Do you agree with this definition?	5	2	Suggest also identifying each stakeholder's position as it relates to the core aim of the organization (ie. if te iorganization is a producer of goods, then suppliers might be secondary stakeholders, while product designers might be primary).	I am curious as to why "position" is important. Is this a reference to an org chart (vp, field sup,etc)? If it is Stakeholder Relationships, why isn't it "relationshps among stakeholders including supply chain."	Prior to defining the relationship, consider defining stakeholder. Also is the relationship financial, knowledge based, service oriented, etc. It is not clear what types of relationships are being considered.			
Within the major focus area of Culture we define Innovative Culture as "the activities and attitudes surrounding adoption of new products, processes, or systems, including, innovation decision process, innovation attitude, innovation championing and attitudes toward change". Do you agree with this definition?	7	0						

Within the major focus area of Culture we define Corporate or Individual Culture as "the characteristics or behavior patterns of a specific population, including actions and practices, policies, norms and ethics". Do you agree with this definition?	7	0						
Within the major focus area of Culture we define Economic Culture as "The characteristics or behavior patterns towards commodities, including consumption, distribution, and production". Do you agree with this definition?	5	2	Not sure I understand this one.	I am not clear on this. This needs to be better defined.				
Within the major focus area of Culture we define Creative Culture as "the ability for original acts and thoughts, including artistic quality, imaginative quality, and intangibles". Do you agree with this definition?	6	1	Suggest you correlate this with the relative verticality of an organization's decision and communication structures to determine who exhibits these behaiors - front line workers, or those designated as te decision makers.	Also consider that in addition to the ability for these, that their are opportunities for creative ideas to be vetted. Just a thought.	I think the culture should not be defined as the "ability" to act creatively, but as the expectation/belief that creativity is important for the company. This may lead to creating the ability. Are you looking at culture as a set of beliefs or are you trying to identify specific observable behaviors that reflect culture?			
Within the major focus area of Risk we define Mitigation as "management of the probability of occurrence, including, management of materials and timing, management through methods and logical path, and cost". Do	5	2	This definition does not take into account the management of Impact of Risk (Quantitatively or Qualitatively.	This is too specific. It seems to relate only to direct cost control especially in producers of goods. Service Organizations must also consider indirect cost such as opportunity costs and consider ROI on	It could be simpler			

you agree with this definition?				innovations related to new technologies and emerging markets.				
Within the major focus area of Risk we define Tolerance as "acceptance of the probability of occurrence, including reliability, maintainability, durability and affordability". Do you agree with this definition?	6	1	I don't understand the phrase "acceptance of the probability of occurrence. Please, provide a vulgar definition.					

Please list Strategic Areas of Change you would add to the innovativeness literature matrix. Please list the major Focus Area to which it/ they belong(s) and explain:			I would reconsider the 2nd part of Mitigation which is the Impact of the risk occurrence along with the Probability in terms of %. Obviously this belongs in the Risk Area.	Don't forget that inclinations towards innovativeness can vary from department to department within the same company. Innovation is usually associated with newer products. We'd expect innovation to come naturally with electronic testing equipment. But who expects to see new ideas in the design of a ditch-digger's shovel? Are we missing something as a result of thinking that way?	Agility: How and how quickly an organization responds to market changes to remain viable, profitable and possibly even on a growth path.	Per my earlier comments, I think the area of conflict needs to be addressed somewhere in the document. Comments appended from correspondence via e-mail: 1. It would have been helpful to have definitions of the Major Focus Areas so I could respond intelligently to the first 4 questions. Definitions were included in the sub-categories so I went to sub-categories to figure out backwards what I thought was included in the definitions of the Major Focus Areas. 2. Your additional chart that displayed the categories and sub-categories has the heading "Strategies for focusing on individual and organizational change." Yet there are primary references around "innovativeness." Innovativeness and change are different to me so I am assuming there is a reason for linking these two concepts and stating them this way. It would have been helpful to have some narrative around that issue.	The organizational structure may be one to consider. For example are the company reporting lines hierarchical or more lateral in nature, what is the division of power. Industry sector may play a role in how innovative ideas are implemented based upon owners that the construction firm serves. Specifically, if a firm is doing primarily government facilities, they may be forced via contract to implement innovations. Whereas as Heavy Civil contractor paving a small segment of roadway may not have the same pressures.	The organizational structure may also be considered as an area of change. Not clear if it is currently captured under "Communications"

Appendix G: Modified Delphi consensus round 1 survey tool

Part 1 Round 1: Definitions

Part 1 Round 1 is designed to gain consensus on changes, updates, additions and revisions based on the results of the initial survey. Please refer to the matrix that has been provided as an attachment while completing this survey.

All responses are confidential and will only be reviewed by the research team.

Major Focus Area definitions:

As a Major Focus Area, Communications is defined as "a stakeholder's ability and means of information exchange among individuals or among and within external organizations". Do you agree with this definition?

- Yes
- No

If no, please explain.

Proposed Major Focus Area additions:

Adaptability has been suggested as a Major Focus Area and is defined as the "ability to change or to be changed to fit changed circumstances". Do you agree with "Adaptability" as a new Major Focus Area?

- Yes
- No

If no, does "Adaptability" fit within one of the following existing Major Focus Areas?

- Demographics
- Communication
- Culture
- Risk

Do you agree with the definition of "Adaptability"?

- Yes
- No

If "No", please explain.

Market Conditions has been suggested as a Major Focus Area and is defined as the "the character of the market into which a firm is entering or is already a part of, including number of competitors, intensity of competition, complexity of challenges and the market's growth rate". Do you agree with "Market Conditions" as a new Major Focus Area?

- Yes
- No

If no, does "Market Conditions" fit within one of the following existing Major Focus Areas?

- Demographics
- Communication
- Culture
- Risk

Do you agree with the definition of "Market Conditions"

- Yes
- No

If no, please explain.

Strategic Areas for Change additions and revisions:

The following questions will present a revised definition with the revision/addition in all caps for minor changes or a comparison of the original definition with the new definition for major revisions.

Within the Major Focus Area of Demographics, the definition of Educational Statistics has been changed to "knowlege resources of the individual or organization, including education level, training level, TENURE and technical skill level". Do you agree with this addition?

- Yes
- No

Please list any comments.

Within the Major Focus Area of Demographics, the definition of Statistical Size has been changed from "number of individuals within the firm or adopter category (1-199 = small, 200-499 = medium, >499 = large)" to "number of individuals within the firm or adopter category (1-99 = small, 100-499 = medium, >499 = large)". Do you agree with this definition change?

Yes

No

Please list any comments.

For this Strategic Area for Change the defintion of Stakeholder is assumed to be "a person, group or organizatoin who affects or can be affected by an organization's actions". Within the Major Focus Area of Communications, the definition of Stakeholder Relationships has been changed from "the position of the stakeholder among others, including supply chain location and relationships among other other stakeholders" to "the role of an organization or individual among other supply chain members and/or project stakeholders". Do you agree with this definition change?

Yes

No

Please list any comments.

Within the Major Focus Area of Culture, the definition of Economic Culture has been changed from "the

characteristics or behavior patterns towards commodities, including consumption, distribution, and production" to "attitudes and behavior towards management of financial resources, goods and services". Do you agree with this definition change?

Yes

No

Please list any comments.

Within the Major Focus Area of Culture, the definition of Creative Culture has been changed from "the ability for original acts and thoughts, including artistic quality, imaginative quality, and intangibles" to "an emphasis on original thoughts and acts, including artistic quality, imaginative quality and intangibles". Do you agree with this definition change?

Yes

No

Please list any comments.

Within the Major Focus Area of Risk, the definition of Mitigation has been changed from "management of the probability of occurrence, including management of materials and timing, management through methods and logical path, and cost" to "management of the probability and impact of an undesirable events occurrence". Do you agree with this definition change?

Yes

No

Please list any comments.

Within the Major Focus Area of Risk, the definition of Tolerance has been changed from "acceptance of the probability of occurrence, including reliability, maintainability, durability and affordability" to "the degree of uncertainty that an individual/organization can handle in regard to an undesirable event". Do you agree with this definition change?

- Yes
- No

Please list any comments.

Suggested Strategic Areas of Change additions:
The following sub-categories have been suggested for addition to the matrix. For the following question, please indicate whether you agree with the addition and proposed definition.

Agility

- Yes
- No

The proposed definition of Agility is "the ability of an individual or organization to respond to market or circumstance changes to remain viable and profitable". Do you agree with this definition?

- Yes
- No

If "yes", to which Major Focus Area does it belong?

- Demographics
- Communications
- Culture
- Risk
- Adaptability

Market Conditions

Please list any comments.

Conflict Management

Yes

No

The proposed definition of Conflict Management is "ability and/or willingness to address conflict". Do you agree with this definition?

Yes

No

If "yes", to which Major Focus Area does it belong?

Demographics

Communications

Culture

Risk

Adaptability

Market Conditions

Please list any comments.

Industry Sector

Yes

No

The proposed definition of Industry Sector is "the sector of the industry served, including product or service provided and type of work put into place". Do you agree with this definition?

- Yes
- No

If "yes", to which Major Focus Area does it belong?

- Demographics
- Communications
- Culture
- Risk
- Adaptability
- Market Conditions

Please list any comments.

Please list any additional comments that you have.

You have completed Part 1 Round 1. Thank you very much for your input. Please click "submit" to deliver your completed survey.

Appendix H: modified Delphi consensus round 1 results

Nr	1	2	3	4	5
As a Major Focus Area, Communications is defined as "a stakeholder's ability and means of information exchange among individuals or among and within external organizations". Do you agree with this definition?	Yes	Yes	No	Yes	Yes
If no, please explain.			seems wordy. what about just saying the ability and means of information exchange		
Adaptability has been suggested as a Major Focus Area and is defined as the "ability to change or to be changed to fit changed circumstances". Do you agree with "Adaptability" as a new Major Focus Area?	No	Yes	Yes	Yes	Yes
If no, does "Adaptability" fit within one of the following existing Major Focus Areas?	Risk				
Do you agree with the definition of "Adaptability"?	Yes	No	Yes	Yes	No
If "No", please explain.		Adaptability is too reactionary when defined as "ability to be changed". It should be a proactive only, showing a willingness and abilitu to chnage when necessary in order to thrive.			The only issue I have is with the line "changed circumstances" as the industry is dynamic, the wording "changing circumstances" may fit better.

Market Conditions has been suggested as a Major Focus Area and is defined as the "the character of the market into which a firm is entering or is already a part of, including number of competitors, intensity of competition, complexity of challenges and the market's growth rate". Do you agree with "Market Conditions" as a new Major Focus Area?	Yes	No	Yes	No	Yes
If no, does "Market Conditions" fit within one of the following existing Major Focus Areas?				Risk	
Do you agree with the definition of "Market Conditions"	Yes	No	Yes	Yes	Yes
If no, please explain.		It would be too unweildy to measure and evaluate the market characteristics you describe above.			I like it! It really captures the dynamic nature.
Within the Major Focus Area of Demographics, the definition of Educational Statistics has been changed to "knowlege resources of the individual or organization, including education level, training level, TENURE and technical skill level". Do you agree with this addition?	Yes	Yes	Yes	No	Yes

Please list any comments.				My challenge is that tenure carries implications depending upon the organization. Tenure could be the cause of why we are change receptive (because of life skills and experience) or tenure could be the primary reason we do not change (always done it this way). If both variables are involved with the use of the word tenure, then I would say okay to include.	
Within the Major Focus Area of Demographics, the definition of Statistical Size has been changed from "number of individuals within the firm or adopter category (1-199 = small, 200-499 = medium, >499 = large)" to "number of individuals within the firm or adopter category (1-99 = small, 100-499 = medium, >499 = large)". Do you agree with this definition change?	Yes	Yes	No	Yes	Yes
Please list any comments.					It always for greater flexibility.

For this Strategic Area for Change the defintion of Stakeholder is assumed to be "a person, group or organizatoin who affects or can be affected by an organization's actions". Within the Major Focus Area of Communications, the definition of Stakeholder Relationships has been changed from "the position of the stakeholder among others, including supply chain location and relationships among other other stakeholders" to "the role of an organization or individual among other supply chain members and/or project stakeholders". Do you agree with this definition change?	Yes	Yes	Yes	Yes	Yes
Please list any comments.					
Within the Major Focus Area of Culture, the definition of Economic Culture has been changed from "the characteristics or behavior patterns towards commodities, including consumption, distribution, and production" to "attitudes and behavior towards management of financial resources, goods and services". Do you agree with this definition change?	Yes	Yes	Yes	Yes	Yes
Please list any comments.					

Within the Major Focus Area of Culture, the definition of Creative Culture has been changed from "the ability for original acts and thoughts, including artistic quality, imaginative quality, and intangibles" to "an emphasis on original thoughts and acts, including artistic quality, imaginative quality and intangibles". Do you agree with this definition change?	Yes	Yes	No	Yes	Yes
Please list any comments.				ability does not suggest action. Emphasis does so i like.	
Within the Major Focus Area of Risk, the definition of Mitigation has been changed from "management of the probability of occurrence, including management of materials and timing, management through methods and logical path, and cost" to "management of the probability and impact of an undesirable events occurrence". Do you agree with this definition change?	No	Yes	No	Yes	Yes
Please list any comments.	Mitigation relates to both the positive influence of opportunities as well as the negative results of risk. I do like the inclusion of 'impact' along with probability.		risk in not necessarly undesirable		Much more succinct and to the point.

Within the Major Focus Area of Risk, the definition of Tolerance has been changed from "acceptance of the probability of occurrence, including reliability, maintainability, durability and affordability" to "the degree of uncertainty that an individual/organization can handle in regard to an undesirable event". Do you agree with this definition change?	Yes	Yes	No	Yes	Yes
Please list any comments.			why is it only undesirable		
Agility	Yes	Yes	No	Yes	Yes
The proposed definition of Agility is "the ability of an individual or organization to respond to market or circumstance changes to remain viable and profitable". Do you agree with this definition?	Yes	Yes		Yes	Yes
If "yes", to which Major Focus Area does it belong?	Risk	Adaptability		Culture	Adaptability
Please list any comments.	the ability to change the individual's or organization's position efficiently,		adaptibily covers this		
Conflict Management	Yes	Yes		Yes	Yes
The proposed definition of Conflict Management is "ability and/or willingness to address conflict". Do you agree with this definition?	No	Yes	Yes	No	Yes
If "yes", to which Major Focus Area does it belong?	Culture	Culture	Culture	Communications	Communications
Please list any comments.	I do not agree with putting the word conflict in as a part of it's own definition			I think it is "and', not "and/or". Both are critical to successful Conflict Management.	
Industry Sector	Yes	No		Yes	Yes

The proposed definition of Industry Sector is "the sector of the industry served, including product or service provided and type of work put into place". Do you agree with this definition?	Yes	No	No	Yes	Yes
If "yes", to which Major Focus Area does it belong?	Demographics			Demographics	Demographics
Please list any comments.			get rid of "the sector of the industry served" and come up with descriptive langague.		
Please list any additional comments that you have.					THe definitions seem to have been tightened up and are more flexible than the previous edition. This will enable for a broader audience.

Appendix I: Modified Delphi consensus round 2 survey tool

Part 1, Round 2: Definitions

This survey is the 2nd consensus round of Part 1, matrix definitions, of the Delphi Process. The 7 questions below remain without consensus.

It has been suggested that the definition of "Communications" be changed from "a stakeholder's ability and means of information exchange among individuals or among and within external organizations" to "the ability and means of information exchange". Do you agree with this definition change?

- Yes
- No

Please list any comments.

It has been suggested that the definition of "Adaptability" be changed from "ability to change or to be changed to fit changed circumstances" to "ability and willingness to fit changing circumstances". Do you agree with this definition change?

- Yes
- No

Please list any comments here.

Into which Major Focus Area does "Market Conditions" fit?

- Demographics
- Communications
- Culture
- Risk
- Adaptability
- None, it stands alone as its own Major Focus Area.

It has been suggested that the definition of "risk mitigation" be changed from "management of the probability and impact of an undesirable event's occurrence" to "management of the probability and impact of an unexpected event's occurrence". Do you agree with this definition change?

Yes

No

Please list any comments.

It has been suggested that the definition of “Conflict Management” be changed from "ability and/or willingness to address conflict" to “ability and willingness to address disagreement”. Do you agree with this definition change?

Yes

No

Please list any comments.

Into which Major Focus Area does “Conflict Management” fit?

Demographics

Communications

Culture

Risk

Adaptability

It has been suggested that the definition of “Industry Sector” be changed from "the sector of the industry served, including product or service provided and type of work put into place" to “Industry specific products, services and systems of work”. Do you agree with this definition change?

Yes

No

Please list any comments.

We appreciate your continued participation. Please click submit to complete this survey.

Appendix J: modified Delphi consensus round 2 results

Nr	1	2	3
It has been suggested that the definition of "Communications" be changed from "a stakeholder's ability and means of information exchange among individuals or among and within external organizations" to "the ability and means of information exchange". Do you agree with this definition change?	Yes	Yes	Yes
Please list any comments.	i like the briefer definition. The challenge might be when i am completing a questionnaire i will wonder about the variables that are contained within the longer definition. Communication could be good in one part but not the other. The question is whether or not this negates the longer definition for the clarity of shorter definition.		
It has been suggested that the definition of "Adaptability" be changed from "ability to change or to be changed to fit changed circumstances" to "ability and willingness to fit changing circumstances". Do you agree with this definition change?	Yes	Yes	Yes
Please list any comments here.	like it....cleaner		
Into which Major Focus Area does "Market Conditions" fit?	Risk	None, it stands alone as its own Major Focus Area.	None, it stands alone as its own Major Focus Area.

It has been suggested that the definition of "risk mitigation" be changed from "management of the probability and impact of an undesirable event's occurrence" to "management of the probability and impact of an unexpected event's occurrence". Do you agree with this definition change?	Yes	No	Yes
Please list any comments.	I like...broader and more inclusive definition.	I do not think it is just the management of unexpected ... but as it applies to the management of uncertain events (positive or negative.)	
It has been suggested that the definition of "Conflict Management" be changed from "ability and/or willingness to address conflict" to "ability and willingness to address disagreement". Do you agree with this definition change?	Yes	No	Yes
Please list any comments.	good change...many may not see disagreement as conflict when the reality is unaddressed disagreement creates unsurfaced conflict that impacts clarity which easily ends up in a downward productivity spiral.		
Into which Major Focus Area does "Conflict Management" fit?	Culture	Risk	Culture

It has been suggested that the definition of “Industry Sector” be changed from "the sector of the industry served, including product or service provided and type of work put into place" to “Industry specific products, services and systems of work”. Do you agree with this definition change?	Yes	Yes	Yes
Please list any comments.	a lot cleaner....good change. Nice work everybody!		

Appendix K: Survey Tool delivered to Expert Panel to Re-code Data

Dear Expert,

Thank you very much for your participation to this point. Your hard work and expertise has helped yield a framework of innovative characteristics that will hopefully benefit members of the construction industry in their mission to meet the changing needs of the industry. This is the final portion of the Delphi Process. This Excel Workbook **includes both Parts 2 and 3** and focuses on the **innovativeness characteristics of individuals and organizations** in the construction industry. Please complete the survey by **selecting the most appropriate answers from the drop down menus** for each characteristic listed on the worksheets labeled "Individual Characteristics" and "Organizational Characteristics". The questions focus on categorizing the characteristics listed into the framework developed in Part 1 as well as into Adopter Categories. The Adopter Categories used in this research are *Innovator, Early Adopter, Early Majority and Late Majority/Laggard* as defined by E.M. Rogers in *Diffusion of Innovations*(2003), going from most innovative to least innovative. Your answers will be kept confidential and used only for the purpose of this research.

Sincerely,

The Change Agents Research Team

Individual Characteristics

#	Characteristic/Attribute	What Major Focus Area and Strategic Area of Change combination does this characteristic fit into? **Major Focus & Strategic Areas**	What Innovativeness Category does this characteristic describe (according to Rogers)? **Primary Innovativeness Category**	What other Innovativeness Category might this characteristic describe (according to Rogers)? **Secondary Innovativeness Category**
1	High level of education			
2	Strong technological background			
3	High level of financial resources			
4	Do not command high levels of opinion leadership in the industry			
5	Introduce innovation into the industry			
6	Conduct Initial assessment of innovation			
7	cosmopolite			
8	Are able to fill innovation information gaps			
9	Utilize mass media as an information source			
10	Maintain more information sources than other members of the construction industry			
11	Exhibit intangible creativity and daring to pursue innovation			
12	See innovation as a chance to derive economic benefit			
13	Actively seek innovation			
14	May fail to consider enough alternatives due to intense focus on innovation			
15	Problem solvers			
16	Forgiving in nature and initially require less of an innovation			
17	Technically capable of implementing innovations			
18	Able to critique innovations new to the industry			
19	Favorable attitudes toward innovation and technology			
20	Willingly engage in high-risk endeavors			
21	High risk tolerance			
22	Value formal education and technical knowledge			

23	Value experience with technology			
24	Not as price sensitive as other industry members			
25	Looked up to in the industry as opinion leaders and serve as references for others that adopt after them			
26	Exhibit effective communication			
27	Able to effectively gather innovation information			
28	maintain a high number of sources			
29	Able to match attributes of innovation to tangible organizational benefits			
30	Seek economic benefit from innovation			
31	Open-minded individuals looking to improve upon daily operations			
32	Willing to pursue innovations			
33	Capable of matching innovations to organizational goals to forward the organization			
34	Able to engage in high-risk endeavors			
35	lack opinion leadership in the industry			
36	look to Early Adopters for leadership			
37	provide a link later adopters to earlier adopters			
38	Require high levels of information			
39	Avoid being on the leading edge of innovation			
40	Discrete			
41	Practical by nature, they are interested in the consequences of innovation			
42	Capable of technological competency			
43	Will innovate only after a longer innovation-decision periods			
44	Use well-established companies and references to reduce innovation risk			
45	Low average level of formal education and training			

46	Minimal technological experience			
47	Limited financial resources			
48	Resistant to change			
49	play a devil's advocate role in a group setting			
50	Hold no opinion leadership in the industry			
51	maintain relationships with those who have shared values			
52	Sparse connections to mass media			
53	ineffective communication			
54	Innovate out of necessity			
55	publicly identify innovations flaws			
56	Last in the industry to adopt innovations			
57	Very conservative attitudes toward innovation			
58	unwilling to increase technological competence			
59	Resist innovation			
60	have negative ideas and fears of change and innovation			
61	fail to recognize the benefits of technology			
62	Require innovations that do not demand high levels of technical knowledge			
63	Require innovations that do not demand significant changes in business practice			
64	draw attention to uncertainty of innovations			
65	Innovate as a result peer-pressure			
66	Innovate as a result of a swing in industry standards			
67	Mitigate risk by avoiding it or significantly reducing uncertainty			
68	Very cautious about innovation due to inability to tolerate high levels of risk			
69	Inability to tolerate high levels of risk			

Organizational Characteristics

#	Characteristic/trait	What Major Focus Area and Strategic Area of Change combination does this characteristic fit into? **Major Focus & Strategic Areas**	What Innovativeness Category does this characteristic describe (according to Rogers)? **Primary Innovativeness Category**	What other Innovativeness Category might this characteristic describe (according to Rogers)? **Secondary Innovativeness Category**
1	higher average levels of education and training			
2	greater average technical knowledge			
3	higher capacity for innovation			
4	greater ability to evaluate innovations new to the industry			
5	Higher average socioeconomic status and income potential, including high financial resources			
6	Conduct business operations in multiple geographic markets			
7	Large Firms			
8	Focus on strong business relationships within the industry supply chain			
9	Serve to introduce innovations to the industry and conduct an early evaluation			
10	lack the respect and industry leadership to strongly influence the purchasing decisions of other industry members			
11	Utilize many innovation information sources, including government and university sources			
12	emphasize information transfer			
13	establish innovation as a part of corporate culture and business strategy			
14	focus on improving quality and decreasing down-stream cost			
15	Forgiving in nature			
16	ability and drive to pursue new ideas			
17	understanding and acceptance that failure is possible			
18	see the long-term economic benefits of innovation			

19	less focused on immediate returns of innovation			
20	Focus on marketability			
21	View innovation in a positive light			
22	Attempt to strengthen innovation accelerators			
23	Pursue innovation			
24	Problem solvers			
25	Value technical aspects of innovation			
26	Can make innovation-decisions without concern of market or competitor trends			
27	Have an innovation champion and advocate			
28	Ability and willingness to face a higher degree of uncertainty			
29	High average levels of education and training			
30	Associates have the ability to seek and apply innovation information			
31	Diverse backgrounds of those involved in innovation-decisions			
32	Control significant financial resources			
33	Display willingness to invest financial resources into innovation			
34	Operate in multiple geographic markets, usually on a regional or national level			
35	Larger firms			
36	Are central in the communication network			
37	Hold high degrees of opinion leadership in the industry			
38	Serve as references for risk reduction to those who adopt after them			
39	Form strong business relationship within the supply chain			
40	Maintain a knowledge of many market sectors			

41	Willingly and effectively share innovation information within the organization and the supply chain			
42	Utilize a high number of information sources including technology transfer programs			
43	Management support and promote a culture that emphasizes innovation and factors that support innovation			
44	Realize and focus on the value of human capital			
45	Seek results and benefits quickly			
46	Focus on quality			
47	Able to see the value of an innovation in meeting the needs of the organization			
48	Have an innate capacity for innovation that is balanced with rational analysis			
49	Demonstrate idealistic foresight focusing on the ideas of people			
50	Emphasize marketability			
51	Seek economic benefit from innovation			
52	Have innovation champions			
53	Work to strengthen innovation accelerators			
54	Implement innovation using multiple approaches including project orientations; they have high standards for innovation, but view failures as a learning opportunity			
55	Positive and ambitious attitudes toward innovation			
56	Hold high standards when evaluating innovation			
57	Seek to stem down-stream costs			
58	Able to face high risks			
59	Ability to tolerate high innovation risk without well-established references			
60	Serve as a link between earlier and later adopters			
61	Are not on the leading edge of innovation adoption			

62	Rely on the experiences of others as references for innovation information			
63	Lack of information transfer with those outside the industry			
64	rather rely on information from peer organizations			
65	Have dual-role associates participating in management and daily construction activities			
66	Tend to be more discrete			
67	Capable of technical competence			
68	Generally engage in a longer innovation-decision process			
69	Seek to make incremental improvements			
70	Fear losing competitive advantage through competitor copying			
71	Need reliable innovation information prior to adopting			
72	Emphasize managing risk involved with innovation adoption			
73	Lower average level of education and technical knowledge			
74	Lower average income and lack of financial resources			
75	Tend to have locally focused operations			
76	Small firm size			
77	Characterized by fragmented relationships and subcontractor dependence (high level of subcontracted work)			
78	Lack opinion leadership in the industry and typically are subject to pressure from other industry stakeholders			
79	tend to relate to those of similar standing			
80	Do no seek sources of innovation information outside of their circle of peers			
81	Exhibit poor innovation information management			

82	Form and maintain discontinuous relationships with limited focus on integration			
83	Overly conservative attitudes toward innovation with a tendency to avoid change			
84	Focus on the past			
85	Chose to maintain standardized business operations			
86	Focus on land development with minimal long-term contingencies			
87	Minimal investment in innovation activities, focusing on maintaining the status quo			
88	Generally innovate only out of economic necessity			
89	Loyal to tradition, opposing change and innovation out of fear and distaste			
90	Require innovations that do not require high degrees of technical ability/knowledge			
91	Last in the industry to innovate, waiting until innovation becomes standard and succumbing to peer-pressure			
92	Mitigate risk by delaying adoption until the innovation has been thoroughly proven			
93	Seek non-discontinuous innovations, those that do not require significant changes in day-to-day operations			
94	Try to avoid risk associated with innovation, and are very cautious of innovation			
95	Risk-averse			

Appendix L: Expert Panel Survey Results and Format for Analysis for Individual Char.

Original Coding: Demographics

Individual MFA	Initial	2	4	7	1	6	MFA Consensus	MFA Majority	Agreement	SAoI Consensus	SAoI Majority
High level of education	1.1	1.1	1.1	1.1	1.2	1.1	Y	Y	Y	N	Y
Strong technological background	1.1	1.1	1.1	3.1	4.1	1.1	N	Y	Y	N	Y
High level of financial resources	1.2	1.2	1.2	4.3	1.2	1.2	N	Y	Y	N	Y
Value formal education and technical knowledge	1.1	1.1	1.1	1.1	1.1	2.1	N	Y	Y	N	Y
Value experience with technology	1.1	4.4	4.1	4.2	4.2	1.5	N	Y	N	N	N
Not as price sensitive as other industry members	1.2	1.4	1.2	4.3	4.3	2.1	N	N		N	N
Low average level of formal education and training	1.1	4.5	1.1	1.1	1.1	1.1	N	Y	Y	N	Y
Minimal technological experience	1.1	1.2	1.1	1.1	6.2	1.1	N	Y	Y	N	Y
Limited financial resources	1.2	1.2	1.2	4.3	1.2	1.2	N	Y	Y	N	Y
							1	**8**	**1**	**0**	**7**
							11%	89%	11%	0%	78%

Original Coding: Communications											
Individual MFA	Initial	2	4	7	1	6	MFA Consensus	MFA Majority	Agreement	SAoI Consensus	SAoI Majority
Do not command high levels of opinion leadership in the industry	3.2	3.1	3.2	4.1	4.3	1.5	N	N		N	N
Introduce innovation into the industry	3.2	4.1	4.1	4.1	4.1	4.1	N	Y	N	N	Y
Conduct Initial assessment of innovation	3.2	3.1	3.2	4.2	4.1	4.1	N	N		N	N
cosmopolite	3.2	0	1.4	4.2	0	3.1	N	N		N	N
Are able to fill innovation information gaps	3.1	3.1	4.1	3.1	5.1	4.1	N	N		N	N
Utilize mass media as an information source	3.1	1.5	3.1	4.2	4.3	1.5	N	N		N	N
Maintain more information sources than other members of the construction industry	3.1	1.5	3.2	1.1	3.1	4.2	N	N		N	N
Looked up to in the industry as opinion leaders and serve as references for others that adopt after them	3.2	4.4	4.1	4.1	3.1	4.2	N	Y	N	N	N
Exhibit effective communication	3.2	3.1	3.1	3.1	3.1	3.2	Y	Y	Y	N	Y
Able to effectively gather innovation information	3.1	3.1	3.1	1.1	1.1	3.1	N	Y	Y	N	Y
maintain a high number of sources	3.1	4.4	3.1	1.1	3.2	2.1	N	N		N	N
lack opinion leadership in the industry	3.2	4.2	3.2	1.1	1.1	1.3	N	N		N	N
look to Early Adopters for leadership	3.2	4.4	5.1	4.1	4.2	4.1	N	Y	N	N	N
provide a link later adopters to earlier adopters	3.2	3.1	5.1	3.1	3.1	4.1	N	Y	Y	N	N
Require high levels of information	3.1	4.2	6.1	6.2	4.2	1.1	N	N		N	N
Resistant to change	3.2	4.2	6.1	5.1	4.2	1.3	N	N		N	N
play a devil's advocate role in a group setting	3.2	4.4	4.5	4.4	3.2	4.1	N	Y	N	N	N
Hold no opinion leadership in the industry	3.2	4.2	1.2	4.2	1.1	1.4	N	N		N	N
maintain relationships with those who have shared values	3.2	1.1	0	3.2	3.2	3.2	N	Y	Y	N	Y
Sparse connections to mass media	3.1	3.1	3.1	3.1	1.1	1.4	N	Y	Y	N	Y
ineffective communication	3.1	3.1	3.1	3.1	3.1	3.1	Y	Y	Y	Y	Y

	2	10	4	1	6
	10%	48%	19%	5%	29%

Original Coding: Culture											
Individual MFA	Initial	2	4	7	1	6	MFA Consensus	MFA Majority	Agreement	SAoI Consensus	SAoI Majority
Exhibit intangible creativity and daring to pursue innovation	4.4	4.1	4.4	4.4	4.1	6.2	N	y	Y	N	N
See innovation as a chance to derive economic benefit	4.3	4.3	4.3	4.3	4.3	4.4	N	Y	Y	N	Y
Actively seek innovation	4.2	4.1	4.1	4.1	4.1	4.2	Y	Y	Y	N	Y
May fail to consider enough alternatives due to intense focus on innovation	4.2	4.4	4.1	4.1	4.2	1.2	N	Y	Y	N	N
Problem solvers	4.2	4.2	5.1	4.2	5.1	4.1	N	Y	Y	N	N
Forgiving in nature and initially require less of an innovation	4.2	1.5	4.2	4.2	5.1	4.1	N	Y	Y	N	N
Technically capable of implementing innovations	4.1	4.4	4.1	5.1	1.1	5.1	N	N		N	N
Able to critique innovations new to the industry	4.1	5.1	4.1	1.1	4.2	3.1	N	N		N	N
Favorable attitudes toward innovation and technology	4.1	4.1	4.1	4.2	4.2	6.2	N	Y	Y	N	N
Able to match attributes of innovation to tangible organizational benefits	4.4	4.3	4.3	4.3	3.1	4.4	N	Y	Y	N	N
Seek economic benefit from innovation	4.3	4.3	4.3	4.3	4.3	4.2	Y	Y	Y	N	Y
Open-minded individuals looking to improve upon daily operations	4.2	4.4	4.1	4.4	5.1	3.2	N	Y	Y	N	N
Willing to pursue innovations	4.1	4.1	4.1	4.1	4.2	6.1	N	Y	Y	N	Y
Capable of matching innovations to organizational goals to forward the organization	4.1	4.2	4.3	4.1	3.1	3.1	N	Y	Y	N	N
Avoid being on the leading edge of innovation	4.4	6.2	4.3	6.2	1.1	6.2	N	N		N	N
Discrete	4.2	4.2	4.2	4.5	4.5	1.5	N	Y	Y	N	N

Practical by nature, they are interested in the consequences of innovation	4.2	4.3	4.3	6.1	4.2	4.4	N	Y	Y	N	N
Capable of technological competency	4.1	4.4	1.1	1.1	1.1	1.1	N	Y	N	N	Y
Will innovate only after a longer innovation-decision periods	4.1	4.2	6.1	6.1	4.2	1.3	N	N		N	N
Innovate out of necessity	4.3	1.5	2.1	4.1	4.3	2.1	N	N		N	N
publicly identify innovations flaws	4.3	4.1	0	3.1	4.2	1.5	N	N		N	N
Last in the industry to adopt innovations	4.3	6.2	1.5	6.2	6.2	4.4	N	Y	N	N	Y
Very conservative attitudes toward innovation	4.2	4.2	4.1	6.2	6.2	4.4	N	Y	Y	N	N
unwilling to increase technological competence	4.2	1.1	4.1	1.1	1.1	4.4	N	Y	N	N	Y
Resist innovation	4.1	4.3	4.1	6.2	4.5	1.3	N	Y	Y	N	N
have negative ideas and fears of change and innovation	4.1	1.5	4.1	4.1	1.1	4.1	N	Y	Y	N	Y
fail to recognize the benefits of technology	4.1	4.2	1.5	1.1	1.1	3.1	N	N		N	N
Require innovations that do not demand high levels of technical knowledge	4.1	6.2	1.5	1.1	6.2	1.1	N	Y	N	N	N
Require innovations that do not demand significant changes in business practice	4.1	4.5	1.5	5.1	6.2	1.3	N	N		N	N
draw attention to uncertainty of innovations	4.1	4.5	6.2	6.1	6.1	6.2	N	Y	N	N	N
Innovate as a result peer-pressure	4.1	1.5	4.1	2.1	3.2	1.5	N	N		N	N
Innovate as a result of a swing in industry standards	4.1	2.1	2.1	2.1	1.5	1.5	N	Y	N	N	Y
							2	23	6	0	9
							6%	**72%**	**19%**	**0%**	**28%**

Original Coding: Risk											
Individual MFA	**Initial**	**2**	**4**	**7**	**1**	**6**	**MFA Consensus**	**MFA Majority**	**Agreement**	**SAoI Consensus**	**SAoI Majority**
Willingly engage in high-risk endeavors	6.2	4.1	4.1	6.2	6.2	6.2	N	Y	Y	N	Y
High risk tolerance	6.2	4.1	4.1	6.2	6.2	6.2	N	Y	Y	N	Y
Able to engage in high-risk endeavors	6.2	4.4	6.2	6.2	6.2	6.2	N	Y	Y	N	Y
Use well-established companies and references to reduce innovation risk	6.1	6.2	6.1	6.1	3.2	6.1	N	Y	Y	N	Y
Mitigate risk by avoiding it or significantly reducing uncertainty	6.1	4.2	6.1	6.1	6.1	2.1	N	Y	Y	N	Y
Very cautious about innovation due to inability to tolerate high levels of risk	6.2	6.1	6.2	6.2	5.1	4.1	N	Y	Y	N	N
Inability to tolerate high levels of risk	6.2	6.2	6.2	6.2	4.2	6.2	N	Y	Y	N	Y
							0	**7**	**0**	**0**	**6**
							0%	100%	0%	0%	86%

Appendix M: Expert Panel Survey Results and Format for Analysis for Organizational Characteristics

Original Coding: Demographics

Organizational MFA	Initial	2	4	7	6	MFA Consensus	MFA Majority	Agreement	SAoI Consensus	SAoI Majority
higher average levels of education and training	1.1	1.1	1.1	1.1	1.1	Y	Y	Y	Y	Y
greater average technical knowledge	1.1	1.3	1.1	1.1	1.1	Y	Y	Y	N	Y
higher capacity for innovation	1.1	4.1	4.1	4.1	4.1	N	Y	N	N	Y
greater ability to evaluate innovations new to the industry	1.1	4.4	1.1	4.4	3.1	N	N		N	N
Higher average socioeconomic status and income potential, including high financial resources	1.2	1.3	1.2	1.2	3.2	N	Y	Y	N	N
Conduct business operations in multiple geographic markets	1.4	1.5	1.4	1.4	3.1	N	Y	Y	N	N
Large Firms	1.3	1.3	1.3	1.3	1.3	Y	Y	Y	Y	Y
High average levels of education and training	1.1	4.2	1.1	1.1	1.1	N	Y	Y	N	Y
Associates have the ability to seek and apply innovation information	1.1	4.4	1.1	1.1	4.1	N	N		N	N
Diverse backgrounds of those involved in innovation-decisions	1.1	4.5	3.1	4.2	1.4	N	N		N	N
Control significant financial resources	1.2	1.2	1.2	1.2	1.2	Y	Y	Y	Y	Y
Display willingness to invest financial resources into innovation	1.2	1.3	4.2	4.3	4.1	N	Y	N	N	N
Operate in multiple geographic markets, usually on a regional or national level	1.4	1.3	1.4	1.4	1.4	N	Y	Y	N	Y
Larger firms	1.3	1.3	1.3	1.3	1.3	Y	Y	Y	Y	Y
Lower average level of education and technical knowledge	1.1	1.1	1.1	1.1	1.1	Y	Y	Y	Y	Y
Lower average income and lack of financial resources	1.2	1.2	1.2	1.2	1.2	Y	Y	Y	Y	Y
Tend to have locally focused operations	1.4	1.4	1.4	1.4	1.4	Y	Y	Y	Y	Y

Small firm size	1.3	1.3	1.3	1.3	1.3	Y	Y	Y	Y	Y
						50%	83%	11%	44%	67%

Original Coding: Communications										
Organizational MFA	Initial	2	4	7	6	MFA Consensus	MFA Majority	Agreement	SAoI Consensus	SAoI Majority
Focus on strong business relationships within the industry supply chain	3.2	3.2	3.2	3.2	3.2	Y	Y	Y	Y	Y
Serve to introduce innovations to the industry and conduct an early evaluation	3.2	3.1	4.1	3.1	4.1	N	N		N	N
lack the respect and industry leadership to strongly influence the purchasing decisions of other industry members	3.2	4.4	3.2	3.2	5.1	N	N		N	N
Utilize many innovation information sources, including government and university sources	3.1	1.5	3.1	4.1	4.4	N	N		N	N
emphasize information transfer	3.1	3.1	3.1	3.1	3.1	Y	Y	Y	Y	Y
Are central in the communication network	3.2	1.5	3.2	3.1	3.1	N	Y	Y	N	N
Hold high degrees of opinion leadership in the industry	3.2	1.5	1.3	3.2	4.2	N	N		N	N
Serve as references for risk reduction to those who adopt after them	3.2	1.5	4.1	3.1	4.1	N	N		N	N
Form strong business relationship within the supply chain	3.2	1.5	3.2	3.2	4.2	N	N		N	N
Maintain a knowledge of many market sectors	3.2	3.1	1.5	1.1	1.1	N	N		N	N
Willingly and effectively share innovation information within the organization and the supply chain	3.1	3.1	3.1	3.2	4.2	N	Y	Y	N	N
Utilize a high number of information sources including technology transfer programs	3.1	4.3	3.1	3.1	3.1	N	Y	Y	N	Y
Serve as a link between earlier and later adopters	3.2	4.3	3.2	3.1	1.2	N	N		N	N
Are not on the leading edge of innovation adoption	3.2	4.3	4.3	6.2	4.3	N	Y	N	N	Y
Rely on the experiences of others as references for innovation information	3.2	4.2	4.3	3.1	6.2	N	N		N	N

Lack of information transfer with those outside the industry	3.1	4.2	3.2	3.1	3.1	N	Y	Y	N	N
rather rely on information from peer organizations	3.1	4.2	4.3	3.1	4.2	N	Y	N	N	N
Characterized by fragmented relationships and subcontractor dependence (high level of subcontracted work)	3.2	1.3	3.2	2.1	6.1	N	N		N	N
Lack opinion leadership in the industry and typically are subject to pressure from other industry stakeholders	3.2	1.5	1.2	3.2	4.2	N	N		N	N
tend to relate to those of similar standing	3.2	1.5	0	3.1	1.3	N	N		N	N
Do no seek sources of innovation information outside of their circle of peers	3.1	1.5	3.1	3.2	3.2	N	Y	Y	N	N
Exhibit poor innovation information management	3.1	3.1	3.1	4.1	3.1	N	Y	Y	N	Y
						9%	45%	9%	9%	23%

Original Coding: Culture										
Organizational MFA	Initial	2	4	7	6	MFA Consensus	MFA Majority	Agreement	SAoI Consensus	SAoI Majority
establish innovation as a part of corporate culture and business strategy	4.2	4.2	4.1	4.1	4.1	Y	Y	Y	N	Y
focus on improving quality and decreasing down-stream cost	4.2	4.3	4.2	4.3	3.2	N	Y	Y	N	N
Forgiving in nature	4.2	4.4	4.1	4.1	4.5	Y	Y	Y	N	N
ability and drive to pursue new ideas	4.4	4.1	4.1	4.1	4.1	Y	Y	Y	N	Y
understanding and acceptance that failure is possible	4.4	4.1	4.2	4.4	6.2	N	Y	Y	N	N
see the long-term economic benefits of innovation	4.3	4.3	4.1	4.3	4.2	Y	Y	Y	N	N
less focused on immediate returns of innovation	4.3	4.1	4.3	6.2	3.2	N	N		N	N
Focus on marketability	4.3	1.5	4.2	2.1	1.5	N	N		N	N
View innovation in a positive light	4.1	4.1	4.1	6.2	4.1	N	Y	Y	N	Y
Attempt to strengthen innovation accelerators	4.1	4.4	4.1	4.2	2.1	N	Y	Y	N	N
Pursue innovation	4.1	4.4	4.1	4.1	4.2	Y	Y	Y	N	N
Problem solvers	4.1	5.1	4.4	4.4	4.5	N	Y	Y	N	N
Value technical aspects of innovation	4.1	4.4	4.1	4.1	4.1	Y	Y	Y	N	N
Can make innovation-decisions without concern of market or competitor trends	4.1	4.1	6.2	5.1	1.5	N	N		N	N
Have an innovation champion and advocate	4.1	4.2	4.2	4.4	1.3	N	Y	Y	N	N
Management support and promote a culture that emphasizes innovation and factors that support innovation	4.2	4.2	4.2	4.4	1.5	N	Y	Y	N	N
Realize and focus on the value of human capital	4.2	4.2	0	4.4	4.2	Y	Y	Y	N	Y
Seek results and benefits quickly	4.2	4.3	4.3	4.3	3.2	N	Y	Y	N	Y
Focus on quality	4.2	4.2	1.5	4.2	3.2	N	N		N	N
Able to see the value of an innovation in meeting the needs of the organization	4.2	4.2	1.1	4.3	4.2	N	Y	Y	N	N

Have an innate capacity for innovation that is balanced with rational analysis	4.4	4.4	3.1	4.1	6.1	N	N		N	N
Demonstrate idealistic foresight focusing on the ideas of people	4.4	4.1	4.1	4.4	1.3	N	Y	Y	N	N
Emphasize marketability	4.3	4.3	4.3	4.3	1.5	N	Y	Y	N	Y
Seek economic benefit from innovation	4.3	4.3	4.3	4.3	4.3	Y	Y	Y	Y	Y
Have innovation champions	4.1	4.1	4.1	4.1	4.1	Y	Y	Y	Y	Y
Work to strengthen innovation accelerators	4.1	0	4.1	4.1	4.4	Y	Y	Y	N	Y
Implement innovation using multiple approaches including project orientations; they have high standards for innovation, but view failures as a learning opportunity	4.1	4.1	4.1	4.4	6.1	N	Y	Y	N	N
Positive and ambitious attitudes toward innovation	4.1	4.1	4.1	4.1	4.2	Y	Y	Y	N	Y
Hold high standards when evaluating innovation	4.1	4.2	4.2	4.1	4.1	Y	Y	Y	N	N
Have dual-role associates participating in management and daily construction activities	4.2	4.4	0	4.2	1.3	N	Y	Y	N	N
Tend to be more discrete	4.2	4.2	0	4.5	2.1	N	Y	Y	N	N
Capable of technical competence	4.1	4.1	1.1	1.1	1.1	N	Y	N	N	Y
Generally engage in a longer innovation-decision process	4.1	4.3	4.3	6.1	1.3	N	N		N	N
Seek to make incremental improvements	4.1	4.3	4.3	6.1	5.1	N	N		N	N
Fear losing competitive advantage through competitor copying	4.1	4.2	0	3.2	2.1	N	N		N	N
Form and maintain discontinuous relationships with limited focus on integration	4.2	3.1	3.2	4.1	5.1	N	N		N	N
Overly conservative attitudes toward innovation with a tendency to avoid change	4.2	1.5	6.2	6.2	5.1	N	N		N	N
Focus on the past	4.2	4.2	6.1	4.1	3.2	N	N		N	N
Chose to maintain standardized business operations	4.2	4.3	6.1	6.1	2.1	N	N		N	N

Focus on land development with minimal long-term contingencies	4.2	4.4	0	6.2	3.2	N	N		N	N
Minimal investment in innovation activities, focusing on maintaining the status quo	4.3	4.3	6.1	5.1	2.1	N	N		N	N
Generally innovate only out of economic necessity	4.3	1.5	4.3	4.3	2.1	N	N		N	N
Loyal to tradition, opposing change and innovation out of fear and distaste	4.1	1.5	6.2	6.2	6.2	N	Y	N	N	Y
Require innovations that do not require high degrees of technical ability/knowledge	4.1	4.2	6.1	4.1	1.1	N	N		N	Y
Last in the industry to innovate, waiting until innovation becomes standard and succumbing to peer-pressure	4.1	6.2	6.2	5.1	6.2	N	Y	N	N	Y
						12	**29**	**3**	**2**	**14**
						27%	64%	7%	4%	31%

Original Coding: Risk										
Organizational MFA	**Initial**	**2**	**4**	**7**	**6**	**MFA Consensus**	**MFA Majority**	**Agreement**	**SAoI Consensus**	**SAoI Majority**
Ability and willingness to face a higher degree of uncertainty	6.2	5.1	6.2	6.2	6.2	N	Y	Y	N	Y
Seek to stem down-stream costs	6.1	4.3	4.3	4.3	3.2	N	Y	N	N	Y
Able to face high risks	6.1	6.2	1.2	6.2	6.2	N	Y	Y	N	Y
Ability to tolerate high innovation risk without well-established references	6.2	6.2	6.2	6.2	3.2	N	Y	Y	N	Y
Need reliable innovation information prior to adopting	6.1	1.5	4.3	6.1	6.1	N	N		N	N
Emphasize managing risk involved with innovation adoption	6.1	4.3	6.1	6.1	6.1	N	Y	Y	N	Y
Mitigate risk by delaying adoption until the innovation has been thoroughly proven	6.1	6.1	6.2	6.1	6.1	Y	Y	Y	N	Y
Seek non-discontinuous innovations, those that do not require significant changes in day-to-day operations	6.1	4.2	6.1	5.1	5.1	N	N		N	N
Try to avoid risk associated with innovation, and are very cautious of innovation	6.1	4.3	6.2	6.2	5.1	N	N		N	N
Risk-averse	6.2	4.2	6.2	6.2	6.2	N	Y	Y	N	Y
						10%	70%	10%	0%	70%