MEASURING CULTURE OF INNOVATION: A VALIDATION STUDY OF THE INNOVATION QUOTIENT INSTRUMENT

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The ability for an organization to innovate has become one of the most important capabilities needed in the new knowledge economy. The research has demonstrated that an organization's culture of innovation in particular predicts organizational innovativeness across multiple industries. To provide support to these organizations in their abilities to understand the culture of innovation, researchers have developed instruments to measure culture of innovation, and while many of these instruments have been widely used to inform organizational opportunities for improvement, few of these instruments have been validated or replicated beyond their initial use. The current study employs multiple factor analytic methods to validate the factor structure of the Innovation Quotient instrument developed by Rao and Weintraub and assess the extent to which the instrument is reliable for multiple organizational groups. The results of this study, as well as implications for researchers interested in culture of innovation, are presented.

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“It's a dangerous business, Frodo, going out your door. You step onto the road, and if you don't keep your feet, there's no knowing where you might be swept off to” (J.R.R. Tolkien). As I embarked on the dangerous business of the doctoral process, I have been swept off to many great places, which have been made possible by the fellowship of many…

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CHAPTER 1

INTRODUCTION

Background

In the Information Age where uncertainty and complexity are the new certainty, it is only through distinction that companies can survive and ensure sustainability in the current marketplace of products, services, and ideas, and it is believed that through innovation this distinction occurs (George, Works, & Watson-Hemphill, 2005). Referred to as the "innovation imperative," the ability for an organization to innovate has become one of the most important capabilities needed in the new knowledge economy (Lawson & Samson, 2001). Evidence of the sensitivity to the topic of innovation extends beyond the fact that innovation boasts over 133 million results from a Google search, and over 900,000 results from ProQuest's Summon repository of articles spanning over 700 databases (ProQuest, 2014). Innovation has also become one of the most important domains of study in business, technology, science, and engineering over the past few decades (O'Sullivan & Dooley, 2009), and has specifically become a hot topic in certain industries that operate in highly regulated, underfunded, or large and complex environments (Christensen, Grossman, & Hwang, 2009; Dougherty & Hardy, 1996; Leavy, 2005; Price, 2014; Thakur, Hsu, & Fontenot, 2012; Vincent, 2005). For example, Lazarus and Fell's (2011) trend analysis in healthcare reported that a survey conducted in 2011 among CEOs around the world demonstrated that innovation is one of the most important business priorities, as executives across multiple industries believed it would "generate 'significant' new revenue and cost reduction over the next three years" (p. 363).

What exactly do organizations must be able to do to innovate their products and services or to transform to operate in new markets or lines of business? What capabilities or practices are necessary to facilitate an organization's ability to manage the competitive market terrain? Theorists argue that organizations require certain tangibles, such as specific innovation processes, as well as intangibles, such as innovative intelligence or innovation culture, to produce other critical business outcomes, specifically market and financial outcomes (e.g., Dyer, Gregersen & Christensen, 2011; O'Sullivan & Dooley, 2009; Skarzynski & Crosswhite, 2014; Weiss & Legrand, 2011). And within the last thirty years, the academic literature has also produced a substantial body of evidence that the ability to innovate, or lack thereof, has indeed contributed to the success or failure for organizations from all sectors or industries (e.g., Brettel & Cleven, 2011; Den Hartog, Van de Aa, & de Jong, 2010; Hurley & Hult, 1998; Zairi & Al-Mashari, 2005). Perel (2005) has argued that that most successful way to manage difficulties associated with an uncertain future and economic turbulence is to "make innovation an integral part of a firm's organization and management DNA" (p. 15).

To make such a focus a priority, Rao and Weintraub (2013) recommend organizational leaders intentionally create a culture of innovation within their organizations, as well as measure or assess the presence of that culture – a recommendation corroborated by Kuczmarski (2003) in his assertion that a "measurement system for assessing innovation" (p. 538) is a key ingredient for an organization's successful approach. Rao and Weintraub (2013) also describe how organizations can use the results from such assessments to identify perceived differences across the multiple factors, particularly between senior leaders and employees and among geographical locations and/or sectors. Aiman-Smith et al. (2005) and Balsano et al. (2008) also advocate the use of a similar quantitative assessment and propose the use of the demographic variables of gender and functional area to facilitate comparison, benchmarking, the development of predictive models, and the reporting of trended results over time as a means to evaluate the efficacy of change initiatives.

Need for the Study

To accommodate organizations in such efforts to understand and improve culture of innovation within an organization, multiple researchers have developed measures to assess this construct, as well as other closely related domains of innovation climate, innovativeness, and innovation capability (e.g. Aiman-Smith et al., 2005; Anderson & West, 1998; Dobni, 2008; Hoe, 2011; Kuščer, 2013; Rao & Weintraub, 2013; Remneland-Wikhamn & Wikhamn, 2011; Sušanj, 2000; and Tohidi, Seyedaliakbar & Mandegari, 2012). Of these instruments the most frequently cited from the literature was the instrument developed by Dobni (2008), which assesses innovation culture as a multi-dimensional construct along the domains of innovation propensity, organizational constituency, organizational learning, creativity and empowerment, market orientation, value orientation, and implementation context. A similar instrument that has become highly visible in the practitioner market for the assessment of innovation culture is the Innovation Quotient instrument developed by Rao and Weintraub (2013). This instrument asks respondents to report their perceptions of their organization's performance in what Rao and Weintraub define as the six building blocks of a culture of innovation – values, behaviors, climate, resources, processes, and success.

While initial efforts have been made to validate some of the existing instruments as predictive of innovation outcomes, ensure internal reliability (e.g., Brettel & Cleven, 2011; Chen, 2011; Sharifirad & Ataei, 2012), and even compare performance with different groups (e.g., Susanj, 2000; Velasco, Zamanillo, & Del Valle, 2013), few of these instruments – including Rao and Weintraub's (2013) Innovation Quotient instrument – have subsequently been replicated and reported in the empirical literature. Estimates of model fit, inter-item relationships, and reliability for the Innovation Quotient instrument in particular have yet to be cited in academic literature. Therefore, there is a need to replicate investigations of innovation culture to assess and improve the validity and reliability of current instrumentation. Through the analysis and validation of such an instrument, organizational leaders and researchers may better assess its current state for its determinants of innovation (Aiman-Smith et al., 2004; Susanj, 2000), therefore leading to better organizational outcomes.

Conceptual Framework

While previous investigators have attempted to relate culture of innovation to other critical organizational outcomes, the work of Rao and Weintraub (2013) focused on the construct of culture of innovation itself, culminating in a comprehensive and multi-factorial theory of innovation culture that can be observed and measured in organizations. Rao and Weintraub's (2013) six building blocks of an innovative culture was built upon the existing literature on organizational culture (Denison, 1996; Hofstede, 1998; Schein, 1984), the practitioner literature on innovation theory (Christensen, Anthony, & Roth, 2004), case studies of hundreds of companies across multiple industries, and other empirical works on innovation (Tellis, Prabhu, & Chandy, 2009). The authors proposed the six building blocks of resources, processes, success, values, behaviors, and climate, each of which consists of three first order factors comprised of three elements, or indicators. Table 1 summarizes each of the six building blocks, their factors (first order factors), and their elements (indicators) (Rao & Weintraub, 2013).

Table 1

Six Building Blocks and Their Respective Factors and Indicators (Rao & Weintraub, 2013)

Building Block	Factors	Elements/Indicators
Resources		
	People	Champions, experts, talent
	Systems	Selection, communication, ecosystem
	Projects	Time, money, space
Processes		
	Ideate	Generate, filter, prioritize
	Shape	Prototype, fail smart, iterate
	Capture	Flexibility, launch, scale
Success		
	External	Customers, competitors, financial
	Enterprise	Purpose, discipline, capabilities
	Individual	Satisfaction, growth, reward
Values		
	Entrepreneurial	Ambiguity tolerance, action oriented, hunger
	Creativity	Imagination, autonomy, playful
	Learning	Curiosity, experiment, failure okay
Behaviors		
	Energize	Inspire, challenge, model
	Engage	Initiative, support, coach
	Enable	Influence, adapt, grit
Climate		
	Safety	Trust, integrity, openness
	Simplicity	No bureaucracy, accountability, decision making
	Collaboration	Community, diversity, teamwork

Rao and Weintraub (2013) proposed that the three building blocks in a culture of innovation that are easiest to understand and observe are an organization's resources, processes, and successes. The extent to which an organization resources its innovation efforts, particularly through the identification of innovation champions and experts within its walls, affects an organization's ability to innovate. Organizations that deploy specific innovation *processes*, such as steps to generate new ideas, filter good ideas from poor ones, prioritize suggestions, develop and test prototypes, and flexibly determine which ideas or products go to scale, are better able to innovate in new markets than organizations that do not employ such methods. Rao and Weintraub (2013) also proposed that organizations that recognize its *successes* at the external/market, enterprise, and individual levels can better engage its customers and maintain market advantage.

The three building blocks to a culture of innovation that are more often neglected and much less frequently measured in organizations are the critical areas of *values*, *behaviors*, and *climate*. Rao and Weintraub (2013) identified that the values of an entrepreneurial focus, creativity, and a willingness to learn play a part in priorities and decisions an organization will face, and will therefore shape the use of its resources and other innovative efforts and processes. Other specific actions or *behaviors* were also found to be conducive to the ability to innovate new products. These include a willingness to adapt to new markets, abandon ineffective approaches, energize employees toward a market focus, and exhibit grit when external forces apply undesired pressure. Rao and Weintraub (2013) finally also demonstrated that a *climate* of safety, trust, willingness to take risks, and limited bureaucracy "fosters learning and encourages independent thinking" (p. 30).

Measuring Culture of Innovation

Rao and Weintraub (2013) demonstrate how organizations can assess their current levels of performance along each of the six building blocks (higher order factors) and 18 first-order factors using an instrument called the Innovation Quotient survey. These authors, as well as other investigators in the field of innovation culture (e.g. Susanj, 2000; Velasco, Zamanillo, & Del Valle, 2013) and organizational culture assessment in general (e.g. Cooke & Rousseau,1988), advocate the use of measurement of culture to compare performance across different groups as a means to inform opportunities for improvement. Some of these inter-group comparisons may include the country of residence of the participants, the industry or sector, the type of organizational work unit (e.g. between departments and entities), the level of employees (e.g. executive leadership, middle leader or manager, or front line staff), or the functional role of the employee (e.g. commercial/customer facing, R&D/innovation, operations, support, or other). These investigators and others support the theory that culture of innovation can be observed and quantified, that the results can be reported by each of the relevant factors, and that organizational leaders can use those results to identify blind spots, make inter-group comparisons, and therefore improve each of the building blocks of a culture of innovation. However, investigators have presented little evidence to replicate the hypothesized factor structure, i.e. measurement model, such as that proposed by Rao and Weintraub's (2013), or to ensure meaningful interpretation of results.

Purpose of the Study and Research Questions

The purpose of this present investigation is to assess the construct validity and reliability of the Innovation Quotient instrument (Rao & Weintraub, 2013). This present investigation will employ multiple factor analytic strategies to examine the hypothesized factor structure of each of the six measurement models within the instrument by estimating model fit, inter-item relationships, and reliability for each of the models. The specific research questions that will be addressed include the following:

1. To what extent do each of the six measurement models within the Innovation Quotient instrument demonstrate evidence for convergent and discriminant validity? To what extent is the hypothesized factor structure of each of the six measurement models of the Innovation Quotient instrument consistent with the administration of this present study (i.e. demonstrate appropriate model fit through confirmatory factor analyses)?

2. To what extent are each of the six measurement models and their hypothesized factors within the Innovation Quotient instrument reliable for multiple organizational groups, including countries, industries, employee levels, functional roles, and the languages of instrument administration?
3. In the absence of evidence for convergent or discriminant validity or reliability, what is a plausible alternative factor structure of culture of innovation, as determined by an exploratory factor analysis (EFA)? To what extent does the new factor structure demonstrate evidence for convergent and discriminant validity, as well as reliability for multiple organizational groups?

Limitations

This present study contains multiple limitations that will be outside the control of this researcher. The first limitation is that of initial validation of the Innovation Quotient (2013) instrument. This instrument was initially published through a practitioner-based publication – the Spring 2013 issue of the MIT Sloan Management Review – and is therefore only in its infancy. The instrument was supported by limited empirical evidence of its validity beyond the assertion that it was "field tested over two years for statistical validity" (2013, p. 31), and has only begun to be assessed in academic literature beyond the initial investigations conducted by the authors. While the instrument authors have deployed the survey extensively since 2013, at this time it is not clear whether the instrument is predictive of other critical organizational outcomes, and it is expected that this present study will support initial validation efforts.

The second key limitation pertains to the use of the cross-sectional survey approach. This present investigation used self-report, common method approach to obtain information about the perceived culture of innovation within the organization, as well as the organizational groups into which the participants self-characterized. While few instruments to assess these constructs exist beyond the use of self-report methods, the use of the this approach may have contributed to multiple threats to the validity of the findings, such as inconsistency in reference points, observer effects, true state of affairs, sensitivity of the construct, dispositional characteristics, or situational characteristics (Donaldson & Grant-Vallone, 2002).

Delimitations

In addition to the study's limitations, additional constraints, or delimitations, will be placed upon the study by this investigator. First, while multiple measures of culture of innovation exist, this present study employed the Innovation Quotient (2013) instrument due its alignment with the literature in organizational culture, its comprehensiveness in integrating the scope of literature in the field of innovation, and its accessibility and user-friendliness to a wide audience of varying educational backgrounds and abilities.

The second delimitation placed upon this investigation was the use of secondary data to evaluate the key research questions. As the instrument's lead author had already executed a detailed, multi-faceted plan to administer the instrument in 138 companies across 24 industries in 13 countries, it was determined that an adequate sample size for the populations under investigation had already been reached, yielding a more robust opportunity to generalize to those groups where the instrument may be considered for future use. As this present study was not considered as a part of the original design and data collection, multiple best practices in survey administration were not guaranteed, such as the use of a sampling power analysis, participant sampling and recruitment, the use of theory to guide the selection and categorization of demographic variables for grouping, equality of sample to population representation, standardized survey instructions, methods to manage common variance, the proper handling of missing data, and other considerations.

As a secondary data source was used for this present study, one additional delimitation was identified that may affect the final findings. The dataset contained participant responses to 54 items measuring constructs that contribute to a culture of innovation, but the data collection process allowed for the instrument to be administered in both the Spanish and English languages. While it is not typically the practice of psychometricians who evaluate the quality and validity of instrumentation to pool respondents who participate in different languages, it was identified by the instrument's author that it is the common practice of the practitioners who use the data to aggregate performance across both languages. As the final results would often be interpreted regardless of the language of administration, it was important to maintain the dataset as a whole.

Definitions of Terms

Behaviors: One of the six building blocks of a culture of innovation from Rao and Weintraub's (2013) Innovation Quotient survey. The building block (higher order factor) of behaviors consists of the three first order factors, energize, engage, and enable, and is represented by a total of nine items.

Climate: One of the six building blocks of a culture of innovation from Rao and Weintraub's (2013) Innovation Quotient survey. The building block (higher order factor) of climate consists of the three first order factors, collaboration, safety, and simplicity, and is represented by a total of nine items.

Culture of innovation: Drawing on literature regarding innovation and organizational culture, Rao and Weintraub (2013) asserted that a culture of innovation is the sum of the values, behavior, climate, resources, processes, and successes of an organization that contribute to an organizations' ability to innovate its products and services.

Innovation Quotient survey: Instrument designed by Rao and Weintraub (2013) to measure a culture of innovation in organizations. The Innovation Quotient survey provides self-report results from participants along the six "building blocks" of a culture of innovation: values, behaviors, climate, resources, processes, and results. Each of the six building blocks consists of three first order factors, indicated by three elements, or items.

Processes: One of the six building blocks of a culture of innovation from Rao and Weintraub's (2013) Innovation Quotient survey. The building block (higher order factor) of processes consists of the three first order factors, ideate, shape, and capture, and is represented by a total of nine items.

Resources: One of the six building blocks of a culture of innovation from Rao and Weintraub's (2013) Innovation Quotient survey. The building block (higher order factor) of resources consists of the three first order factors, people, systems, and projects, and is represented by a total of nine items.

Success: One of the six building blocks of a culture of innovation from Rao and Weintraub's (2013) Innovation Quotient survey. The building block (higher order factor) of success consists of the three first order factors, external, enterprise, and individual, and is represented by a total of nine items.

Values: One of the six building blocks of a culture of innovation from Rao and Weintraub's (2013) Innovation Quotient survey. The building block (higher order factor) of values consists of the three first order factors, entrepreneurial, creativity, and learning, and is represented by a total of nine items.

Summary

Chapter 1 presented a background of the nature of innovation in organizations, the importance of a culture of innovation and its measurement and assessment, and the need for this present study to affirm the factor structure of measures of culture of innovation. The chapter also described the theoretical framework that formed the basis for the instrument of choice to accomplish the key research objectives and then provided a summary of the research questions, hypotheses, limitation, and delimitations. Chapter 2 provides a review of the literature related to this present study, specifically topics of organizational culture, innovation, culture of innovation and its measurement. Chapter 3 describes the use of factor analytic methods to address the key research questions, followed by a presentation of the findings of the analyses in Chapter 4. The fifth chapter articulates the conclusions and recommendations for future research and for practitioners interested in the culture of innovation in organizations.

CHAPTER 2

REVIEW OF THE RELATED LITERATURE

The alarming notion of 'innovate or die' has become the new ultimatum for any organization seeking sustainability (van Hamersveld & de Bont, 2007). Innovation is the "lifeblood of our global economy and a strategic priority for virtually every CEO around the world" (Dyer, Gregersen, Christensen, 2011). To address such a demand, a flurry of activity among academicians, professional organizations, and other coalitions among all industries have dedicated resources specifically to supporting organizations in their efforts to increase their capacity to innovate. For example, in 2012 Harvard Business School and Harvard Medical School joined forces to create an annual Forum on Healthcare Innovation. The goal of this forum was to "unite leading executives, policymakers, and academics in a cross-disciplinary exploration of innovative actions to improve quality, reduce costs, and, ultimately, increase value in the health care industry" (Harvard Business School, 2014a, p.1). The result of that original forum was a publication called, "Five Imperatives: Addressing Healthcare's Innovation Challenge" (Harvard Business School, 2014b, p. 1), which summarized the results from a survey of healthcare leaders about quality and costs of care, as well as the documentation of the key ideas that emerged from these great minds that focused on the future of the industry amidst these challenges. The short but informative pamphlet left its readers with five imperatives:

1. Make value the central objective – the importance of care coordination and shared information;
2. Promote novel approaches to process improvement – create an environment that encourages improvement but also acknowledges that failure is an important component in experimentation and learning;

3. Make consumerism work – make products that meet patient needs and engage patients to manage their own health;
4. Decentralize approaches to problem solving – engage providers, innovators, and patients to collaborate to improve; and
5. Integrate new approaches – built on past successes, but integrate new knowledge into the community (2014b, p. 8).

Innovation

If such an alarmist phrase of 'innovate or die' has become a reality for organizations facing increased competition over the turn of the century (van Hamersveld & de Bont, 2007), then it may be helpful for organizational leaders, regardless of industry, to thoroughly investigate exactly what innovation actually means – both its definition and its implications for organizational outcomes. Where did the urgency of innovation come from, and what does it look like today? Authors spanning multiple fields of study have discussed whether innovation should be defined as a process or a product (e.g., Baregheh, Rowley, and Sambrook, 2009; Brophey, & Brown, 2009; Quintane, Casselman, Reiche, & Nylund, 2011; Weiss & Legrand, 2011), a continuous or a breakthrough process (e.g., Cole, 2002; Steiber & Alänge, 2013; Terziovski, 2002), synonymous with creativity, organizational learning, other terms (e.g., O'Cass & Ngo, 2007; Sharifirad & Ataei, 2012), macro or micro in nature (e.g., Kaufman, Tsangar, & Vrontis, 2012), and whether innovation should be extended to encompass open and/or closed innovation characteristics (e.g., Brettel & Cleven, 2011; Enzing, Batterink, Janszen, & Omta, 2011; Huizingh, 2011; Lee, Chen, Tsui, & Yu, 2014).

Recognizing the disparities in the definitions of innovation that flood the management literature, Baregheh, Rowley, and Sambrook (2009) conducted a content analysis of the definitions of innovation in the disciplines of economics, entrepreneurship, business, management, technology, science, and engineering from the year 1934 through the present. Through this study the authors uncovered that the definitions of innovation were diverse but could be categorized into the major buckets of innovation types (e.g. product, service, process), stages (e.g. adoption, creation, creation, implementation), social context (e.g. organization, customer, employee, external environment), means (e.g. idea, invention, technology, market), and aims (e.g. competition, success, differentiation). While the definitions continue to stockpile in the literature, O'Sullivan and Dooley (2009), who are known experts in the study of innovation management, propose that innovation should be view as the *application* of a *process*, and described it as follows:

> Applying innovation is the application of practical tools and techniques that make changes, large and small, to products, processes, and services that results in the introduction of something new for the organization that adds value to customers and contributes to the knowledge store of the organization. (2009; p. 5)

As a process our understanding of innovation has taken many turns throughout recent history. Rothwell (1992) describes the shifts in our perceptions of the innovation process over time since the early 1950s and summarizes five key generations: 1) the technology push model from the early 1950s to the mid-1960s; 2) the market pull model from the mid-1960s to the early 1970s; 3) the coupling model from the early 1970s to the early 1980s; 4) the integrated, parallel model from the early 1980s to the mid-1990s; and 5) the integrated, networked model since the late 1990s. The Criteria for Performance Excellence (Baldrige Performance Excellence Program, 2013), one of the most frequently used sources of insight for leaders across multiple industries, corroborates this notion of an integrated, networked model with its admonitions to organizational leaders who seek to understand the contribution of innovation to overall performance and results:

> [Innovation is] making meaningful change to improve products, processes, or organizational effectiveness and create new value for stakeholders. Innovation involves adopting an idea, process, technology, product, or business model that is either new or new to its proposed application. The outcome of innovation is a discontinuous or breakthrough change in results, products, or processes. Innovation benefits from a supportive environment, a process for identifying strategic opportunities, and a willingness to pursue intelligent risks. Successful organizational innovation is a multistep process of development and knowledge sharing, a decision to implement, implementation, evaluation, and learning. Although innovation is often associated with technological innovation, it is applicable to all key organizational processes that can benefit from change through innovation, whether breakthrough improvement or a change in approach or outputs. Innovation could include fundamental changes in an organization's structure or business model to accomplish work more efficiently. (p. 46)

Determinants of Innovation in Organizations

This integrated perspective of innovation is consistent with ideas proposed by complexity theorists such as Goldstein (2008) and demonstrate that multiple components and/or structures must work together simultaneously as a part of a whole system to be able to produce innovation within or for an organization. Multiple researchers have developed integrated models in an attempt to summarize the key determinants of innovation within the organizational setting across multiple sectors, some of which include Hurley and Hult's (1998) organization and market driven innovation model, Sun, Wong, Zhao, and Yam's (2012) multi-level conceptual model of innovation performance, and Crossan and Apaydin's (2010) multi-dimensional framework of organizational innovation.

Hurley and Hult (1998) drew from the literature in market orientation, organizational learning orientation, and innovation to develop a conceptual framework that describes these orientations as predictive of organizational innovativeness (see Figure 1). The authors identified the organizational characteristics – structural and process, as well as cultural – that predict the organizational outcomes of capacity to innovate, and competitive advantage and performance. These structural and process characteristics included organization size and resources, age, differentiation of the organization, low formalization, loose coupling, autonomy, lack of hierarchy, market intelligence, and planning. The cultural characteristics included a market focus, learning and development, status differential, participative decision making, support and collaboration, power sharing, communication, and tolerance for conflict and risk-taking. After controlling for size, Hurley and Hult (1998) empirically tested the effect of each of the cultural attributes on innovative capacity, and found learning and collaboration and participative decision making accounted for the largest amount of variance in capacity to innovate.

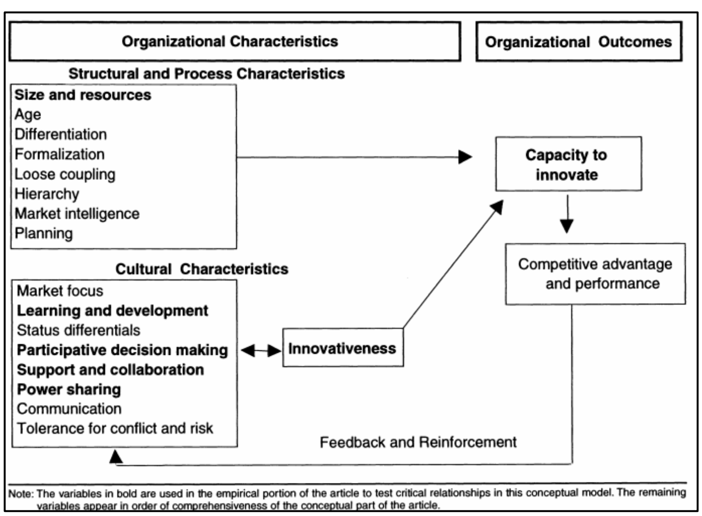

Figure 1. Model of organization and market driven innovation.

Sun, Wong, Zhao, and Yam (2012) proposed the use of a multi-factor, multi-level model of innovation competence, which suggested that the strategic enablers of leadership and strategy provides the foundation for the operational enablers of culture, methods, and resources, which in turn affect the use of innovation processes, such as idea generation, idea screening, and idea implementation (see Figure 2). This multi-level model ensures the innovation competence of the organization. A cross-case study method was utilized to affirm the contribution of each of these enablers and processes on innovation competence among seven manufacturing companies in Hong Kong. When leadership and strategy for innovation are strong, Sun, Wong, Zhao, and Yam (2012) found methods were applied to approach innovation, leading to better innovation processes and results compared to cases where less emphasis was placed on the strategic and operational enablers. Regardless of the result of each company's innovation competence, the authors also uncovered that each of the seven cases identified the importance of a culture of innovation as a key enabler for improving their abilities to innovate.

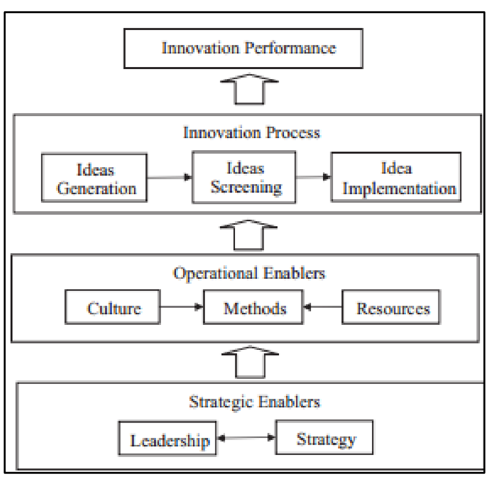

Figure 2. Conceptual model of innovation performance

Crossan and Apaydin (2010) conducted a systematic review of the literature on innovation from which their multi-dimensional framework of organizational innovation was designed. Seeking to identify a comprehensive approach to innovation, the authors organized their findings into the key buckets of determinants of innovation and dimensions of innovation (see Figure 3). The key determinants of innovation included individual and group level leadership, managerial levers, and business processes, where the dimensions of innovation include both innovation as a process itself and innovation as an outcome. Like Sun, Wong, Zhao, and Yam's (2012) model, Crossan and Apaydin (2010) began with the key attributes of leadership and other managerial levers, such as mission, goals, and strategy, structure and systems, resource allocation, organizational learning and knowledge management, and organizational culture, and they proposed that these domains lead organizations to employee innovation processes at varying levels, directions, sources, and loci, which impacted the organization's success with product innovation as an outcome. Where the model proposed by Crossan and Apaydin's (2010) is unique is in the understanding that each of these determinants and dimensions occur at multiple levels of analysis within an organization. Guided by the use of upper echelon theory (Hambrick & Mason, 1984), both individual and group level factors influenced each group's ability and motivation to innovate, thus adding insight into the need for exploration into the constructs at varying levels within an organization.

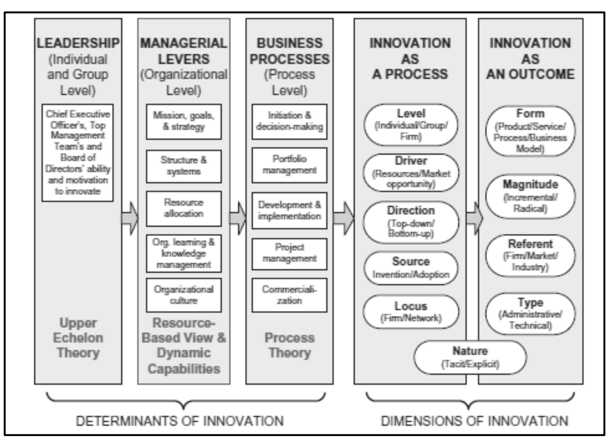

Figure 3. Multi-dimensional framework of organizational innovation.

Each of the authors of the three previous models conceptualized and affirmed many of the specific organizational characteristics and/or determinants that they hypothesized contributed to an organization's ability to innovate (Crossan & Apaydin, 2010; Hurley & Hult, 1998; Sun, Wong, Zhao & Yam, 2012). Recognizing the importance of each of these determinants, as well as other key factors identified in the literature, Rao and Weintraub (2013) presented their model of the *Building Blocks* that predict an organization's ability to innovate. Table 2 demonstrates how this model both encompasses and differs from the previous models.

Table 2

Rao and Weintraub's (2013) Building Blocks and Previous Models

Key Construct	Hurley & Hult's (1998) Organizational Characteristics	Sun's et al. (2012) Strategic and Operational Enablers	Crossan & Apaydin's (2010) Determinants of Innovation	Rao & Weintraub's (2013) Building Blocks
Age	x			x
Communication	x			x
Differentiation	x			x
Formalization	x			x
Hierarchy	x		x	x
Idea implementation		x	x	x
Ideas generation		x		x
Ideas screening		x		x
Leadership		x	x	x
Learning and development	x		x	x
Loose coupling	x			x
Market Intelligence/focus	x		x	x
Methods		x		x
Organizational culture		x	x	x
Participative decision making	x		x	x
Power sharing	x			x
Project management			x	x
Size and resources	x	x	x	x
Status				x
Strategy/planning	x	x	x	x
Support and collaboration	x			x
Tolerance for conflict and risk	x			x

While the authors have created unique labels to describe each of these domains, factors, and indicators, Rao and Weintraub (2013) integrate in a nonlinear fashion each of the constructs identified by the previous researchers, as well as others, to propose a comprehensive construct they term an organization's culture of innovation, depicted by Rao (2014) in Figure 4 and presented in Rao and Weintraub's (2013) Innovation Quotient instrument (see Appendix C).

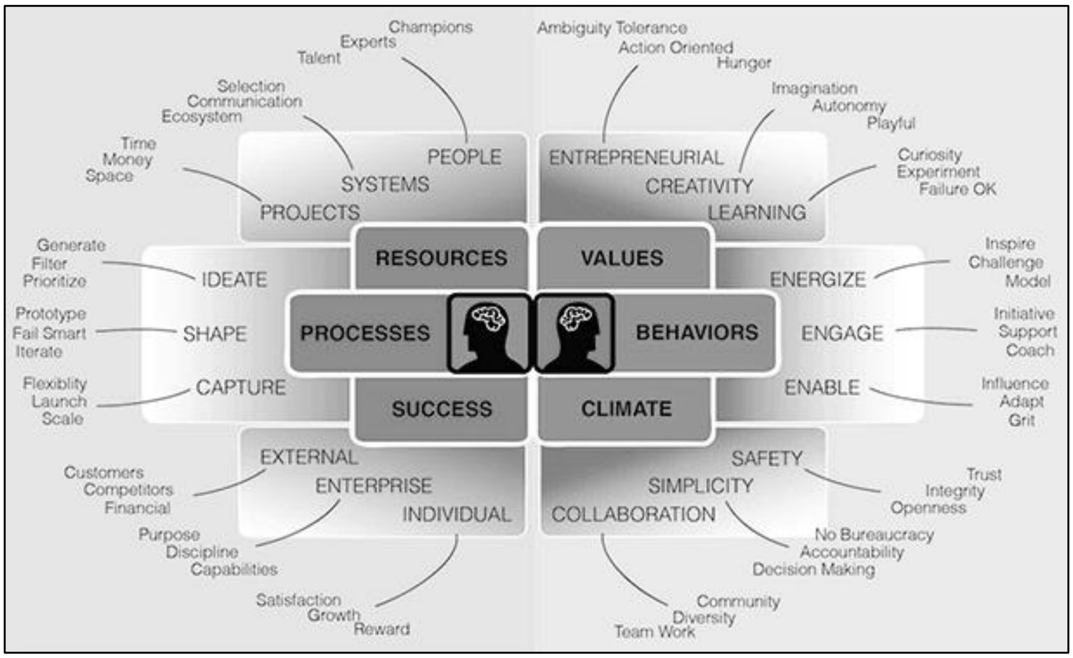

Figure 4. Building blocks to a culture of innovation.

Culture

The idea of the culture of an organization, or specifically its organizational culture, has also undergone thorough scrutiny and investigation in academic literature (e.g. Allaire & Firsirotu, 1984; Denison, 1996; Hatch, 1993; Hoffman & Hegarty, 1993; Hofstede, 1998). The most frequently referenced view is that of Schein (1984), who defined organizational culture as a "pattern of basic assumptions that a given group has invented, discovered, or developed in learning to cope with its problems of external adaptation and internal integration, and that have worked well enough to be considered valid, and therefore, to be taught to new members as the correct way to perceive, think, and feel in relation to those problems" (p. 3). To be able to respond to these 'external problems', Schein (1984) contended that three levels of culture – basic assumptions, values, and artifacts and creations – as well as the interaction among these three levels, are generated and manifest themselves in different ways by the organization's members. As described by Bellot (2011), artifacts, or the visible structures and processes of the organization, are the most visible to an outside observer, whereas the values, which are the strategies, goals, and philosophies of the organization, are less visible to an outside observer. The most difficult to observe, and therefore understand, are the underlying assumptions of the organization's members, which include the unconscious beliefs, perceptions, thoughts, and feelings of its individual members. Taken together each of these critical facets of an organization – its structures and processes (artifacts), strategies, goals, and philosophies (values), and beliefs, perceptions, thoughts, and feelings of individual members (assumptions) – reflect the organizational culture of the social construct we know as the organization.

To describe how these assumptions, values, and artifacts are generated, multiple theorists have presented cultural typologies that help explain differences among cultures both within and between organizations. Handy (1996) identified four culture types, which include power, role, task, and person culture. Hofstede et al. (1990) theorized that culture presented itself through practices in its values, rituals, heroes, and symbols, and through factor analytic methods provided empirical support for six independent factors of cultural orientation – process versus results; employee versus job; parochial versus professional; open versus closed systems; loose versus tight control; and normative versus pragmatic focus. Additional theories advocate for the separation or the integration of organizational climate as a topic of related study (e.g., Schneider, Ehrhart, & Macey, 2013; Scott, Mannion, Davies, & Marshall, 2003). Denison (1996) also argued that while culture and climate have been presented to both overlap and diverge throughout the history of their study, future research should aim to "incorporate the traditions of climate research within the culture literature" (p. 646). In an effort to synthesize these multiple perspectives in literature around organizational culture, Denison (1996) succinctly summarized the similarities between the findings of multiple researchers, compared them to those that typify organizational climate, and classified the culture and climate types along the domains of an organization's structure, support, risk, cohesiveness, and outcome orientation.

Culture of Innovation

Schneider, Ehrhart, and Macey (2013) posited that it is helpful for the research and practice of organizational culture to study its variety of values and behaviors within the context of "a culture for-something, such as for a *culture of well-being* or a *culture of innovation*" (p. 377). The study of a culture of innovation, therefore, supports this aim and may involve integrating the definitions of innovation and organizational culture. While it has not been the practice of most researchers to define culture of innovation in a systematic fashion through the integration of a formal definition of innovation with cultural domains, such as structure, support, risk, cohesiveness, and outcome orientation (Denison, 1996), authors have certainly canvassed these key domains indirectly, as well as those related to the strikingly similar topics of innovative culture, innovation capability, innovative capacity, innovation competence, innovation climate, and global innovation culture (e.g., Crossan & Apaydin, 2010; Hurley & Hult, 1998; Kleinschmidt, De Brentani, & Salomo, 2007; Lemon & Sahota, 2004; Panayides, 2006; Sarros, Cooper, & Santora, 2008; Shahin & Zeinali, 2010; Sun et al., 2012).

Most theorists and investigators have not defined innovation culture as an integrated construct, but have instead focused on describing the key dimensions or factors that contribute to an innovation culture. An example of this is Dobni (2008), who defined innovation culture as "a multi-dimensional context which includes the intention to be innovative, the infrastructure to support innovation, operational level behaviors necessary to influence a market and value orientation, and the environment to implement innovation" (p. 540), a definition which has influenced and shaped the work of many other investigations (e.g. Humphreys, McAdam, & Leckey, 2005; Sharifirad & Ataei, 2012), as well as the four conceptual models of innovation described in the previous section (Crossan & Apaydin, 2010; Hurley & Hult, 1998; Rao & Weintraub, 2013; Sun et al., 2012).

As interest in the culture of innovation in organizations has climbed, dozens of other voices have emerged to support or slightly modify existing notions of this multi-dimensional construct. Anderson and West (1998) proposed a four-factor model of work group innovation climate – vision, participative safety, task orientation, and support for innovation. Humphreys, McAdam, and Leckey (2005) applied Frances' (2000) dimensions of innovativeness, which include direction, capability, culture, learning, structure and process, and decision making, to evaluate the progression of innovativeness of a small-to-medium enterprise over time. Also operating with the theory that the climate research better aids in the understanding of the surface structures of culture and that climate can more easily be assessed and measured, Remneland-Wikhamn, and Wikhamn (2011) integrated Patterson's et al. (2005) research on climate to innovation, proposing four dimensions of flexibility, innovation support and approaches, outward focus, and reflexivity. And as was described above, Rao and Weintraub (2013) incorporated each of the dimensions that predict innovation, including abstracted factors within the domains of values, behaviors, climate, resources, processes, and success, to the comprehensive construct termed a culture of innovation. A brief summary of examples of researchers who have attempted to define and study the factors that contribute to a culture of innovation, innovativeness, innovation climate, and other related constructs is shown in Table 3.

Table 3

Sampling of Literature: Factors that Contribute to an Innovation Culture

Study	Factors of Innovation Culture, Innovativeness, and/or Innovation Climate
Bakovic, Lazibat, & Sutic, 2013	Autonomy, cannibalization, pro-activeness, and risk-taking
Brettel & Cleven, 2011	Orientation toward new technologies, learning orientation, willingness to take risks, and future market orientation
Chen, 2011	Vision, participation safety, support for innovation, task orientation, interaction frequency
Enzing et al., 2011	Upfront activities, organizational routines, company culture (flexibility, openness, cooperation, management style, human focus, etc.)
Herrmann, Gassmann, & Eisert, 2007	Orientation toward new technologies, learning orientation, willingness to take risks, long-term orientation, customer orientation, and independent units
Kumar & Uzkurt, 2010	Individualism-collectivism, masculinity-femininity, power distance, and uncertainty avoidance
Lee et al., 2014	Innovation and flexibility, outward focus, reflexivity
McAdam et al., 2007	Direction, capability, culture, learning, structures/processes, and decision making
O'Cass & Ngo, 2007	Encouraging creativity, being receptive to new ideas, decentralizing decision making, and encouraging open communication
O'Connor, Roos, & Vickers-Willis, 2007	Innovation capability: various innovation resource assets (or inputs), and immediate transformative assets (culture, systems, processes, procedures)
Panuwatwanich, Stewart, & Mohamed, 2009	Propensity for creativity, freedom and autonomy, and innovation support and facilitation
Sarros, Cooper & Santora, 2008	Articulates vision, provides individual support, and performance-oriented culture
Saunila & Ukko, 2013	Leadership practices, employee skills/innovativeness, processes/tools for idea management, supporting culture, external sources for information, development of individual knowledge, employee welfare, and linkage to strategic goals
Shahin & Zeinali, 2010	Decision making, direction, capability, culture, and structure/process
Sharifirad & Ataei, 2012	Innovation propensity, organizational constituency, organizational learning, creativity and empowerment, market orientation, value orientation, and implementation context
Steiber & Alänge, 2013	Leaders, structures, incentives, continuous learning, and change oriented board
Velasco, Zamanillo, & Del Valle, 2013	Leadership, culture, and human resources

Measures of Culture of Innovation

Previous empirical works investigating the relationships between a culture of innovation and other critical outcomes required that the construct of culture of innovation be operationally defined, quantified, and measured. In order to identify existing instruments to define and measure culture of innovation, an extensive literature search was conducted to identify a menu of possible instruments (refer to Table 4) from which a final instrument could be selected. This literature review took place in three stages. First, a search for the key words of "innovation culture" AND "measurement" was conducted among all databases listed in the Serials Solutions databases and packages (which included 39 open archives such as ABI/Inform, ProQuest, EBSCO, etc.) for all empirical, peer-reviewed publications. No date restrictions were imposed upon the search. Each of the abstracts of these articles was read to determine if one of the above construct (or a related construct of innovation climate, innovativeness, culture of innovation, etc.) was measured using a quantitative instrument. Each of these remaining articles was read in its entirety and was eliminated from final inclusion if the article referenced the measurement of innovation itself, as defined by a process or product instead of the culture of innovation, or if the article was not related to the topic of this present study. However, the article was included if it reported the use of a measure of organizational culture in relation to innovation, or investigated relationships between innovation and organizational learning, for example. Finally, a second-level search was conducted through Google Scholar to determine whether additional studies could be identified that utilized those instruments to measure culture of innovation. Using the same scanning technique described above, and after eliminating duplicate results, additional articles were identified, leading to a total of nearly 60 empirical articles, theoretical articles, and literature review or meta-analytic articles that were retained due to their discussion on the topic of the measurement of innovation culture.

In order to critically appraise each article for key abstractions that relate to this present study, Garrard's (2011) matrix method was used. To review the articles employing this investigative approach, a matrix was developed that contained each of the following column headers: search term, author, year, type of article, reason for inclusion, key constructs of study, measures used, list of subscales or factors reported, instrument scale, factor analytic methods conducted, audience, sample size, sample characteristics, industry, study purpose, key relationships observed between culture of innovation and other outcomes, whether the actual instrument items were included in the article, and other final notes and observations. The content of each of the articles was systematically analyzed in order to obtain information to complete each of the columns of the matrix. While nearly 400 results were produced from the initial search, only about 60 results were selected and analyzed using the matrix method above, which finally produced ten articles that presented a unique, non-adapted instrument of innovation culture, innovation capability, innovation climate, innovativeness, or other related construct.

The majority of these 60 works could be classified into one of four types of studies: 1) the testing of relationship between culture of innovation and other outcomes, which included the development of a new measures of innovation culture (or a related construct) using a univariate model/factor with a range of two to four survey items in total (e.g., Panayides, 2006; Sun et al., 2012); 2) the testing of relationship between a culture of innovation and other outcomes, which included the adaptation of previously used measures of innovation culture (e.g., Hurley & Hult, 1998; Sharifirad, & Ataei, 2012); 3) the development and validation of a new measure of a multi-factorial construct of innovation culture (e.g., Dobni, 2008; Kuscer, 2013); and 4) a literature review or conceptual article summarizing the importance of the measurement of multi-dimensional model of innovation culture or prescribing the improvement of innovation culture within organizations (e.g., Rao & Weintraub, 2013; Slater, Mohr, & Sengupta, 2014). Table 4 summarizes examples of key instruments that have been developed in order to measure a culture of innovation or a related construct, as well as the evidence for the validity and reliability presented by the original authors for each instrument.

Instrument Evaluation

While many instruments have been developed as a means to measure culture of innovation or a related construct for multiple purposes, much variation exists among the instruments in their design, particularly related to the inclusion of domains or factors, level of rigor in the analysis, and recommendations for applied use. Switzer et al. (1999) and Kimberlin and Winterstein (2008) summarized some key criteria that should be utilized in the selection of an instrument for such a research purpose, including participant characteristics, research goals, administration issues (such as user-friendliness, parsimony, and feasibility), critical psychometric issues of reliability and validity, and the presence of existing instruments. Subjecting the list of instruments shown in Table 4 to evaluation against the criteria of validity, reliability, parsimony, and interpretation/user-friendliness, it is clear that some instruments may be better suited for subsequent evaluation and validation compared to others.

Table 4

Summary of Instruments: Culture of Innovation or a Related Construct

Reference	Purpose	Instrument	Subscales	Validity/Reliability
Aiman-Smith et al., 2005*	Summarize the development of a tool to measure Value Innovation Potential	Value Innovation Potential Assessment Tool (VIPAT)	Meaningful work, risk-taking culture, customer orientation, agile decision-making, business intelligence, open communication, empowerment, business planning, learning	Reliabilities, as measured by Cronbach alpha, were greater than 0.70; Content/convergent validity were checked
Anderson & West, 1998	Measure and relate facets of climate for innovation and innovativeness	Team Climate Inventory	Vision, participative safety, task orientation, support for innovation	Reliabilities, as measured by Cronbach alpha, ranged from 0.67 to 0.98; Discrim/consensual validity
Dobni, 2008*	Develop a comprehensive instrument for measuring innovation culture	Dobni (2008)	Innovation propensity, organizational constituency, organizational learning, creativity and empowerment, market orientation, value orientation, and implementation context	Reliabilities, as measured by Cronbach alpha, ranged from 0.74 to 0.82; Content/construct validity were checked
Hoe, 2011*	Develop an instrument	Hoe (2011)	Shared vision, management support, community and individual creativity, implementation, and motivators	No summary results were reported; Not reported
Humphreys et al., 2005*	Apply instrument to evaluate a SME organization over time	Francis' (2000) Centrim G2 Innovation Audit	Direction, capability, culture, learning, structure and process, and decision making	Only average ratings over time are presented; Not reported
Kuščer, 2013	Test elements of *mountain destination innovativeness*; develop measure	Kuscer (2013)	Sociocultural sustainability and stakeholder participation, environmental sustainability (natural environment), and proactiveness	Reliabilities, as measured by Cronbach alpha, ranged from 0.899 to 0.92; Content validity checked
Rao & Weintraub,2013*	Propose and advocate for use of instrument	Innovation Quotient Survey	Values, behaviors, climate, resources, processes, and success	"Field tested over two years for statistical validity" (2013, p. 31)
Remneland-Wikhamn & Wikhamn, 2011	Propose and validate instrument	Open Innovation Climate Measure	Innovation and flexibility, outward focus, and reflexivity	Reliabilities, as measured by Cronbach alpha, ranged from 0.66 to 0.83; Discrim/converg validity

(table continues)

Table 4 *(continued)*

Reference	Purpose	Instrument	Subscales	Validity/Reliability
Sušanj, 2000	Examine differences in innovation culture and climate in different countries	FOCUS Questionnaire	Risk-taking, open to criticism, forefront of technology, flexibility, challenging old ideas, searching for new markets, pioneering	Discrim/converg validity
Tohidi, Seyedaliakbar & Mandegari, 2012	Propose and validate a measurement scale to capture learning capabilities	Organizational Learning Capabilities	Managerial commitment/empowerment, experimentation, risk taking, interaction with the external environment and openness and knowledge transfer and integration	Reliabilities, as measured by Cronbach alpha, ranged from 0.73 to 0.89; Discrim/converg validity

Note. *Denotes a more comprehensive alignment to previous research models of determinants of innovation

Validity. The first criterion to consider is the instrument's validity, and in this case the extent to which the instrument captures the key domains hypothesized to determine or constitute a culture of innovation. Even though multiple authors conducted inter-item correlation analyses to evaluate convergent and discriminant validity internal to the instruments, of the ten instruments identified in the previous research and presented in Table 4 only five of these instruments, also denoted by an asterisk in the table, incorporated the factors that were articulated by the more complex models of determinants of innovation (Crossan & Apaydin, 2010; Hurley & Hult, 1998; Sun, Wong, Zhao & Yam, 2012). These five instruments included the following: the Value Innovation Potential Assessment Tool (VIPAT) (Aiman-Smith et al., 2005); Dobni's instrument of innovation culture (Dobni, 2008); Hoe's (2011) innovation climate instrument; Humphrey's et al. (2005) adaptation of Francis' (2000) Centrim G2 Innovation Audit; and the Innovation Quotient Survey (Rao & Weintraub, 2013).

Score Reliability. The second selection criterion of score reliability and aspects of internal constancy showed revealed that because Hoe (2011) and Humphreys et al. (2005) did not present a description of their efforts to affirm the validity or reliability of their instruments, as well as the subsequent results from these analyses, only three final instruments remain that may serve as viable candidates for further research where instrumentation of culture of innovation is investigated. These include the Value Innovation Potential Assessment Tool (VIPAT) (Aiman-Smith et al., 2005), Dobni's instrument of innovation culture (Dobni, 2008), and the Innovation Quotient Survey (Rao & Weintraub, 2013). Researchers interested in questions about the topic of culture of innovation may seek to review and employ one of these three instruments.

Parsimony. Rao and Weintraub's (2013) Innovation Quotient Survey demonstrates an example of a more parsimonious assembly of items along the construct of culture of innovation, satisfying the third criterion of instrumentation evaluation. The previous research has, in various forms, affirmed that each of the key factors described among these three instruments indeed predict or contribute to a culture of innovation, leading to greater innovation performance or other critical organizational outcomes (e.g., Bakovic, Lazibat, & Sutic, 2013; Brettel & Cleven, 2011; Chen, 2011; Herrmann, Gassmann, & Eisert, 2007; McAdam, Keogh, Reid, & Mitchell, 2007; O'Cass & Ngo, 2007; O'Connor, Roos, & Vickers-Willis, 2007; Saunila & Ukko, 2013). Table 5 presents a matrix that identifies similarities and differences among the factors within the three instruments. As Rao and Weintraub's (2013) Innovation Quotient survey contains the greatest number (count) of factors (18 total factors of three indicators each), each of the factors are listed, alongside the similar factors that appear in the Value Innovation Potential Assessment Tool (VIPAT) (Aiman-Smith et al., 2005) and Dobni's instrument of innovation culture (Dobni, 2008). As is illustrated in Table 5, Rao and Weintraub's (2013) instrument identifies the sum of ideas presented by both of the other two instruments, but with 54 items more parsimoniously captures what each of the key factors identified in Dobni's (2008) instrument assesses with 70 items. While the instrument developed by Aiman-Smith et al. (2005) contains only 33 items, which may be more user-friendly and less likely to contribute to survey fatigue, the instrument does not address the key construct of resources while more rigorously addressing the external domains of customer orientation (five items), business intelligence (three items), and business planning (four items), which Rao and Weintraub (2013) capture with a total of nine items.

Table 5

Similarities and Differences Among Instruments

Domains	Rao and Weintraub, 2013 Factors (indicators/1 item for each indicator)	Similar Factor in Aiman-Smith et al., 2005	Similar factor in Dobni, 2008
Resources	People (champions, experts, talent) Systems (selection, communication, ecosystem) Projects (time, money, space)		Value orientation (7)
Processes	Ideate (generate, filter, prioritize) Shape (prototype, fail smart, iterate) Capture (flexibility, launch, scale)	Learning (3)	Creativity and empowerment (6); Implementation context (17)
Success	External (customers, competitors, financial) Enterprise (purpose, discipline, capabilities) Individual (satisfaction, growth, reward)	Customer orientation (5); Business intelligence (3); Business planning (4); Meaningful work (3)	Innovation propensity (9); Market orientation (8)
Values	Entrepreneurial (ambiguity tolerance, action oriented, hunger) Creativity (imagination, autonomy, playful) Learning (curiosity, experiment, failure okay)	Risk-taking culture (5)	Organizational constituency (13)
Behaviors	Energize (inspire, challenge, model) Engage (initiative, support, coach) Enable (influence, adapt, grit)	Empowerment (3)	Organizational learning (10); More implementation context
Climate	Safety (trust, integrity, openness) Simplicity (no bureaucracy, accountability, decision making) Collaboration (community, diversity, teamwork)	Open communication (3); Agile decision-making (4)	More organizational constituency
Item total	*54 items*	*33 items*	*70 items*

Interpretation and user-friendliness. The extent to which the participants are able to interpret the instrument items can affect the validity of the results (Switzer et al., 1999). In investigations that involve comparisons among groups at different levels in an organization, it is important the interpretation of the instrument carry the same meaning for all groups and is in essence what this present study seeks to understand. Therefore, while each of the instruments contains the occasional word choice that would be difficult to interpret by both leaders/managers and front line employees, there are two instruments in particular (Aiman-Smith et al., 2005 and Dobni, 2008) that contained multiple items that would be difficult to interpret by front line employees, which would have to be adapted and changed significantly in order to be implemented on a large scale. For example, Aiman-Smith's (2005) instrument contains the following items, which would be difficult for front line employees to interpret and assess:

> "12. We are encouraged to think in terms of total customer solutions;
>
> 27. In the organization, we use scenario planning as part of our business plan creation;
>
> 28. In the organization, we use simulations as part of our business plan creation;
>
> 30. The organization takes a broad value chain perspective when examining new opportunities;
>
> 33. One of our innovation strategy development processes is identifying similar ways our customers use our products." (p. 40)

Dobni's (2008) instrument also contains phrases that would require significant alteration:

> "1. Over the next year we could change up to 50 percent of the processes that support our current business model;
>
> 2. We are prepared to commit new resources or redirect current resources to support ventures that result from our innovation strategy;
>
> 4. We have already put measurable resources (human and financial) behind our innovation agenda;
>
> 5. We are prepared to discontinue products and services that only marginally serve our purposes in efforts to build capacity for new products and services;
>
> 8. Ideas flow smoothly through to commercialization;
>
> 10. There is an understanding that mistakes will occur or an opportunity will not transpire as expected;
>
> 11. We can quickly facilitate changes to our products and services based on client or competitive reaction;

14. We can modify systems and processes fairly quickly and as necessary to support competitive thrusts;

17. Performance management information is used for improvement rather than for control." (p. 546)

As the items on the Rao and Weintraub (2013) Innovation Quotient instrument are still somewhat abstract in some cases but contain shorter phrases with simpler expressions, this instrument best meets the criterion of interpretation and user-friendliness.

The Innovation Quotient Survey to Measure Culture of Innovation

The Innovation Quotient Survey, developed by Rao and Weintraub (2013), assesses an individual's perceptions of the culture of innovation in the organization where the participant is employed. The aggregate results of the instrument measure the performance of an organization along each of the six building blocks that contribute to a culture of innovation – values, behaviors, climate, resources, processes, and success – each of which is represented by three first order factors. While the authors do not report in detail the efforts undertaken to validate the instrument or assess its reliability over time or for multiple differing groups, other research has demonstrated that the constructs on which the building blocks were determined indeed contribute to and predict opportunities for innovativeness or innovation capability in organizations (e.g., Bakovic, Lazibat, & Sutic, 2013; Brettel & Cleven, 2011; Chen, 2011; Herrmann, Gassmann, &Eisert, 2007; McAdam, Keogh, Reid, & Mitchell, 2007; O'Cass & Ngo, 2007; O'Connor, Roos, & Vickers-Willis, 2007; Saunila & Ukko, 2013).

Values. Rao and Weintraub's building block of *values* is composed of three factors – entrepreneurial, creativity, and learning. Organizations that value innovation, have an entrepreneurial spirit toward exploring opportunities to create new things, tolerate ambiguity, encourage diverse perspectives, provide the freedom to pursue new opportunities, constantly experiment, and are not afraid to take risks predict key behaviors that increase the likelihood of innovation (Rao & Weintraub, 2013). Sarros, Cooper, and Santora (2008) also illustrated that the ability for an organization to articulate its vision, a key factor of innovation culture, significantly predicted its climate for organizational innovation. Clarity of vision toward attaining specific innovative objectives (Anderson & West, 1998; Slater, Mohr, and Sengupta, 2014) and shared vision as a means to avoiding specific innovation fads (Hoe, 2011) have been shown to serve as key factors that contribute to innovation performance. Chen (2011) demonstrated the role of vision as a key factor of service innovation culture to predict innovation in organizations, mediated by charged behavior – which also included factors of challenging ideas and taking risks. Studies have also corroborated the supposition that an organization's willingness to take risks predict the presence of radical product innovations (Bakovic, Lazibat, & Sutic, 2013; Brettel & Cleven, 2011; Herrmann, Gassmann, & Eisert, 2007). O'Cass and Ngo (2007) also found that innovation culture, constituted by high factor loadings in receptiveness to new ways of doing things, encouraging creativity, and communicating how work contributes to the big picture, predicted brand performance and market orientation.

Behaviors. A leader's ability to energize, engage, and enable are the three key leadership behaviors (and factors) that Rao and Weintraub (2013) demonstrated to be necessary for leading innovation in organizations. Leaders who provide additional support for innovation through personally modeling and taking initiative, coaching, feedback, influence strategies, challenge, and other methods impact innovation (Chen, 2011; Saunila & Ukko, 2013; O'Connor, Roos, & Vickers-Willis, 2007; Scott & Bruce, 1994; Slater, Mohr, and Sengupta, 2014; Sharifirad & Ataei, 2012; Xerri & Brunetto, 2011). Steiber and Alange's (2013) case study of Google identified the importance of leaders as facilitators of the innovation process. Velasco, Zamanillo, and Del Valle (2013)'s cross-company case study illustrated the importance of leadership in mobilizing an organization toward innovation. Other investigations that sought to measure culture of innovation identified leadership, management support, or empowerment as a key factor that contributes to the success of innovation efforts (Aiman-Smith et al., 2005; Anderson & West, 1998; Enzing et al., 2011; Hoe, 2011; Tohidi, Seyedaliakbar, & Mandegari, 2012).

Climate. The three factors of climate – collaboration, safety, and simplicity – assess the extent to which an organization can ensure community, diversity, teamwork, trust, integrity, openness, a lack of bureaucracy, accountability, and decision-making as key drivers of innovation (Rao & Weintraub, 2013). Enzing et al., (2011) identified that company culture, as characterized by flexibility, openness, cooperation, human focus, etc., predict short- and longer-term market success of products in the food and beverage industry. Other studies reinforced this effect in other industries (Anderson & West, 1998; Hoe, 2011; McAdam, Keogh, Reid, & Mitchell, 2007; Panuwatwanich, Stewart, & Mohamed, 2009; Saunila & Ukko, 2013; Shahin & Zeinali, 2010; Velasco, Zamanillo, & Del Valle, 2013; Xerri & Brunetto, 2011). Of these constructs, the prevalence of agility and flexibility in decision-making, along with localized autonomy in particular, has shown to be highly predictive of opportunities for innovation across industries (Aiman-Smith et al., 2005; Humphreys et al., 2005; McAdam, Keogh, Reid, & Mitchell, 2007; O'Cass & Ngo, 2007; Panuwatwanich, Stewart, & Mohamed, 2009; Shahin & Zeinali, 2010).

Resources. The building block that Rao and Weintraub (2013) propose that appears to be the least frequently studied in the literature is that of resources. Rao and Weintraub (2013) propose that without resources, which include people, systems, and projects, innovation is less likely to occur, as often human resources in particular are those most likely to produce innovation within an organization. Previous studies affirm the importance of human resources as key to delivering innovative results (Saunila & Ukko, 2013; Scott & Bruce, 1994). O'Connor, Roos, & Vickers-Willis's (2007) case study particularly investigated the role of resource assets (human, relational, physical, and monetary) and found that that sum of these assets produce the capacity for an organization to innovate within its industry. Saunila and Ukko's (2013) investigation of the factors that contribute to innovation capability found that "the expertise of the employees play an important role for the development of the innovation capability of the organization" (p. 1001), a finding corroborated by others who have evaluated the role of knowledge and expertise of individuals throughout an entire organization (Scott & Bruce, 1994; Enzing et al., 2011; Hoe, 2011; Velasco, Zamanillo, & Del Valle, 2013). Some studies have focused on use the monetary and technological resources, although exclusively focused on research and development expenditures and technologies, and their influence on innovation outcomes (e.g. Kaufman, Tsangar, & Vrontis, 2012; O'Connor, 2008; Saunila & Ukko, 2013; Susanj, 2000).

Processes. Rao and Weintraub's (2013) building block of processes supports what a majority of the research in the field of innovation management prescribes – that systematic processes to ideate (generate ideas, filter and prioritize ideas), shape (prototype, iterate with quick feedback loops, etc.) and capture (processes tailored to context and easy to move quickly to scale or to market) produce innovation in organizations. As much of the practitioner literature has focused on how to deploy such processes within organizations (e.g. Christensen, Grossman, & Hwang, 2009; Dyer, Gregersen, & Christensen, 2011; O'Sullivan & Dooley, 2009; Rao, 2014; Zairi & Al-Mashari, 2005), much research has been conducted regarding the effectiveness of such models. Slater, Mohr, and Sengupta's (2014) extensive review of the literature identified that one of the key contributors to radical product innovation capability in an organization is the innovation process involving discovery, incubation, and acceleration. While the theory that resulted from this literature review has not yet been tested, other empirical works identified that such processes indeed contribute to opportunities for innovation (e.g. Enzing et al., 2011; McAdam, Keogh, Reid, & Mitchell, 2007, O'Connor, Roos, & Vickers-Willis, 2007; Saunila & Ukko, 2013; Shahin & Zeinali, 2010; Sharifirad & Ataei, 2012; Steiber & Alange, 2013). Researchers who have developed instruments to measure culture of innovation, as previously described, have also identified innovation management processes as critical enough a factor to incorporate into their respective measurement models (e.g. Hoe, 2011; Humphreys et al., 2005; Susanj, 2000; Tohidi, Seyedaliakbar, & Mandegari, 2012).

Success. Operating from the assumption that innovation activities must be perceived as successful to encourage employees to engage in continued use, organizations should assess the extent to which they experience success with their innovation efforts, which can be reflected in the three factors of external, enterprise, and individual success (Rao & Weintraub, 2013). Organizations that track the external market orientation and/or customer focus of their products may be more likely to develop products that are innovative, and can therefore be financially successful as well (Brettel & Cleven, 2011; Dobni, 2008; Herrmann, Gassmann, & Eisert, 2007; Kuščer, 2013; Lee et al., 2014; Remneland-Wikhamn & Wikhamn, 2011; Sarros, Cooper, & Santora, 2008).

Culture of Innovation Across Groups

The measurement and reporting of results of the construct of culture of innovation can be useful for organizational leaders to ascertain the extent to which its employees perceive the presence of each of these key determinants of innovation within the organization (Aiman-Smith et al., 2005; Dobni, 2008; Rao & Weintraub, 2013; Remneland-Wikhamn & Wikhamn, 2011; Susanj, 2000). The Spanish Society for Quality (Asociacion Espaniola para la Calidad, or AEC; 2015), utilizing Rao and Weintraub's (2013) Innovation Quotient instrument, engages organizations from Spain and beyond to participate in a key initiative aimed at the organizational assessment and/or measurement of their culture innovation culture. The AEC presents an organization's results benchmarked from within the organization across hierarchical levels and functional areas, and outside the organization across sectors and countries. While most of the remaining instruments have not been validated or applied across multiple industries in a similar manner, a great number of investigations and theories developed in healthcare, for example, have centered around the topics of the actual nature of organizational culture and its subcultures (e.g. Bellot, 2011), creativity (e.g., Lazarus & Fell, 2011), innovation implementation (e.g. Birken, Lee, & Weiner, 2012; Birken et al., 2013), and innovation and change (e.g., Dopson, Fitzgerald, & Ferile, 2008). Previous findings have corroborated that differences in the factors of a culture of innovation, as well as the items used to measure those factors, may exist among countries (national cultures), industries, employee levels, functional roles, and even the languages of instrument administration (e.g. Aiman-Smith et al., 2005; Çakar & Ertürk, 2010; Kaufman, Tsangar, & Vrontis, 2012; Kuščer , 2013; Hoffman, 1999; Martens, 2013; McAdam, Keogh, Reid, & Mitchell, 2007; National Audit Office, 2009; O'Connor, Roos, & Vickers-Willis, 2007; Sun, Wong, Zhao, & Yam, 2012; Susanj, 2000; Unger, Rank, & Gemünden, 2014; Wilhelm & Wilhelm, 2012).

Summary

This chapter discussed key topics relevant to the study of the measurement of culture of innovation. First, innovation itself was defined, and three models identified from the literature were presented which summarized the key determinants of innovation in organizations. An analysis of organizational culture was stated as it relates to the culture ‘for innovation’ as is recommended by Schneider, Ehrhart, and Macey (2013). A summary of the key instruments that measure culture of innovation and related constructs was shared, along with a brief analysis of those instruments deemed most feasible for use in applied organizational settings. Next, the brief amount of literature of the measurement of culture of innovation among groups was described. Chapter 3 presents the key methods utilized in the design of this present study, as well as further detail regarding the selected instrumentation.

CHAPTER 3

METHODOLOGY

The following section presents the research methods utilized in this present study, including the research design, sampling methods, instrumentation, data collection, and data analysis procedures. The key objective of this current study was to assess the validity and reliability of the Innovation Quotient instrument, as proposed by Rao and Weintraub (2013). The three research questions for this study were as follows:

1. To what extent do each of the six measurement models within the Innovation Quotient instrument demonstrate evidence for convergent and discriminant validity? To what extent is the hypothesized factor structure of each of the six measurement models of the Innovation Quotient instrument consistent with the administration of this present study (i.e. demonstrate appropriate model fit through confirmatory factor analyses)?
2. To what extent are each of the six measurement models and their hypothesized factors within the Innovation Quotient instrument reliable for multiple organizational groups, including countries, industries, employee levels, functional roles, and the languages of instrument administration?
3. In the absence of evidence for convergent or discriminant validity or reliability, what is a plausible alternative factor structure of culture of innovation, as determined by an exploratory factor analysis (EFA)? To what extent does the new factor structure demonstrate evidence for convergent and discriminant validity, as well as reliability for multiple organizational groups?

Research Design

To address the research questions stated above this study employed a quantitative research design, stemming from a post-positivist perspective of inquiry (Creswell, 2013).

Because the aim of the investigation was to evaluate the validity and reliability of an existing instrument/survey, the use of independent and dependent variables were not considered. However, methods specific to the assessment of content and construct validity, convergent validity, and discriminant validity were used to investigate the accuracy of the Innovation Quotient survey (Rao & Weintraub, 2013) as a measure of culture of innovation, as well as its score reliability (internal consistency) and appropriateness for use to compare performance across administration language, country, industry, functional role, and employee level.

Threats to internal validity. This present study itself comprised specific procedures to identify evidence for the validity of the Innovation Quotient (2013) instrument. To assess content validity – or “how thoroughly the instrument samples the relevant target domain” (Grimm & Yarnold, 2000, p. 104) – two methods were utilized, including a rigorous review of the literature to select instrumentation, and the use of the appropriate statistical methods to investigate its psychometric properties.

First, the process used to conduct a rigorous review of the literature to select appropriate instrumentation was presented in Chapter 2. This review of the literature produced a list of ten instruments that measured culture of innovation or a related construct (Table 4). Each of these ten instruments was subjected to a systematic review against four criteria: (1) the extent to which the original authors provided evidence for the validity of the instrument; (2) the information the original authors provided regarding the reliability of the instrument; (3) the extent to which the instrument parsimoniously taps each relevant domain with an elegant number of items; and (4) the level of appropriateness for use with administration language, country, industry, functional role, and employee level. Please refer to Chapter 2 for the presentation of the review of these instruments against these four criteria.

The second approach to ensure the content and construct validity of the instrument, as well as to verify convergent and discriminant validity, was the completion of the appropriate statistical methods to illustrate the factor structure of the instrument (Cronbach & Meehl, 1955; Goldberg & Velicer, 2006; Messick, 1989). Inter-item correlation matrices were examined, and items within factors were expected to produce higher correlations (illustrating evidence for convergent validity), while items from different factors were expected to produce lower correlations (illustrating evidence for discriminant validity) (Lissitz & Samuelsen, 2007). Results from multiple confirmatory factor analyses (CFA) were also assessed to ensure appropriate model fit for the six building blocks and their full measurement models (Hair, Black, Babin, & Anderson, 2010).

Threats to external validity. As this present study itself comprised specific procedures to identify evidence for the external validity of the Innovation Quotient (2013) instrument, steps were taken to ensure the generalizability of the results. First, in order to ensure that the instrument could be applied in settings beyond its current proposed use (i.e. evaluate population validity), this investigation estimated internal consistency (score reliability) for each of the demographic variables that are typically used in practice for comparative purposes by organizations and in research. Evaluation of score reliability for each of the groups in which comparisons are expected helps demonstrate the instrument may be applied to groups similar to those under investigation in this study, such as administration languages, countries, industries, functional roles, and employee levels (Aiman-Smith et al., 2005; Çakar & Ertürk, 2010; Kaufman, Tsangar, & Vrontis, 2012; Kuščer , 2013; Hoffman, 1999; Martens, 2013; McAdam, Keogh, Reid, & Mitchell, 2007; National Audit Office, 2009; O'Connor, Roos, & Vickers-Willis, 2007; Sun, Wong, Zhao, & Yam, 2012; Susanj, 2000; Unger, Rank, & Gemünden, 2014;

Wilhelm & Wilhelm, 2012). Next, in order to ensure that the instrument could be applied in settings beyond its current proposed use (i.e. evaluate population validity), this investigation used a cross-validation, resampling methodology (Byrne, Shavelson, & Múthen, 1989; Obsorne, 2008; Osborne. & Fitzpatrick, 2012). By conducting an initial analysis of the hypothesized models, then cross-validating in an independent sample to confirm those results, the findings may lead to a better understanding of how the instrument could be applied in other settings.

Sample

A sufficiently large sample size was needed for the number of variables ($p = 54$) for this present study. Assuming the use of the traditional recommendation of $N > 10p$, the desired sample size would be approximately $N = 540$ for each analysis. Kline (2011) also indicated a sample size of 540, or at least $N > 10p$, would be necessary to have produce confidence in the variable scores and factors.

In order to obtain a dataset that would yield the desired number of participants across each of the groups previously described, a large dataset was required. The lead author of the Innovation Quotient instrument was contacted to seek permission to use, as well as obtain additional evidence for its validity and reliability, in current administrations. This investigator identified at this time that the instrument's lead author had already executed a detailed, multi-faceted administration of the instrument to just under 20,000 participants from 138 companies across 24 industries in 13 countries. Therefore, this existing, secondary dataset was obtained for use in this present study.

Since the publication of their original publication in 2013, Rao and Weintraub have continued to administer the instrument to dozens of other organizations across the globe. In 2014, the Spanish Society for Quality (2015) selected the instrument (renamed the *Index of*

Culture of Innovation in Spain) over other noteworthy instruments to be made available to their list of over 1,000 member organizations worldwide, which engaged another 66 firms to participate. The remaining firms to whom the instrument has been administered were obtained through convenience based on consulting relationships with the instrument author. Of all the firms that participated, invitations were sent to each and every employee in the respective organizations, but participation rates were not provided or reported by each of the firms.

The final dataset used for this present study consisted of a total sample size of N = 19,781 participants, where the total dataset was randomly split in two (n_1 = 9,860, n_2 = 9,921). Across the entire sample, 27% of the participants were male, 18% were female, and 55% did not report their gender. The age ranges of the participants were as follows: younger than 26 years old (4%), from 26 to 35 years old (28%), from 36 to 45 years old (34%), older than 45 years old (26%), and those that did not report their age (8%). The education level of the participants included professional studies/vocational training (17%), bachelor or grade school (39%), postgraduate/ master's degree (21%), doctorate (2%), and those that did not report their educational attainment (10%). Company seniority was also evenly dispersed as follows: less than one year (7%), from one to three years (15%), from four to eight years (23%), from nine to 15 years (20%), more than 15 years (27%), and those that did not report their company seniority (8%). Total representation of participants for the entire dataset is presented in Tables 6 through 10.

Table 6

Participating Countries

Country	n_1	n_2	Country	n_1	n_2
Spain	5,237	5,192	Mexico	70	69
Chile	2,346	2,410	Germany	69	55
Colombia	797	837	Scotland	21	31
United States	447	430	United Kingdom	25	26
Panamá	385	407	Saudi Arabia	12	18
El Salvador	356	349	Belgium	9	4
Portugal	86	93			

Table 7

Participating Industries

Industry	n_1	n_2	Industry	n_1	n_2
Financial and Insurance	2,404	2,442	IT – Software and Electronics	238	244
Telecommunications	1,053	1,128	Retail	239	236
Professional Services	841	911	Education	221	213
Industrial Machinery and Equipment	802	836	Public and State Administration	203	210
Health Care and Social Services	665	619	Transport and logistics	206	179
Aerospace and Defense	647	567	Pharmaceuticals	161	171
Food & Beverages	435	420	Biotechnology and Research	42	30
Construction and Building Materials	396	389	Media and Publication	40	28
Industrial Metals and Mining	384	393	Agriculture and Fisheries	20	14
Automobile and Parts	315	308	NGO’s	14	8
Oil & Chemicals	283	304	Distributors	7	5
Energy - Electricity and Gas	241	263	Hotels, Restaurants, Lodging	3	3

Table 8

Participating Functional Roles

Role	n_1	n_2	Role	n_1	n_2
Operations	4,164	4,127	Others	956	928
Commercial	1,942	1,986	R&D / Innovation	920	932
Support	1,878	1,948			

Table 9

Participating Organizational Levels

Area	n_1	n_2
Staff, without direct reports	5,991	5,953
Manager, with direct reports	2,793	2,833
Director or executive	1,076	1,135

Table 10

Participating Languages

Language	n_1	n_2
Spanish	9,027	9,105
English	833	816

Instrumentation

Rao and Weintraub (2013) developed their Innovation Quotient instrument based on studies conducted by Tellis, Prabhu and Chandy (2009), who investigated innovation among 759 companies across 17 markets, the work of Christensen, Anthony, and Roth (2004), Schein (1999), O'Reilly (1989), and Denison (1996). While specific results of tests for reliability and validity were not reported, the authors stated that the elements and factors were "field-tested for over two years for statistical validity and executive acceptance as both a diagnostic and actionable tool. Data [were] gathered from 1,026 executives and managers in 15 companies headquartered in the United States, Europe, Latin America, and Asia" (Rao & Weintraub, 2013,

p. 31). As no additional evidence for the validity and/or reliability of the instrument was originally presented, the need to apply approaches to examine the validity and reliability of the instrument, as previously described, was evident. While other authors have cited this new instrument and the theoretical framework from which it was derived (e.g. Anthony, 2014; Silva, 2014), no additional use of the instrument in subsequent investigations within the last two years is evident in the published literature.

Rao and Weintraub's Innovation Quotient (2013) instrument consisted of six building blocks (values, behaviors, climate, resources, processes, and success), each of which were represented by three first order factors. Each first order factor was indicated by three elements, or indicators, represented by one survey question/item. There were a total of $p = 54$ indictors on the instrument, which were assessed using an ordinal, Likert-style scale where 1 = not at all, 2 = to a small extent, 3 = to a moderate extent, 4 = to a great extent, and 5 = to a very great extent. In addition to the instrument, an additional 15 to 18 categorical, demographic questions were solicited, but only the grouping variables of countries, industries, employee levels, functional roles, and languages of instrument administration were utilized in this present study. While it is typically not common practice among the academic community to pool data administered in more than one language, this present study maintained the pooled dataset administered in two languages. Practitioners who seek to compare their performance across multiple countries, industries, organizational levels, functional roles, etc. often analyze results regardless of the language of administration, and it has been the practice of the instrument's author to facilitate such analyses. Therefore it was necessary to consider the dataset in aggregate. Future research may wish to assess the extent to which the measurement models are invariant across such groups or administrations.

Data Analysis and Procedures

As this investigation employed the use of a secondary dataset, no additional procedures were required to manage missing data (Kline, 2011). The dataset (*N* = 19,781) obtained from the instrument author was used to address the research questions which took place in two stages.

For the first stage of the analysis, and consistent with best practice in conducting research to evaluate model fit and estimate other psychometric properties of instruments (Osborne, 2008), a cross-validation method was used to split the dataset in half, randomly using the Statistical Package for the Social Sciences (SPSS version 22; IBM Corp., 2013). The first half of the dataset (n_1 = 9,860) was utilized to address each of the research questions for each of the six hypothesized measurement models within the Innovation Quotient (2013) instrument – values, behaviors, climate, resources, processes, and success. Each of the six hypothesized measurement models is presented in Figure 5. These measurement models each include three first order factors, each of which is measured by three indicators, where each of the first order factors are allowed to correlate with each other.

For each of the six models, data screening procedures were utilized to ensure the integrity, normality, and reliability of the first dataset. Univariate statistics of mean, standard deviation, skewness, and kurtosis, as well as Pearson inter-item correlations, were computed and examined for each of the 54 items using the Statistical Package for the Social Sciences (SPSS version 22; IBM Corp., 2013). Individual items that exceeded the recommended standardized values for skewness or kurtosis (+/- 3.0) were considered non-normal (Kline, 2011), but were considered in the analysis regardless of skewness or kurtosis, as Field (2009) indicated that extremely large sample sizes are likely to reduce standard errors, yielding standard *z* scores for skewness and kurtosis that are more likely to yield extreme values. Each of the item distributions was also visually assessed to ensure that each of the categories within the ordinal scales was populated, and that the q-q plots of the distribution did not deviate from the expected distribution.

Pearson item correlations for all items within each of the measurement models were obtained using the Statistical Package for the Social Sciences (SPSS version 22; IBM Corp., 2013) to assess item relatedness within each model (Table 13), where correlations greater than 0.30 demonstrated appropriate relationship (Hair, Black, Babin, & Anderson, 2010) . Also, because the assumption of multivariate normality is required within the general linear model, tests for multivariate normality within each of the six measurement models were conducted in LISREL 9.2 (SSI, 2015) based upon Mardia's (1985; SSI, 2015) recommendations. Models that failed to pass the test were managed by extracting and applying the asymptotic covariance matrix for issues with multivariate non-normality (Curran, West, & Finch, 1996; Kline, 2011) during model fit analyses.

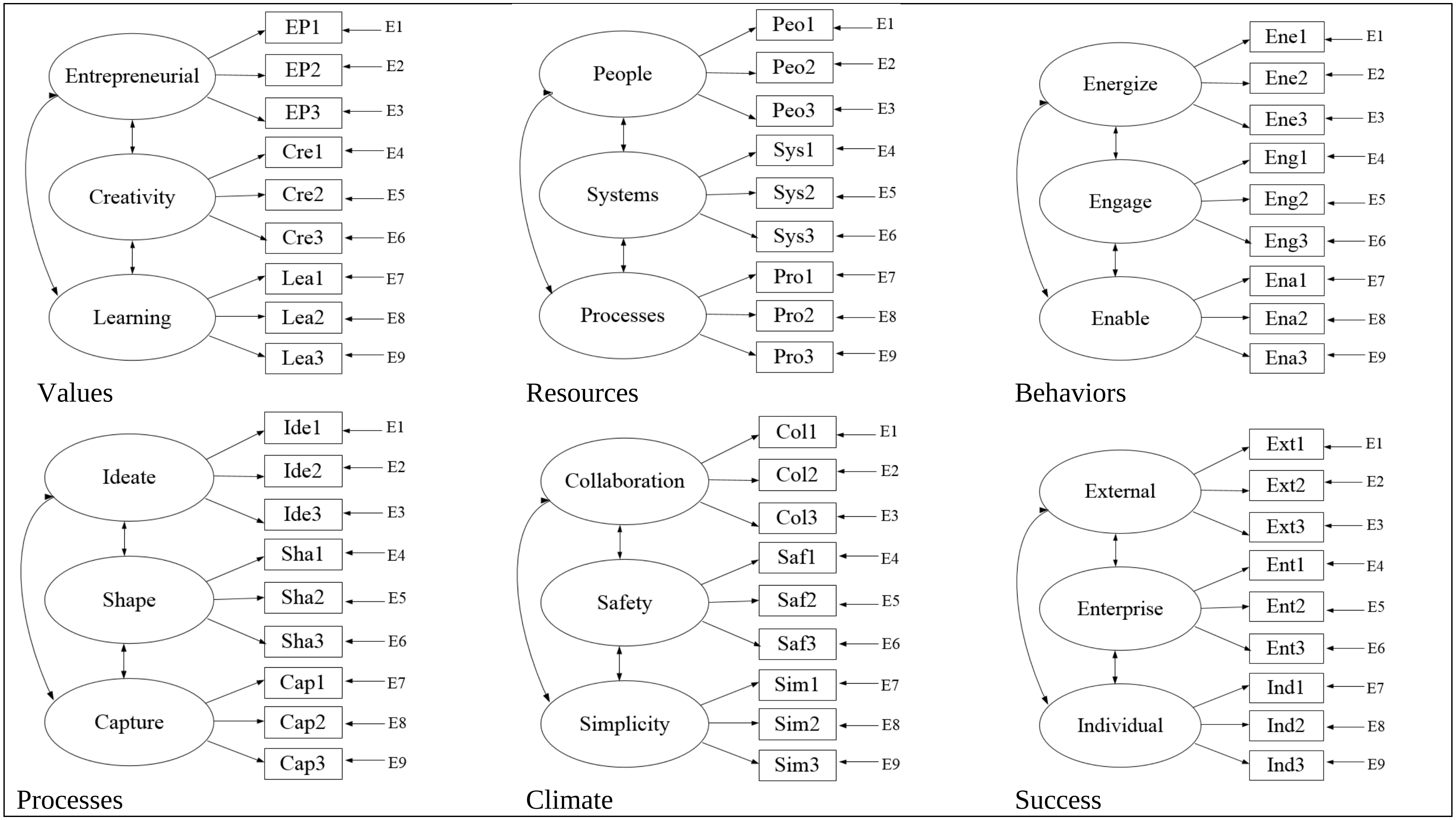

Figure 5. Hypothesized factor structure for each of the six building blocks.

Confirmatory factor analyses (CFAs) were performed in LISREL 9.2 (Kline, 2011; SSI, 2015) for each of the six models to determine model fit of the factor structures proposed by Rao and Weintraub (2013). Hair, Black, Babin, and Anderson (2010) asserted that the use of a CFA approach is appropriate if the investigator seeks to affirm a factor pattern that has previously been theorized. As Rao and Weintraub (2013) have provided the initial evidence for the validity of the factor structures of the Innovation Quotient instrument, and as additional information has been sought from these researchers via electronic mail to identify the results underlying their findings, a CFA was used to assess model fit for this present study.

As each of the items in every model was ordinal in scale, a polychoric matrix was used (Tello, Moscoso, García, & Chaves, 2006; Tello, Moscoso, García, & Abad, 2010). The unweighted least squares (ULS) estimation method (Kline, 2011) was employed for each CFA in which the presence of multivariate non-normality for each of the six measurement models was identified and where a fewer number of indicators per factor was present (Forero, Maydeu-Olivares, & Gallardo-Pujol, 2009). Multiple indices were utilized to interpret adequacy of model fit in addition to the chi-square tests (χ^2) – performance on values approximately greater than 0.90 on the comparative fit index (CFI), greater than 0.95 the adjusted goodness of fit index (AGFI), and lower than 0.10 on the standardized root mean square residual (SRMR) (Hair, Black, Babin, & Anderson, 2010; Brown, 2006). While it has been stated that current research advises against drawing conclusions based on strict RMSEA cutoffs, results that sit within the confidence interval at 1.0 or less were interpreted as having a desirable fit (Hair, Black, Babin, & Anderson, 2010).

To specify each of the models, the first indicator for each first order factor was set to one for the first test of model fit. In cases where the model with only first order factors failed to produce appropriate model fit or too much error, additional considerations were made, including the decision to specify a higher order factor for that model – based on the theory that the factors of each measurement model relate to the higher order construct (Rao & Weintraub, 2013) – or the option to collapse factors to produce a two-factor solution if multicollinearity was present (Kline, 2011). Also, in cases where common method variance (CMV) exceeded 50% of the total variance explained by all of the indicators within a model, the inclusion of a common, social desirability latent factor was considered to establish a better fit (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003). If model fit still could not be produced, evaluation of factor loading estimates and modification indices were used to correlate errors, combine related first order factors, or make other appropriate revisions. Finally, while multiple processes were used to identify the model with best fit, it was noted that "specification searches based on purely empirical grounds are discouraged because they are inconsistent with the theoretical basis of CFA" (Hair, Black, Babin, & Anderson, 2010), so the simplest model demonstrating acceptable goodness of fit was selected.

Results from each of the six CFAs were used to either corroborate the hypothesized models or to propose the models demonstrating the best solutions and model fits. Using the proposed models, assessments of the average variance extracted (AVE) and composite reliability (CR) were conducted to provide additional evidence for convergent validity for each construct, and the AVE and the squared interconstruct correlations (SIC) were used to compare to AVE to assess divergent validity. The AVE is the sum of the squared standardized factor loadings, or item reliability, divided by the number of items, and it was expected that each exceeded 0.50 (Fornell & Larcker, 1981), where SIC values were expected to fall below the AVE values of the correlated constructs. The CR is the sum of the factor loadings squared, divided by that squared sum plus the squared sum of the error variance terms, and was expected to exceed 0.70 (Hair, Black, Babin, & Anderson, 2010) for each construct.

To evaluate score reliability (Thompson, 2003), initial estimates of item relatedness, as measured by the proxy of Cronbach's alpha coefficients, were computed for the overall measurement models, for each factor, and for each of the group samples for which analysis is typically reported in organizations – by countries, industries, employee levels, functional roles, and languages of instrument administration. Alpha coefficients were loosely and contextually interpreted, as it is known that alpha values increase as the number of items increases (Field, 2009). However, these results were used to interpret opportunities for improvement by improving the reliability of the instrument for future use.

Assuming undesirable results were identified for any of the six measurement models for the research questions, such as lack of acceptable evidence for the convergent or discriminant validity, a new measurement model would need to be proposed, which would be completed in the second stage of the analysis. To address the third research question, an exploratory factor analysis (EFA) would be conducted in SPSS (SPSS version 22; IBM Corp., 2013) using the total item inventory supplied by the Innovation Quotient instrument to identify a plausible factor structure, which would then be corroborated through a content analysis of the items to ensure alignment with prior theory. The Minimum Average Partial and parallel analysis methods would be used to determine the number of factors to retain (Henson & Roberts, 2006; O'Connor, 2000; Velicer, 1976). As previous researchers have theorized that the factors between and across each of the models correlate with one another, the principal axis factoring method of extraction with a direct oblimin rotation strategy would be used to produce the factors and capture the relationships among the items and their respective factors (Costello & Osborne, 2011). At each iteration of the analysis, multiple criteria would be used to determine whether to remove or delete items based on the pattern matrix, such as items that did not load by at least 0.32 on any factor or items that cross-loaded on more than one factor with a value greater than 0.32 (Costello & Osborne, 2011). Items with communality coefficients (h^2) less than 0.40 (Costello & Osborne, 2011) would be considered in tandem with an examination of factor loadings and related item content, but evaluation of communalities will not be used in isolation to remove items.

Once a new measurement model is proposed, the second half of the dataset (n_2 = 9,921) would be used to cross-validate the findings with a new sample. This cross-validation through an independent sample ensures that recommended changes to the measurement model or factor structure are valid across new samples (Brown, 2006; Byrne, Shavelson, & Muthén, 1989; Osborne & Fitzpatrick, 2012). To replicate the results, the newly proposed measurement model(s) would be subject to each of previous CFA analyses described in Stage 1 using the second half of the dataset (n_2 = 9,921).

Summary

This chapter articulated the methods used to select participants for this study, select the instrument to use to measure the construct of culture of innovation, and to collect and analyze the data to address the key research questions. Chapter 4 reports the results and findings for the research questions.

CHAPTER 4

RESULTS

The key objective of this present study was to assess the validity and reliability of the Innovation Quotient instrument, as proposed by Rao and Weintraub (2013). The investigation employed data screening, inter-item correlations, factor analytic methods, and estimates of internal consistency to evaluate the validity and reliability for each of the six measurement models – values, behaviors, climate, resources, processes, and success. This chapter presents the findings from both Stage 1 and Stage 2.

Stage 1

Data screening procedures were conducted to ensure accuracy and reliability of the results. As the dataset was obtained through a secondary source, no missing data were identified. Item descriptives, including item means, standard deviations, skewness and kurtosis, were analyzed for each of the models' items using SPSS version 22 (IBM Corp., 2013) and are shown in Table 11. The standardized values for skewness and kurtosis were also evaluated, and a majority of the values demonstrated a negative skew, indicating a preference for general agreement higher than the mean for many of the scales. While the large sample size (n_1 = 9,860) drove standard errors low, leading to highly inflated *z*-scores for skewness, this was not determined as problematic (Field, 2009), even though it was noted that many of the individual items exceeded the recommended thresholds of the absolute value of ±3.0 (Kline, 2011). No items exceeded Kline's (2011) recommended threshold of ±20.0 for *z*-kurt. These findings provided preliminary evidence that each of the item distributions demonstrated levels of normality that could be handled in continued analysis using modern statistical estimates.

Table 11

Item Descriptives

Block	Factor	Item	Mean	SD	Skew	Kurt	z-skew	z-kurt
Values								
	Entrepreneurial	Ent1	3.86	0.977	-.760	.228	-30.801	4.631
		Ent2	3.44	0.976	-.409	-.254	-16.583	-5.157
		Ent3	3.23	1.011	-.223	-.490	-9.056	-9.932
	Creativity	Cre1	3.54	1.010	-.495	-.271	-20.082	-5.503
		Cre2	3.35	1.109	-.336	-.613	-13.632	-12.435
		Cre3	3.45	1.094	-.387	-.567	-15.707	-11.504
	Learning	Lea1	3.53	0.965	-.465	-.147	-18.845	-2.983
		Lea2	3.29	1.036	-.222	-.568	-8.989	-11.509
		Lea3	3.32	1.102	-.286	-.673	-11.594	-13.652
Resources								
	People	Peo1	3.34	1.142	-.367	-.630	-14.884	-12.782
		Peo2	2.90	1.117	.013	-.778	0.527	-15.772
		Peo3	3.77	0.914	-.693	.367	-28.103	7.439
	Systems	Sys1	3.02	1.056	-.142	-.535	-5.741	-10.857
		Syst2	3.09	1.021	-.156	-.527	-6.313	-10.682
		Sys3	3.27	1.000	-.256	-.386	-10.380	-7.820
	Projects	Pro1	2.83	1.107	.055	-.765	2.226	-15.513
		Pro2	2.98	1.092	-.055	-.639	-2.214	-12.946
		Pro3	2.94	1.119	-.046	-.770	-1.860	-15.621
Behaviors								
	Energize	Ene1	3.22	1.121	-.311	-.638	-12.603	-12.938
		Ene2	3.20	1.142	-.275	-.724	-11.133	-14.675
		Ene3	3.09	1.082	-.186	-.604	-7.544	-12.255
	Engage	Eng1	2.81	1.097	.081	-.716	3.284	-14.513
		Eng2	2.80	1.038	.149	-.575	6.047	-11.663
		Eng3	3.15	1.026	-.270	-.450	-10.950	-9.114
	Enable	Ena1	3.10	1.015	-.227	-.432	-9.205	-8.754
		Ena2	3.31	1.032	-.436	-.345	-17.670	-7.003
		Ena3	3.33	1.025	-.432	-.291	-17.534	-5.897
Processes								
	Ideate	Ide1	3.19	0.974	-.217	-.364	-8.800	-7.384
		Ide2	3.21	0.987	-.258	-.385	-10.461	-7.812
		Ide3	3.12	0.992	-.232	-.341	-9.398	-6.907
	Shape	Sha1	2.99	1.001	-.098	-.500	-3.972	-10.132
		Sha2	3.09	1.021	-.188	-.529	-7.632	-10.733
		Sha3	2.98	0.961	-.131	-.216	-5.328	-4.379

(table continues)

Table 11 *(continued)*

Block	Factor	Item	Mean	SD	Skew	Kurt	z-skew	z-kurt
	Capture	Cap1	2.81	1.109	.009	-.807	0.366	-16.352
		Cap2	3.01	1.059	-.068	-.626	-2.745	-12.687
		Cap3	2.99	1.032	-.100	-.576	-4.074	-11.676
Climate								
	Collaboration	Col1	2.94	1.054	-.024	-.627	-0.987	-12.715
		Col2	3.36	1.012	-.401	-.285	-16.273	-5.784
		Col3	3.45	1.011	-.471	-.244	-19.110	-4.955
	Safety	Saf1	3.45	0.985	-.521	-.093	-21.136	-1.888
		Saf2	3.53	0.959	-.521	.008	-21.134	0.162
		Saf3	3.46	1.034	-.523	-.267	-21.201	-5.407
	Simplicity	Sim1	2.70	1.101	.137	-.773	5.540	-15.679
		Sim2	3.07	1.061	-.202	-.643	-8.181	-13.043
		Sim3	3.02	1.006	-.095	-.554	-3.853	-11.223
Success								
	External	Ext1	3.34	1.024	-.275	-.374	-11.144	-7.589
		Ext2	3.28	1.039	-.220	-.386	-8.910	-7.829
		Ext3	3.26	1.001	-.210	-.245	-8.503	-4.967
	Enterprise	Ent1	3.44	1.055	-.426	-.349	-17.280	-7.079
		Ent2	3.24	1.039	-.258	-.423	-10.460	-8.579
		Ent3	3.49	0.989	-.440	-.098	-17.827	-1.982
	Individual	Ind1	3.09	1.098	-.155	-.662	-6.267	-13.416
		Ind2	3.12	1.025	-.215	-.518	-8.715	-10.500
		Ind3	2.81	1.106	.043	-.720	1.737	-14.604

As this present study employed multivariate methods to specify the factor structure of each measurement model and needed to identify the most appropriate estimation method for analysis, the assumption of multivariate normality was assessed for each of the six models using LISREL 9.2 (SSI, 2015) based upon Mardia's recommendations (Mardia, 1985; SSI, 2015). Extreme, statistically significant values for *z*-skew and *z*-kurt showed that none of the six measurement models met the criteria for multivariate normality (Table 12; Mardia, 1985), which Kline (2011) suggested may occur due to large sample size. Therefore, it was determined that an unweighted least squares method (ULS) of estimation would be applied, which has been shown to outperform the weighted least squares estimation in accuracy when there are few indicators per factor or high levels of skewness in the univariate distributions (Forero, Maydeu-Olivares, & Gallardo-Pujol, 2009).

Table 12

Tests for Multivariate Normality

Model	Relative Multivariate Kurt	*z*-skew	*z*-kurt
Values	1.250	51.858*	52.938*
Resources	1.235	52.659*	50.881*
Behaviors	1.359	49.682*	65.600*
Processes	1.320	38.090*	61.382*
Climate	1.277	53.671*	56.409*
Success	1.322	46.583*	61.637*

* $p < .001$

Pearson item correlations for all items within each of the measurement models were obtained to assess evidence for convergent and divergent validity within each model (Table 13). Every item-correlation produced a statistically significant result at the $p < .01$ level which were liberally interpreted as a function of the large sample size ($n = 9{,}860$). Across all of the models inter-item correlations within each building block/model ranged from $r = .315$, $p < .01$ to $r = .797$, $p < .01$, indicating moderate and sometimes high correlations both within and across related factors (Hair, Black, Babin, & Anderson, 2010). This provided initial evidence for convergent validity, but limited evidence for discriminant validity was determined, therefore suggesting the possible presence of higher order factors for all six models – values, resources, behaviors, processes, climate, and success, or evidence for common method variance (CMV) (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003). This finding also informed the consideration of a higher order factor in the subsequent specification of the measurement model for each of the six confirmatory factor analyses when initial model fit without the higher order factor could not be obtained. Using computations according to Fornell and Larcker (1981), final assessments of convergent and discriminant validity would also be investigated through an analysis of the AVE, SIC, and CR measures for each model.

Table 13

Inter-item correlations

Values									
	EP1	EP2	EP3	Cre1	Cre2	Cre3	Lea1	Lea2	Lea3
EP1	1.00								
EP2	.647	1.00							
EP3	.465	.522	1.00						
Cre1	.604	.565	.507	1.00					
Cre2	.455	.424	.360	.534	1.00				
Cre3	.463	.480	.429	.535	.458	1.00			
Lea1	.480	.471	.401	.558	.425	.602	1.00		
Lea2	.566	.549	.474	.614	.509	.530	.619	1.00	
Lea3	.417	.507	.439	.556	.424	.613	.572	.626	1.00
Resources									
	Peo1	Peo2	Peo3	Sys1	Sys2	Sys3	Pro1	Pro2	Pro3
Peo1	1.00								
Peo2	.560	1.00							
Peo3	.375	.415	1.00						
Sys1	.535	.539	.429	1.00					
Sys2	.556	.595	.413	.656	1.00				
Sys3	.517	.500	.390	.519	.591	1.00			
Pro1	.560	.524	.332	.533	.578	.565	1.00		
Pro2	.480	.515	.315	.509	.548	.476	.556	1.00	
Pro3	.504	.546	.344	.513	.574	.488	.603	.644	1.00
Behaviors									
	Ene1	Ene2	Ene3	Eng1	Eng2	Eng3	Ena1	Ena2	Ena3
Ene1	1.00								
Ene2	.797	1.00							
Ene3	.801	.784	1.00						
Eng1	.712	.693	.770	1.00					
Eng2	.553	.550	.586	.634	1.00				
Eng3	.668	.648	.690	.667	.590	1.00			
Ena1	.695	.665	.712	.688	.588	.744	1.00		
Ena2	.684	.655	.694	.630	.521	.683	.729	1.00	
Ena3	.679	.664	.691	.627	.521	.666	.698	.750	1.00

(table continues)

Table 13 *(continued)*

Processes	Ide1	Ide2	Ide3	Sha1	Sha2	Sha3	Cap1	Cap2	Cap3
Ide1	1.00								
Ide2	.717	1.00							
Ide3	.598	.697	1.00						
Sha1	.610	.625	.592	1.00					
Sha2	.527	.535	.531	.587	1.00				
Sha3	.482	.524	.543	.524	.536	1.00			
Cap1	.511	.513	.481	.559	.520	.505	1.00		
Cap2	.549	.541	.523	.632	.560	.503	.637	1.00	
Cap3	.548	.549	.529	.617	.561	.513	.617	.753	1.00

Climate	Col1	Col2	Col3	Saf1	Saf2	Saf3	Sim1	Sim2	Sim3
Col1	1.00								
Col2	.596	1.00							
Col3	.576	.674	1.00						
Saf1	.569	.642	.710	1.00					
Saf2	.417	.499	.491	.563	1.00				
Saf3	.443	.539	.527	.534	.547	1.00			
Sim1	.476	.468	.435	.468	.384	.459	1.00		
Sim2	.468	.520	.523	.520	.410	.486	.485	1.00	
Sim3	.613	.546	.564	.576	.422	.456	.517	.581	1.00

Success	Ext1	Ext2	Ext3	Ent1	Ent2	Ent3	Ind1	Ind2	Ind3
Ext1	1.00								
Ext2	.704	1.00							
Ext3	.653	.754	1.00						
Ent1	.541	.578	.603	1.00					
Ent2	.602	.626	.646	.694	1.00				
Ent3	.573	.594	.622	.584	.639	1.00			
Ind1	.482	.502	.500	.465	.556	.566	1.00		
Ind2	.522	.532	.539	.513	.606	.577	.705	1.00	
Ind3	.458	.481	.502	.455	.549	.496	.549	.648	1.00

High and/or redundant inter-item correlations within factors and across related factors for each of the measurement models also suggested the possible presence of multicollinearity or common method variance in the measurement of each of the constructs. Multicollinearity can become an issue and threaten the validity of future findings when structural models or between-group comparisons are made at the construct level (Kline, 2011). To determine the extent to which multicollinearity might be present within each measurement model, Kline's (2011) recommendation to calculate a squared multiple correlation between each variable and each of the others was conducted in SPSS version 22 (IBM Corp., 2013). This value was also used to compute the variance inflation factor (VIF) for each individual item within the factor model and the overall measurement model where a redundant variable would be noted if the VIF ratio of the total standardized variance exceeded the unique variance by a factor of 10.0 or greater. None of the squared multiple correlations (R^2_{smc}) were greater than the .90 threshold (Kline, 2011). As none of the item values exceeded this threshold and maintained an appropriate tolerance for analysis (less than 10.0) (Table 14), it was determined that there were no redundant items and little evidence of extreme multicollinearity within a measurement model or within a factor.

Table 14

Variance Inflation Factors (VIF)

Block	VIF by Item per Block Items 1 through 9	Factor	VIF by Item for Factor 1	2	3
Values	3.663, 3.636, 2.532, 4.016, 2.532, 3.484, 3.534, 4.237, 3.690	Entrepreneurial	2.976	3.257	2.212
		Creativity	2.674	2.331	2.342
		Learning	2.959	3.356	3.021
Resources	3.185, 3.367, 2.028, 3.597, 4.348, 3.145, 3.650, 3.413, 3.802	People	2.392	2.513	1.815
		Systems	3.086	3.546	2.604
		Projects	2.786	3.106	3.425
Behaviors	7.143, 6.329, 8.000, 5.618, 3.165, 5.128, 5.988, 5.556, 5.181	Energize	6.494	5.988	6.098
		Engage	3.717	3.058	3.344
		Enable	4.237	5.076	4.587
Processes	4.219, 5.128, 4.000, 4.184, 3.268, 2.933, 3.425, 5.102, 4.902	Ideate	3.704	4.785	3.460
		Shape	2.755	2.817	2.469
		Capture	3.040	4.651	4.425
Climate	3.460, 4.167, 4.608, 4.673, 2.809, 3.067, 2.604, 3.040, 3.745	Collaboration	2.786	3.584	3.425
		Safety	2.667	2.732	2.577
		Simplicity	2.299	2.625	2.778
Success	4.049, 5.376, 5.208, 3.802, 5.000, 3.861, 3.861, 4.854, 3.226	External	3.690	5.102	4.405
		Enterprise	3.546	4.016	3.012
		Individual	3.509	4.367	2.950

As little evidence for multicollinearity was identified, the diagnostic test for common method variance (CMV) was conducted in SPSS version 22 (IBM Corp., 2013) using Harman's single-factor method (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003) to determine if a common method factor explained 50% or greater of the cumulative variance. Each of the models failed Harman's single-factor test (Table 15) with a percent of variance greater than 50%, indicating the possible threat of a common method bias across the entire survey instrument, as well as for each of the six measurement models. This finding revealed the possible consideration of a common, social desirability factor in the subsequent specification of the measurement models when initial model fit without the higher order factor could not be obtained.

Table 15

Common Method Variance

Model	% variance explained
All 54 items	50.123%
Values	56.906%
Resources	56.687%
Behaviors	70.872%
Processes	61.443%
Climate	57.528%
Success	62.138%

Model Fit Assessment and Reliability

To evaluate the extent to which the hypothesized factor structure of each of the six measurement models of the Innovation Quotient instrument is consistent with the administration of this present study, a confirmatory factor analysis (CFA) for each of the hypothesized measurement models (Figure 5) was conducted using LISREL 9.2 (SSI, 2015). As each of the instrument's items was measured on an ordinal scale, a polychoric correlation matrix was applied in the CFA instead of the Pearson correlation matrix (Tello, Moscoso, García, & Abad, 2010). Additional procedures for model specification, estimation, and analysis are summarized in Chapter 3. Greater detail of model fit analysis and interpretation is described below for the values measurement model, but similar processes were used for each of the model fit assessments.

Values. Multiple CFA models were conducted to identify a model of best fit for values (Table 16). First, initial CFA results for the three-factor, hypothesized measurement model (Figure 6) for *values* demonstrated adequate model fit, χ^2 = 1117.818, *df* = 24, *CFI* = 0.960, *AGFI* = 0.996, *SRMR* = 0.029, but presented error that *approached* the undesirable suggested threshold of 0.100 for the *RMSEA* upper bound, *RMSEA* = 0.097 (0.094; 0.100). To improve model fit and reduce error, additional model specifications were considered. First, because the Harman's test for common method variance had returned an adverse result (CMV = 56.91%), the model was specified by loading each of the nine items onto their respective factors, as well as onto a common factor, which improved the fit and reduced the error but returned a non-positive definite result which Kline (2011) suggested may be attributed to multicollinearity. This result, coupled with the finding that high inter-item correlations between and across indicators of entrepreneurial, creativity, and learning were identified by prior theory and in this present study, and under the assumption that multicollinearity was not present based on desirable VIF values, a three-factor model with a higher order factor was conducted. This specification did not improve model fit or reduce error, and still returned a non-positive definite result, specifying negative error variances in the model, causing the analysis to not converge. Next, modification indices were reviewed to identify the impact of correlation of item errors within a factor on overall variance and fit, and it was identified that by allowing the errors of items EP1 and EP3 to correlate, better fit was obtained. Another iteration of this approach identified that the three-factor model, where the errors of EP1 and EP3, as well as the errors of Cre1 and Cre2, were allowed to correlate, produced the most significant result, χ^2 = 892.644, *df* = 22, *CFI* = 0.968,

AGFI = 0.996, *SRMR* = 0.026, *RMSEA* = 0.090 (0.087; 0.094). A final, two-factor model where the Creativity and Learning factors were collapsed into a single factor was attempted due to high inter-factor correlations (Figure 6, Table 16) but did not improve the final result. It was decided that the three-factor, EP1-EP3, Cre1-Cre2 errors model best fit the data with the least error, given the current sample. However, as a significant amount of error was not reduced, the hypothesized and most parsimonious model – the three factor model – was retained as the model that would best suit researchers and practitioners interested in assessing the model of values in research or organizations, respectively (Table 16, Figure 6).

Standardized coefficients, structure coefficients, and R^2 values of the confirmed model were reviewed to avoid misinterpretation of the relationships among the items and their corresponding factors (Table 17) (Graham, Guthrie, & Thompson, 2003). Standardized path coefficients ranged from 0.660 to 0.856, indicating strong loadings on each of the indicators' respective factors, but also suggested possible similarity, as the coefficients were very close in range across factors. Structure coefficients for each of the three latent factors were also high, ranging from 0.628 to 0.827, suggesting a possible lack of discriminant validity across each of the factors within the model. Such high values for EP1 illustrate, for example, that for every one-unit increase of both creativity and learning, performance on entrepreneurial's EP1 increased 0.767 and 0.717, respectively. The relationships between the latent variables indirectly increased the relationship between a discriminant factor and an individual item. For each of the measured variables in the model, the amount of variance explained ranged from R^2 = 0.478 to 0.732 (Table 17), and in most cases was less than some of the structure coefficients of other factors.

For the values model, it was identified that three factors within the model – entrepreneurship, creativity, and learning – were highly correlated (Table 18), explaining the higher structure coefficients between the three factors. To evaluate convergent and discriminant validity, AVE and CR, as well as SIC values, were computed. While each of the three factors' AVE and CR values exceeded desirable thresholds of 0.5 and 0.7 for each, the SIC values exceeded the corresponding AVE values ($SIC_{EP,Cre}$ = 0.824; $SIC_{EP,Lea}$ = 0.719; $SIC_{Cre,Lea}$ = 0.933), illustrating that the factors do not discriminate well among each other.

Table 16

CFA Results for Values

Model	χ^2	*df*	*CFI*	*AGFI*	*RMSEA*	*RMSEA CI*$_{90}$	*SRMR*
3 factor	1117.818*	24	0.960	0.996	0.097	(0.094; 0.100)	0.029
3 factor with common factor	767.737*†	12	0.989	0.998	0.072	(0.067; 0.077)	0.014
3 factor with higher order factor	1117.818*†	24	0.960	0.996	0.097	(0.094; 0.100)	0.029
3 factor, EP1-EP3 errors	978.182*	23	0.965	0.996	0.093	(0.089; 0.096)	0.027
3 factor, EP1-EP3, Cre1-Cre2 errors	892.644*	22	0.968	0.996	0.090	(0.087; 0.094)	0.026
2 factors, EP and combined Cre-Lea	1280.804*	26	0.954	0.995	0.100	(0.097; 0.103)	0.031

Note. **p* < .001. χ^2=Satorra-Bentler (1988) scaled chi-square; † = solution is not positive definite; CFI = comparative fit index; AGFI = adjusted goodness of fit index; RMSEA = root mean-square error of approximation; SRMR = standardized root mean square.

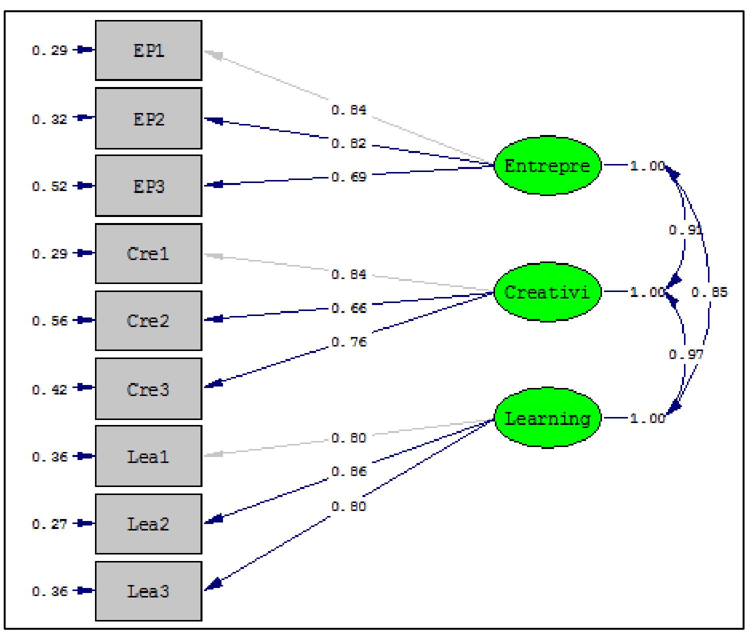

Figure 6. Standardized solution for values.

Table 17

Pattern and Structure Coefficients for Values

Item	Unstandardized Coefficients	Error Variance	Pattern Coefficients	Structure Coefficients			R^2
				Entrepreneurial	Creativity	Learning	
EP1	1.000	0.287 (0.015)	0.845	.	0.767	0.717	0.713
EP2	0.976 (0.010)	0.320 (0.014)	0.825	.	0.749	0.700	0.680
EP3	0.819 (0.011)	0.522 (0.015)	0.692	.	0.628	0.587	0.478
Cre1	1.000	0.294 (0.013)	0.840	0.763	.	0.811	0.706
Cre2	0.786 (0.010)	0.564 (0.014)	0.660	0.599	.	0.638	0.436
Cre3	0.906 (0.008)	0.421 (0.014)	0.761	0.691	.	0.735	0.579
Lea1	1.000	0.363 (0.014)	0.798	0.677	0.771	.	0.637
Lea2	1.072 (0.009)	0.268 (0.013)	0.856	0.726	0.827	.	0.732
Lea3	0.999 (0.010)	0.364 (0.014)	0.797	0.676	0.770	.	0.636

*$p < .05$

Table 18

Intra-construct Correlations, SIC, AVE, and CR

	Entrepreneurship	Creativity	Learning	**AVE**	**CR**
Entrepreneurship	1.000	0.824	0.719	**0.625**	**0.832**
Creativity	0.908	1.000	0.933	**0.573**	**0.800**
Learning	0.848	0.966	1.000	**0.668**	**0.858**

Note: Values below the diagonal are estimates of intra-construct correlations, and values above the diagonal are squared intra-construct correlations (SIC).

Resources. Four CFA models were run to identify the best fit for resources (Table 19). CFA results for the three-factor, hypothesized measurement model (Figure 7) for resources demonstrated a desirable model fit, χ^2 = 883.691, *df* = 24, *CFI* = 0.980, *AGFI* = 0.997, *SRMR* = 0.021, *RMSEA* = 0.060 (0.057; 0.064). While the data fit the hypothesized model, additional model specifications were considered, due to considerations described above in the values section. A summary of the additional models considered, which also included a three-factor model with a common latent factor, a higher order factor, and a model with correlated errors based on analysis of modification indices, are presented in Table 16. However, as a significant amount of error was not reduced through these efforts, the hypothesized and most parsimonious three-factor model was also retained for subsequent analysis (Table 19, Figure 7).

Standardized path coefficients ranged from 0.525 to 0.823, indicating strong loadings on each of the indicators' respective factors, but also suggested possible inter-factorial similarity. Structure coefficients for each of the three latent factors were also high, ranging from 0.463 to 0.784, suggesting a possible lack of discriminant validity across each of the factors within the model (Graham, Guthrie, & Thompson, 2003). For the measured variables, the amount of variance explained ranged from R^2 = 0.276 to 0.677 (Table 20), with most above 0.521.

The three factors within the model – people, systems, and projects – were highly correlated (Table 21), explaining the higher structure coefficients between the three factors. To evaluate convergent and discriminant validity, AVE and CR, as well as SIC values, were computed (Table 21). While AVE and CR values exceeded desirable thresholds of 0.5 and 0.7 for the systems (AVE = 0.593, CR = 0.813) and project factors (AVE = 0.601, CR = 0.819), the AVE for processes did not for AVE (AVE = 0.466, CR = 0.719), demonstrating lower convergent validity for this factor. As the SIC values exceeded the corresponding AVE values for all three factors ($SIC_{Peo,Sys}$ = 0.908; $SIC_{Peo,Pro}$ = 0.776; $SIC_{Sys,Pro}$ = 0.796), it was determined that the factors did not discriminate well between each other.

Table 19

CFA Results for Resources

Model	χ^2	*df*	*CFI*	*AGFI*	*RMSEA*	*RMSEA* CI_{90}	*SRMR*
3 factor	883.691*	24	0.980	0.997	0.060	(0.057; 0.064)	0.021
3 factor with common	1503.830*┼	12	0.993	0.998	0.051	(0.046; 0.055)	0.014
3 factor with higher order	883.691*	24	0.980	0.997	0.060	(0.057; 0.064)	0.021
3 factor, Pro2-Pro3 errors	612.883*	23	0.986	0.998	0.051	(0.048; 0.055)	0.018

Note. *p < .001. χ^2=Satorra-Bentler (1988) scaled chi-square; ┼ = errors could not be identified; CFI = comparative fit index; AGFI = adjusted goodness of fit index; RMSEA = root mean-square error of approximation; SRMR = standardized root mean square.

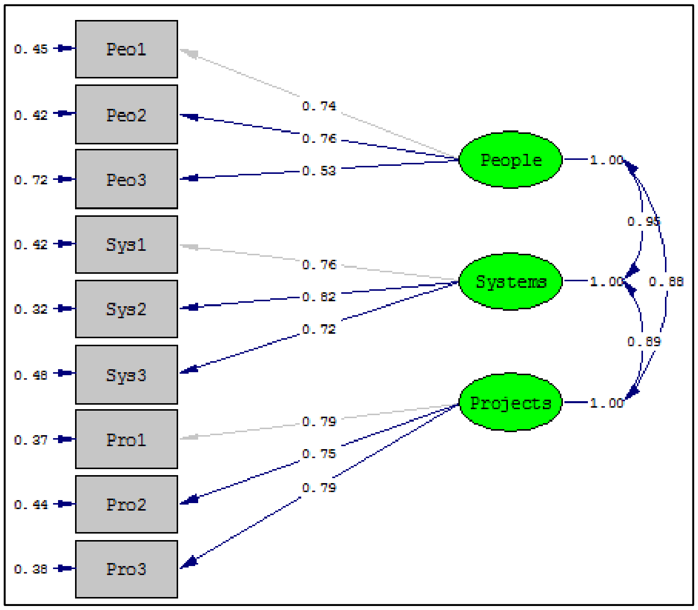

Figure 7. Standardized solution for resources.

Table 20

Pattern and Structure Coefficients for Resources

Item	Unstandardized Coefficients	Error Variance	Pattern Coefficients	Structure Coefficients People	Systems	Processes	R^2
Peo1	1.000	0.454 (0.013)	0.739	.	0.704	0.651	0.546
Peo2	1.029 (0.010)	0.422 (0.013)	0.760	.	0.724	0.670	0.578
Peo3	0.710 (0.012)	0.724 (0.013)	0.525	.	0.500	0.463	0.276
Sys1	1.000	0.420 (0.013)	0.761	0.725	.	0.679	0.580
Sys2	1.080 (0.008)	0.323 (0.012)	0.823	0.784	.	0.734	0.677
Sys3	0.948 (0.009)	0.479 (0.013)	0.722	0.689	.	0.644	0.521
Pro1	1.000	0.374 (0.013)	0.791	0.697	0.706	.	0.626
Pro2	0.947 (0.009)	0.439 (0.013)	0.749	0.660	0.668	.	0.561
Pro3	0.993 (0.008)	0.383 (0.013)	0.785	0.692	0.700	.	0.617

*$p < .05$

Table 21

Intra-construct Correlations, SIC, AVE, and CR

	People	Systems	Projects	**AVE**	**CR**
People	1.000	0.908	0.776	**0.466**	**0.719**
Systems	0.953	1.000	0.796	**0.593**	**0.813**
Projects	0.881	0.892	1.000	**0.601**	**0.819**

Note: Values below the diagonal are estimates of intra-construct correlations, and values above the diagonal are squared intra-construct correlations (SIC).

Behaviors. Four CFA models were run to identify the best fit for behaviors (Table 22). CFA results for the three-factor, hypothesized measurement model (Figure 8) for behaviors demonstrated a desirable model fit, χ^2 = 1903.178, *df* = 24, *CFI* = 0.975, *AGFI* = 0.998, *SRMR* = 0.022, *RMSEA* = 0.090 (0.087; 0.094). While the data fit the hypothesized model, where the upper bound for the RMSEA remained below 1.0, additional model specifications were considered due to considerations described above. A summary of additional models conducted, including the three-factor model with a common latent factor, a higher order factor, and a model with correlated errors based on analysis of modification indices, are summarized in Table 19. However, as a significant amount of error was not reduced through these efforts, the hypothesized and most parsimonious three-factor model was also retained for subsequent analysis (Table 22, Figure 8).

Standardized path coefficients ranged from 0.695 to 0.916, indicating strong loadings on each of the indicators' respective factors, but also suggested possible inter-factorial similarity, and even possible duplication for energize's Ene3 at 0.916. Structure coefficients for each of the three latent factors were also high, ranging from 0.641 to 0.823, suggesting multiple indirect relationships across factors leading to increases in item values and reducing evidence for discriminant validity (Graham, Guthrie, & Thompson, 2003). For each of the measured variables in the model, the amount of variance explained ranged from R^2 = 0.483 to 0.839 (Table 23).

The three factors within the model – energize, engage, and enable – were highly correlated (Table 24), explaining the higher structure coefficients between the three factors. To evaluate convergent and discriminant validity, AVE and CR, as well as SIC values, were computed (Table 24). AVE and CR values exceeded desirable thresholds of 0.5 and 0.7 for all three factors of energize (AVE = 0.794, CR = 0.920), engage (AVE = 0.635, CR = 0.838) and enable (AVE = 0.726, CR = 0.888), but because the AVE values for each factor were still lower than each of the SIC results ($SIC_{Ene,Eng}$ = 0.852; SIC_{EneEna} = 0.808; $SIC_{Eng,Ena}$ = 0.870), it was determined that the factors did not discriminate well among each other.

Table 22

CFA Results for Behaviors

Model	χ^2	*df*	*CFI*	*AGFI*	*RMSEA*	*RMSEA CI₉₀*	*SRMR*
3 factor	1903.178*	24	0.975	0.998	0.090	(0.087; 0.094)	0.022
3 factor with common	656.065*┼	12	0.996	1.00	0.048	(0.043; 0.053)	0.007
3 factor with higher order	1903.179*	24	0.975	0.998	0.090	(0.087; 0.094)	0.022
3 factor, Eng1-Eng2	1670.012*	23	0.978	0.998	0.086	(0.083; 0.090)	0.021

Note. **p* < .001. χ^2=Satorra-Bentler (1988) scaled chi-square; ┼ = errors could not be identified; CFI = comparative fit index; AGFI = adjusted goodness of fit index; RMSEA = root mean-square error of approximation; SRMR = standardized root mean square.

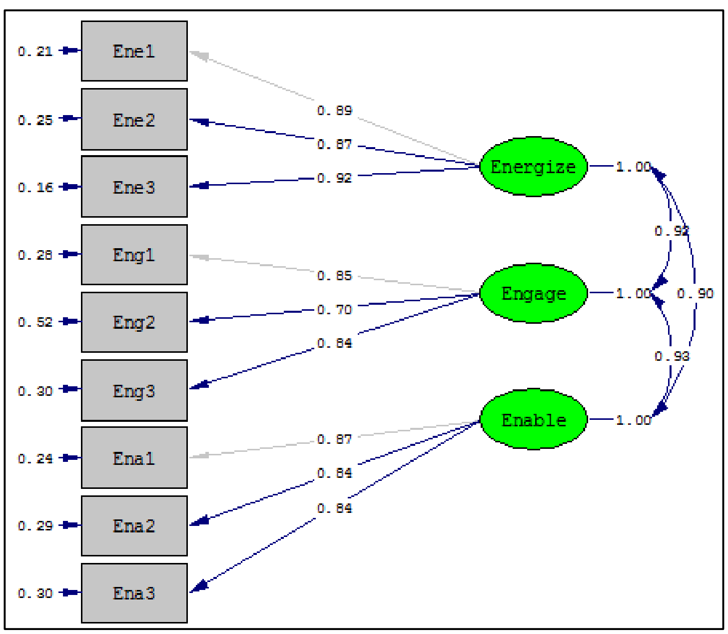

Figure 8. Standardized solution for behaviors.

Table 23

Pattern and Structure Coefficients for Behaviors

Item	Unstandardized Coefficients	Error Variance	Pattern Coefficients	Structure Coefficients Energize	Engage	Enable	R^2
Ene1	1.000	0.207 (0.011)	0.891	.	0.822	0.801	0.793
Ene2	0.972 (0.004)	0.250 (0.011)	0.866	.	0.799	0.779	0.750
Ene3	1.028 (0.004)	0.161 (0.011)	0.916	.	0.845	0.823	0.839
Eng1	1.000	0.279 (0.012)	0.849	0.784	.	0.792	0.721
Eng2	0.819 (0.007)	0.517 (0.013)	0.695	0.641	.	0.648	0.483
Eng3	0.986 (0.005)	0.300 (0.012)	0.837	0.773	.	0.781	0.700
Ena1	1.000	0.236 (0.012)	0.874	0.786	0.815	.	0.764
Ena2	0.966 (0.005)	0.286 (0.012)	0.845	0.760	0.788	.	0.714
Ena3	0.956 (0.005)	0.302 (0.012)	0.836	0.752	0.780	.	0.698

*$p < .05$

Table 24

Intra-construct Correlations, SIC, AVE, and CR

	Energize	Engage	Enable	**AVE**	**CR**
Energize	1.000	0.852	0.808	**0.794**	**0.920**
Engage	0.923	1.000	0.870	**0.635**	**0.838**
Enable	0.899	0.933	1.000	**0.726**	**0.888**

Note: Values below the diagonal are estimates of intra-construct correlations, and values above the diagonal are squared intra-construct correlations (SIC).

Processes. Multiple CFA models were run to identify the best fit for processes (Table 25). CFA results for the three-factor, hypothesized measurement model (Figure 9) for processes demonstrated a desirable model fit, χ^2 = 924.771, *df* = 24, *CFI* = 0.983, *AGFI* = 0.998, *SRMR* = 0.019, *RMSEA* = 0.062 (0.058; 0.065). Additional model specifications were considered, and a summary of the additional models conducted, including the three-factor model with a common latent factor, a higher order factor, and a model with correlated errors based on analysis of modification indices, are shown in Table 22. However, as a significant amount of error was not reduced through these efforts, the hypothesized and most parsimonious three-factor model was also retained for subsequent analysis (Table 25, Figure 9).

Standardized path coefficients ranged from 0.686 to 0.848, indicating strong loadings on each of the indicators' respective factors but also suggested possible inter-factorial similarity. Structure coefficients for each of the three latent factors were also high, ranging from 0.602 to 0.771, suggesting multiple indirect relationships across factors leading to increases in item values and reducing evidence for discriminant validity (Graham, Guthrie, & Thompson, 2003). For each of the measured variables in the model, the amount of variance explained ranged from R^2 = 0.532 to 0.718 (Table 26).

The three factors within the model – ideate, shape, and capture – correlated highly (Table 27), explaining the higher structure coefficients among the three factors. To evaluate convergent and discriminant validity, AVE and CR, as well as SIC values, were computed (Table 27). AVE and CR values exceeded desirable thresholds of 0.5 and 0.7 for all three factors of ideate (AVE = 0.672, CR = 0.860), shape (AVE = 0.552, CR = 0.786) and capture (AVE = 0.673, CR = 0.860), but because the AVE values for each factor were still lower than each of the SIC results ($SIC_{Ide,Sha}$ = 0.826; $SIC_{Ide,Cap}$ = 0.615; $SIC_{Sha,Cap}$ = 0.828), it was determined that the factors did not discriminate well among each other, with the exception of ideate and capture, where the SIC between these two factors was less than the AVE for ideate.

Table 25

CFA Results for Processes

Model	χ^2	*df*	*CFI*	*AGFI*	*RMSEA*	*RMSEA* CI_{90}	*SRMR*
3 factor	924.771*	24	0.983	0.998	0.062	(0.058; 0.065)	0.019
3 factor with common	1806.877*†	12	0.996	1.000	0.045	(0.040; 0.050)	0.010
3 factor with higher order	924.771*†	24	0.983	0.998	0.062	(0.058; 0.065)	0.019
3 factor, Ide1-Ide3	580.986*	23	0.990	0.999	0.050	(0.046; 0.053)	0.016

Note. *p < .001. χ^2=Satorra-Bentler (1988) scaled chi-square; † = solution is not positive definite; CFI = comparative fit index; AGFI = adjusted goodness of fit index; RMSEA = root mean-square error of approximation; SRMR = standardized root mean square.

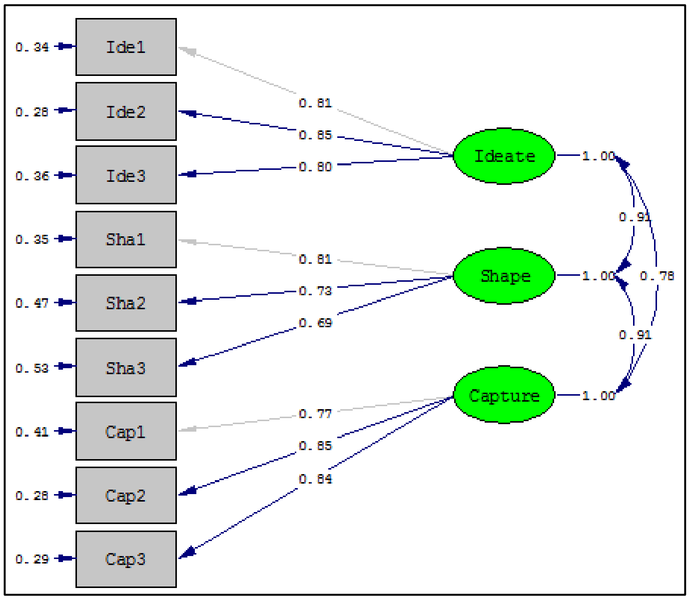

Figure 9. Standardized solution for processes.

Table 26

Pattern and Structure Coefficients for Processes

Item	Unstandardized Coefficients	Error Variance	Pattern Coefficients	Structure Coefficients Ideate	Shape	Capture	R^2
Ide1	1.000	0.342 (0.013)	0.811	.	0.737	0.636	0.658
Ide2	1.044 (0.007)	0.282 (0.012)	0.848	.	0.771	0.665	0.718
Ide3	0.986 (0.008)	0.360 (0.013)	0.800	.	0.727	0.627	0.640
Sha1	1.000	0.349 (0.012)	0.807	0.734	.	0.734	0.651
Sha2	0.905 (0.007)	0.468 (0.013)	0.730	0.664	.	0.664	0.532
Sha3	0.851 (0.008)	0.529 (0.013)	0.686	0.624	.	0.624	0.471
Cap1	1.000	0.411 (0.013)	0.768	0.602	0.699	.	0.589
Cap2	1.103 (0.009)	0.283 (0.012)	0.847	0.664	0.771	.	0.717
Cap3	1.099 (0.009)	0.288 (0.012)	0.844	0.662	0.768	.	0.712

*$p < .05$

Table 27

Intra-construct Correlations, SIC, AVE, and CR

	Ideate	Shape	Capture	**AVE**	**CR**
Ideate	1.000	0.826	0.615	**0.672**	**0.860**
Shape	0.909	1.000	0.828	**0.552**	**0.786**
Capture	0.784	0.910	1.000	**0.673**	**0.860**

Note: Values below the diagonal are estimates of intra-construct correlations, and values above the diagonal are squared intra-construct correlations (SIC).

Climate. Multiple CFA models were run to identify the best fit for climate (Table 28). CFA results for the three-factor, hypothesized measurement model (Figure 10) for climate demonstrated an acceptable model fit, χ^2 = 1755.376, *df* = 24, *CFI* = 0.962, *AGFI* = 0.995, *SRMR* = 0.030, *RMSEA* = 0.086 (0.082; 0.089). Additional model specifications were considered, and the additional models conducted, including the three-factor model with a common latent factor, a higher order factor, and a model with correlated errors based on analysis of modification indices, are summarized in Table 25. However, as a significant amount of error was not reduced through these efforts, the hypothesized and most parsimonious three-factor model was also retained for subsequent analysis (Table 28, Figure 10).

Standardized path coefficients ranged from 0.664 to 0.843, indicating strong loadings on each of the indicators' respective factors, but also suggested possible inter-factorial similarity. Structure coefficients for each of the three latent factors were also high, ranging from 0.573 to 0.785, suggesting multiple indirect relationships across factors leading to increases in item values and reducing evidence for discriminant validity (Graham, Guthrie, & Thompson, 2003). For each of the measured variables in the model, the amount of variance explained ranged from R^2 = 0.440 to 0.710 (Table 29).

The three factors within the model – collaboration, safety, and simplicity – were highly correlated (Table 30), explaining the higher structure coefficients among the three factors. To evaluate convergent and discriminant validity, AVE and CR, as well as SIC values, were computed (Table 30). AVE and CR values exceeded desirable thresholds of 0.5 and 0.7 for all three factors of collaboration (AVE = 0.617, CR = 0.829), safety (AVE = 0.552, CR = 0.785) and simplicity (AVE = 0.532, CR = 0.772), but because the AVE values for each factor were still lower than each of the SIC results ($SIC_{Col,Saf}$ = 0.867; $SIC_{Col,Sim}$ = 0.805; $SIC_{Saf,Sim}$ = 0.745), it was determined that the factors did not discriminate well among each other.

Table 28

CFA Results for Climate

Model	χ^2	*df*	*CFI*	*AGFI*	*RMSEA*	*RMSEA CI*$_{90}$	*SRMR*
3 factor	1755.376*	24	0.962	0.995	0.086	(0.082; 0.089)	0.030
3 factor with common	215.070*†	12	0.984	0.996	0.079	(0.074; 0.084)	0.019
3 factor with higher order	1755.376*	24	0.962	0.995	0.086	(0.082; 0.089)	0.030
3 factor, Saf2-Saf3	1381.982*	23	0.970	0.996	0.078	(0.074; 0.081)	0.026

Note. **p* < .001. χ^2=Satorra-Bentler (1988) scaled chi-square; † = solution is not positive definite; CFI = comparative fit index; AGFI = adjusted goodness of fit index; RMSEA = root mean-square error of approximation; SRMR = standardized root mean square.

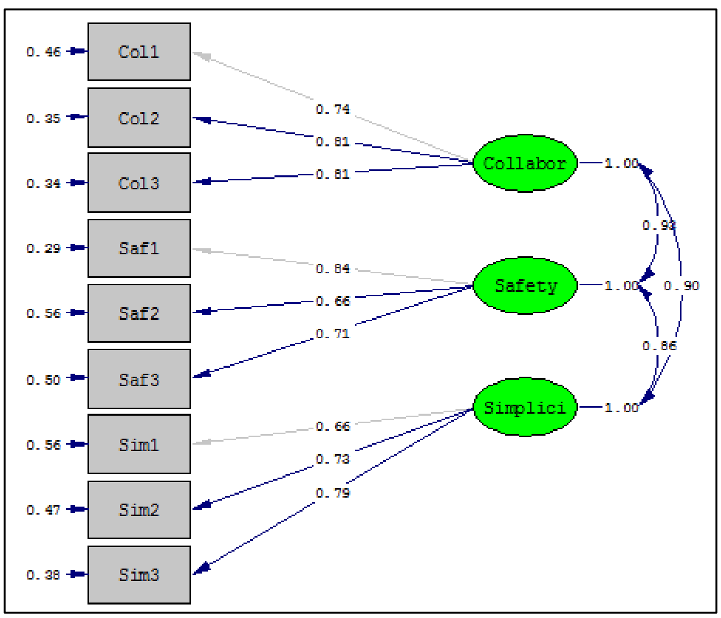

Figure 10. Standardized solution for climate.

Table 29

Pattern and Structure Coefficients for Climate

Item	Unstandardized Coefficients	Error Variance	Pattern Coefficients	Structure Coefficients: Collaboration	Safety	Simplicity	R^2
Col1	1.000	0.457 (0.013)	0.737	.	0.686	0.661	0.543
Col2	1.094 (0.009)	0.350 (0.012)	0.806	.	0.750	0.723	0.650
Col3	1.102 (0.009)	0.340 (0.012)	0.812	.	0.756	0.728	0.660
Saf1	1.000	0.290 (0.013)	0.843	0.785	.	0.728	0.710
Saf2	0.787 (0.008)	0.560 (0.013)	0.664	0.618	.	0.573	0.440
Saf3	0.842 (0.008)	0.497 (0.013)	0.710	0.661	.	0.612	0.503
Sim1	1.000	0.559 (0.013)	0.664	0.596	0.573	.	0.441
Sim2	1.097 (0.013)	0.470 (0.013)	0.728	0.653	0.628	.	0.530
Sim3	1.190 (0.014)	0.376 (0.013)	0.790	0.709	0.682	.	0.624

*$p < .05$

Table 30

Intra-construct Correlations, SIC, AVE, and CR

	Collaboration	Safety	Simplicity	**AVE**	**CR**
Collaboration	1.000	0.867	0.805	**0.617**	**0.829**
Safety	0.931	1.000	0.745	**0.552**	**0.785**
Simplicity	0.897	0.863	1.000	**0.532**	**0.772**

Note: Values below the diagonal are estimates of intra-construct correlations, and values above the diagonal are squared intra-construct correlations (SIC).

Success. Four CFA models were run to identify the best fit for success (Table 31). CFA results for the three-factor, hypothesized measurement model (Figure 11) for success demonstrated an acceptable model fit, χ^2 = 982.654, *df* = 24, *CFI* = 0.983, *AGFI* = 0.998, *SRMR* = 0.019, *RMSEA* = 0.064 (0.060; 0.067). Additional model specifications were considered, and the additional models conducted, including the three-factor model with a common latent factor, a higher order factor, and a model with correlated errors based on analysis of modification indices, are summarized in Table 28. However, as a significant amount of error was not reduced through these efforts, the hypothesized and most parsimonious three-factor model was also retained for subsequent analysis (Table 31, Figure 11).

Standardized path coefficients ranged from 0.747 to 0.862, indicating strong loadings on each of the indicators' respective factors, but also suggested possible inter-factorial similarity. Structure coefficients for each of the three latent factors were also high, ranging from 0.560 to 0.761, suggesting multiple indirect relationships across factors leading to increases in item values and reducing evidence for discriminant validity (Graham, Guthrie, & Thompson, 2003). For each of the measured variables in the model, the amount of variance explained ranged from R^2 = 0.558 to 0.743 (Table 32).

The three factors within the model – external, enterprise, and individual – correlated highly (Table 33), explaining the higher structure coefficients among the three factors. To evaluate convergent and discriminant validity, AVE and CR, as well as SIC values, were computed (Table 33). AVE and CR values exceeded desirable thresholds of 0.5 and 0.7 for all three factors of external (AVE = 0.705, CR = 0.878), enterprise (AVE = 0.640, CR = 0.842) and individual (AVE = 0.639, CR = 0.841), but because the AVE values for each factor were still lower than each of the SIC results ($SIC_{Ext,Ind}$= 0.561; $SIC_{Ext,Ent}$ = 0.794; $SIC_{Ent,Ind}$ = 0.694), it was determined that the factors did not discriminate well among each other, with the exception of external and individual, where the SIC between these two factors was less than the AVE for external.

Table 31

CFA Results for Success

Model	χ^2	*df*	*CFI*	*AGFI*	*RMSEA*	*RMSEA* CI_{90}	*SRMR*
3 factor	982.654*	24	0.983	0.998	0.064	(0.060; 0.067)	0.019
3 factor with common	9.399†	12	0.997	0.999	0.040	(0.035; 0.045)	0.008
3 factor with higher order	982.654*	24	0.983	0.998	0.064	(0.060; 0.067)	0.019
3 factor, Ent1-Ent2	666.111*	23	0.989	0.999	0.053	(0.050; 0.057)	0.016

Note. *$p < .001$. χ^2=Satorra-Bentler (1988) scaled chi-square; † = solution is not positive definite; CFI = comparative fit index; AGFI = adjusted goodness of fit index; RMSEA = root mean-square error of approximation; SRMR = standardized root mean square.

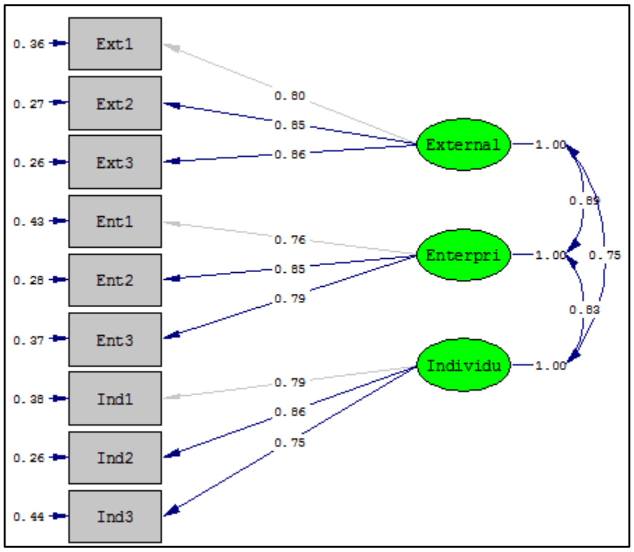

Figure 11. Standardized solution for success.

Table 32

Pattern and Structure Coefficients for Success

Item	Unstandardized Coefficients	Error Variance	Pattern Coefficients	Structure Coefficient			R^2
				External	Enterprise	Individual	
Ext1	1.000	0.357 (0.012)	0.802	.	0.715	0.601	0.643
Ext2	1.065 (0.007)	0.271 (0.012)	0.854	.	0.761	0.640	0.729
Ext3	1.075 (0.008)	0.257 (0.012)	0.862	.	0.768	0.646	0.743
Ent1	1.000	0.428 (0.013)	0.756	0.674	.	0.630	0.572
Ent2	1.122 (0.008)	0.280 (0.012)	0.848	0.756	.	0.706	0.720
Ent3	1.050 (0.008)	0.369 (0.012)	0.794	0.707	.	0.661	0.631
Ind1	1.000	0.378 (0.013)	0.789	0.591	0.657	.	0.622
Ind2	1.088 (0.009)	0.264 (0.012)	0.858	0.643	0.715	.	0.736
Ind3	0.947 (0.010)	0.442 (0.013)	0.747	0.560	0.622	.	0.558

*$p < .05$

Table 33

Intra-construct Correlations, SIC, AVE, and CR

	External	Enterprise	Individual	**AVE**	**CR**
External	1.000	0.794	0.561	**0.705**	**0.878**
Enterprise	0.891	1.000	0.694	**0.640**	**0.842**
Individual	0.749	0.833	1.000	**0.639**	**0.841**

Note: Values below the diagonal are estimates of intra-construct correlations, and values above the diagonal are squared intra-construct correlations (SIC).

Summary. Each of the six original, hypothesized measurement models was the least complicated model that demonstrated acceptable model fit (Table 34), demonstrating evidence for convergent validity. However, none of the individual measurement models demonstrated evidence for discriminant validity, indicating a high degree of items that load across theoretically different factors. A lack of discriminant validity, however, can often been expected when factors are hypothesized to be highly related in structural models. However, as common variance was found between the constructs for each model, it was determined that there was a need for additional analyses to better explain the nature of the relationships between the individual items.

Table 34

CFA Results Summary

Model	Spec	χ^2	*df*	*CFI*	*AGFI*	*RMSEA*	*RMSEA CI*$_{90}$	*SRMR*
Values	3 factor	1117.818*	24	0.960	0.996	0.097	(0.094; 0.100)	0.029
Resources	3 factor	883.691*	24	0.980	0.997	0.060	(0.057; 0.064)	0.021
Behaviors	3 factor	1903.178*	24	0.975	0.998	0.090	(0.087; 0.094)	0.022
Processes	3 factor	924.771*	24	0.983	0.998	0.062	(0.058; 0.065)	0.019
Climate	3 factor	1755.376*	24	0.962	0.995	0.086	(0.082; 0.089)	0.030
Success	3 factor	982.654*	24	0.983	0.998	0.064	(0.060; 0.067)	0.019

Note. *p < .001. χ^2=Satorra-Bentler (1988) scaled chi-square; CFI = comparative fit index; AGFI = adjusted goodness of fit index; RMSEA = root mean-square error of approximation; SRMR = standardized root mean square.

Reliability. Estimates of score reliability, as measured by coefficient alpha, were computed in order to support understanding regarding improvements for each of the six original measurement models and for each of the groups for which additional analyses are conducted in organizations – by countries (national cultures), industries, employee levels, functional roles, and the languages of instrument administration. Estimates were only computed for groups that had a minimum sample size of 30. Tables 35 through 37 illustrate that most of these first-order factor estimates exceeded Nunnally's (1978) recommended threshold of 0.70, with many of them higher than 0.90, for the entire first half of the dataset. Many of these estimates also met or exceeded reliability findings identified in previous literature (e.g. Aiman-Smith et al., 2005; Anderson & West, 1998; Dobni, 2008; Kuščer, 2013; Remneland-Wikhamn & Wikhamn, 2011; and Tohidi, Seyedaliakbar & Mandegari, 2012). However, in some instances reliability estimates did not meet the desired threshold and are illustrated by bold type in Tables 35 through 37. Confidence intervals for score reliability estimates are shown in Appendix C.

While many of these estimates still approximated the threshold, which is a desirable result considering each coefficient was estimated from a pool of only three items, multiple patterns where thresholds were not met were identified. First, while the reliability estimate for the factor of people within the resources model was sufficient for the entire sample ($\alpha = 0.712$), the thresholds were not consistent for all countries (for Spain, the United States, and Germany), industries (industrial machinery and equipment, health care and social services, aerospace and defense, food and beverages, construction and building materials, industrial metals and mining, IT – software and electronics, education, public and state administration, pharmaceuticals, and biotechnology and research), for the organizational level of managers, for the functional role of R&D, or for the English language. Another pattern emerged for the creativity factor within the values model. While the overall estimate for the whole sample was $\alpha = 0.755$, a lack of evidence for reliability was identified for multiple industries (construction and building materials, industrial metals and mining, automobile and parts, education, public and state administration, transport and logistics, and pharmaceuticals). The pattern for the simplicity factor in the climate model showed questionable reliability for one country (Germany), but among multiple industries (construction and building materials, industrial metals and mining, automobile and parts, IT – software and electronics, public and state administration; and biotechnology and research). A final pattern identified is that very few consistently poor findings emerged within a particular country, organizational level, functional role, or language. However, for some particular industries (construction and building materials, automobile and parts, public and state administration, and biotechnology and research), reliability results, overall, were insufficient for four or more factors.

In conclusion, while AVE values for most of the factors exceeded 0.50, all factors exceeded the CR threshold of 0.70, and most areas were reliable across groups, a lack of divergent validity was identified for each of the six measurement models, a result that can be expected when the factors are hypothesized to be highly related when conducting structural models. As multicollinearity was excluded as a possible contributor to this issue via investigation of squared multiple correlation and VIF values (Table 14), it was next hypothesized by the investigator that due to the high amount of cross loading and common variance across factors, it could be theorized that each of the six measurement models may actually be first order factors in the more global construct of culture of innovation, when these six factors are measured by nine common items. A follow-up investigation of a more global measurement model of a culture of innovation was considered before investigating an alternative plausible model.

Table 35

Initial Block Score Reliability Estimates and Factor Estimates by Country

Model	α	Factor	α	1	2	3	4	5	6	7	8	9
Values	.904	Entrepreneurial	.781	.792	.753	.713	.736	.733	.704	.700	**.664**	.745
		Creativity	.755	.728	.731	.717	.789	.732	.709	.820	.709	.810
		Learning	.820	.804	.798	.837	.750	.826	.824	.841	.820	.796
Resources	.904	People	.712	**.689**	.720	.727	**.693**	.730	.721	.753	.744	**.688**
		Systems	.811	.788	.811	.809	.749	.835	.837	.807	.863	.733
		Projects	.819	.796	.774	.836	.863	.851	.891	.859	.742	.850
Behaviors	.948	Energize	.920	.917	.914	.903	.889	.923	.922	.913	.925	.854
		Engage	.837	.817	.845	.829	.801	.846	.832	.854	.854	.723
		Enable	.888	.880	.885	.883	.814	.913	.897	.859	.887	.772
Processes	.921	Ideate	.859	.846	.862	.842	.792	.898	.875	.871	.833	.823
		Shape	.785	.746	.830	.782	.670	.822	.780	.818	.840	.707
		Capture	.857	.844	.838	.880	.781	.877	.878	.848	.854	.810
Climate	.906	Collaboration	.827	.820	.802	.796	.803	.813	.831	.836	.809	.822
		Safety	.784	.765	.779	.719	.803	.824	.758	.798	**.637**	.782
		Simplicity	.768	.747	.751	.724	.744	.789	.740	.806	.734	**.589**
Success	.923	External	.877	.858	.854	905	.850	.920	.917	.830	.899	.869
		Enterprise	.842	.841	.789	.839	.848	.844	.847	.825	.763	.742
		Individual	.837	.833	.821	.816	.792	.861	.820	.844	.853	.758

Note: α = alpha coefficient, 1 = Spain, 2 = Chile, 3 = Colombia, 4 = United States, 5 = Panama, 6 = El Salvador, 7 = Portugal, 8 = Mexico, 9 = Germany.

Table 36

Initial Factor Score Reliability Estimates by Industry

Factor	α	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Entrepreneurial	.781	.762	.806	.821	.757	.821	.790	.749	.694	.656	.749	.803	**.681**	.749	.826	.665	.808	.772	.710	**.669**	.786
Creativity	.755	.764	.760	.799	.766	.712	.737	.727	**.693**	**.638**	**.681**	.731	.708	.748	.795	**.650**	**.673**	**.660**	**.683**	.727	.776
Learning	.820	.848	.836	.820	.800	.793	.807	.781	.731	.778	.739	.801	.756	.776	.835	.752	.798	.794	.751	.741	.798
People	.712	.754	.747	.705	**.693**	**.670**	**.699**	**.673**	**.643**	**.639**	.702	.700	.716	**.682**	.731	**.555**	**.562**	.701	**.638**	**.630**	.811
Systems	.811	.846	.829	.827	.807	.775	.766	.784	.748	.733	.716	.740	.744	.800	.805	.745	.722	.764	**.687**	.703	.816
Projects	.819	.853	.842	.812	.830	.781	.762	.790	.752	.729	.703	.790	.827	.811	.852	.743	**.680**	.773	.816	.747	.791
Energize	.920	.925	.928	.933	.918	.910	.915	.879	.884	.883	.890	.910	.906	.908	.873	.878	.915	.907	.893	.910	.905
Engage	.837	.855	.860	.835	.840	.810	.807	.805	.765	.783	.779	.829	.824	.778	.846	.767	.798	.750	.798	.707	.719
Enable	.888	.908	.900	.893	.870	.870	.886	.819	.825	.849	.859	.897	.884	.805	.831	.851	.902	.844	.838	.782	.827
Ideate	.859	.879	.882	.854	.853	.871	.836	.851	.792	.807	.793	.833	.838	.836	.833	.870	.816	.821	.794	.773	.866
Shape	.785	.823	.857	.760	.805	.763	**.697**	.746	.704	.704	**.663**	.725	**.672**	.747	.754	.708	.722	.727	.719	**.589**	**.595**
Capture	.857	.895	.880	.851	.843	.812	.840	.804	.773	.745	.820	.828	.799	.778	.829	.760	.824	.849	.778	.723	.837
Collaboration	.827	.841	.834	.844	.829	.787	.834	.774	.732	.763	.800	.827	.817	.759	.823	.808	.772	.839	.792	**.557**	.773
Safety	.784	.800	.806	.785	.780	.757	.793	.771	**.648**	.759	**.662**	.787	.789	.701	.711	.752	.740	.770	.788	**.652**	.850
Simplicity	.768	.794	.806	.757	.793	.733	.734	.722	**.650**	**.689**	**.639**	.763	.706	**.695**	.763	.724	**.683**	.706	.651	**.487**	.745
External	.877	.925	.871	.870	.877	.846	.857	.776	.851	.843	.749	.861	.828	.820	.838	.829	.826	.868	.828	.804	.811
Enterprise	.842	.861	.841	.856	.850	.825	.835	.772	.794	.794	.777	.829	.834	.769	.754	.827	.811	.824	.772	.801	.851
Individual	.837	.854	.869	.852	.826	.815	.827	.772	.728	.760	.782	.834	.852	.805	.842	.819	.833	.804	.790	.733	**.699**

Note: α = alpha coefficient, 1 = Financial and insurance, 2 = Telecommunications, 3 = Professional services, 4 = Industrial machinery and equipment, 5 = Health care and social services, 6 = Aerospace and defense, 7 = Food and beverages, 8 = Construction and building materials, 9 = Industrial metals and mining; 10 = Automobile and parts, 11 = Oil and chemicals, 12 = Energy – electricity and gas, 13 = IT – software and electronics, 14 = Retail, 15 = Education, 16 = Public and state administration; 17 = Transport and logistics, 18 = Pharmaceuticals, 19 = Biotechnology and research, 20 = Media and publication.

Table 37

Estimates by Organizational Level, Functional Role, and Language

Factor	α	Staff	Man	Exec/Dir	Ops	Com	Sup	Oth	R&D	Span	Eng
Entrepreneurial	.781	.785	.776	.771	.781	.772	.789	.761	.775	.782	.740
Creativity	.755	.755	.745	.798	.754	.750	.740	.792	.733	.753	.773
Learning	.820	.818	.812	.848	.817	.838	.828	.772	.819	.825	.768
People	.712	.724	**.681**	.712	.722	.718	.705	.712	**.679**	.716	**.682**
Systems	.811	.817	.791	.825	.813	.829	.799	.785	.764	.814	.761
Projects	.819	.830	.790	.820	.809	.828	.807	.858	.758	.814	.854
Energize	.920	.920	.920	.916	.918	.924	.924	.884	.919	.923	.882
Engage	.837	.848	.819	.816	.842	.855	.820	.812	.791	.840	.790
Enable	.888	.894	.882	.862	.893	.891	.888	.833	.874	.893	.821
Ideate	.859	.866	.846	.854	.867	.861	.868	.831	.805	.864	.799
Shape	.785	.796	.771	.757	.796	.814	.770	.739	.708	.792	**.687**
Capture	.857	.861	.851	.845	.861	.871	.857	.816	.820	.862	.791
Collaboration	.827	.833	.813	.829	.836	.810	.822	.821	.807	.829	.801
Safety	.784	.791	.775	.762	.778	.786	.786	.787	.772	.784	.777
Simplicity	.768	.768	.754	.803	.764	.785	.755	.766	.743	.771	.730
External	.877	.881	.864	.882	.876	.882	.880	.870	.860	.878	.864
Enterprise	.842	.844	.835	.843	.842	.843	.847	.828	.820	.844	.826
Individual	.837	.843	.820	.842	.843	.841	.833	.792	.831	.841	.781

Note: α = alpha coefficient, Man = Manager, Exec/Dir = Executive or director, Ops = Operations, Com = Commercial, Sup = Support, Oth = Other, R&D = Research and development, Span = Spanish, Eng = English.

An Integrated Model of Culture of Innovation

A global measure of the culture of innovation is consistent with previously discussed instruments, such as those proposed by Aiman-Smith et al. (2005) and Dobni (2008). However, Aiman-Smith's et al. (2005) instrument reflected a less comprehensive view of the contributors to a culture of innovation, overlapped with other organizational culture constructs, and consisted of only nine factors – learning, customer orientation, business intelligence, business planning, meaningful work, risk-taking culture, empowerment, open communication, agile decision-making. Dobni's (2008) instrument tapped into each of the critical areas of innovation culture with seven factors – value orientation, creativity and empowerment, implementation context, innovation propensity, market orientation, organizational constituency, and organizational learning – but required 70 items to measure these constructs. It could be theorized that the Innovation Quotient instrument in this present study also consists of fewer than the original 18 factors, and captured the more comprehensive view of innovation culture with 54 or fewer items. With a possible consideration of nine observed variables per factor, improvement in the measurement model would be possible through item elimination, as necessary.

To evaluate the extent to which the factor structure of the integrated culture of innovation model, as measured by the Innovation Quotient instrument using a six-factor measurement model, better fits the data for this present study, a confirmatory factor analysis (CFA) was conducted using LISREL 9.2 (SSI, 2015). This proposed, integrated model is illustrated in Figure 12, where each of the blocks of a culture of innovation is represented as a factor instead of its own measurement model. As each of the instrument's items was measured on an ordinal scale, the polychoric correlation matrix was applied in the CFA instead of the Pearson correlation matrix (Tello, Moscoso, García, & Abad, 2010). Additional procedures for model specification, estimation, and analysis are summarized in Chapter 3.

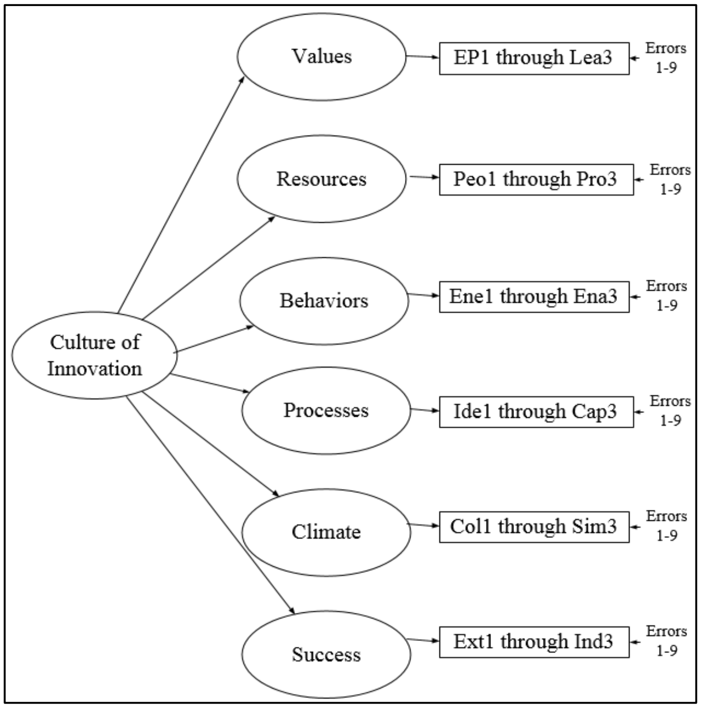

Figure 12. Proposed factor structure of culture of innovation (integrated model).

Iteration 1. Results for the initial integrated, six-factor model only approached acceptable levels for model fit, χ^2 = 45,281.565, *df* = 1,362, *CFI* = 0.891, *AGFI* = 0.995, *SRMR* = 0.033, *RMSEA* = 0.057 (0.057; 0.058) (Table 38). While performance on the AGFI and error indices of SRMR and RMSEA were desirable, the CFI still did not reach the recommended threshold of 0.10 (Hair, Black, Babin, & Anderson, 2010). Each of the standardized factor loadings were greater than 0.60 (Hair, Black, Babin, & Anderson, 2010). However, AVE and SIC values were also computed for each of the variables (AVE_{Values} = 0.515, $AVE_{Behaviors}$ = 0.514, $AVE_{Resources}$ = 0.566, $AVE_{Processes}$ = 0.523, $AVE_{Climate}$ = 0.672, $AVE_{Success}$ = 0.574), and it was identified that while each of the six factors had AVE values greater than 0.50, none of the factors demonstrated evidence of discriminant validity, as each of the SIC values exceeded that of the respective factors' AVE values. Therefore, additional improvement of the model was sought.

Table 38

CFA Results for Culture of Innovation (Integrated Model)

Model	χ^2	*df*	*CFI*	*AGFI*	*RMSEA*	*RMSEA CI$_{90}$*	*SRMR*
Iteration 1. 6-factor (54 items)	45,281.565*	1,362	0.891	0.995	0.057	(0.057; 0.058)	0.033
Iteration 2. 6-factor (50 items)	38,397.666*	1,160	0.898	0.996	0.057	(0.057; 0.058)	0.032
Iteration 3. 6-factor (46 items)	36,074.666*	974	0.891	0.992	0.061	(0.060; 0.061)	0.033

Note. **p* < .001. χ^2=Satorra-Bentler (1988) scaled chi-square; † = solution is not positive definite; CFI = comparative fit index; AGFI = adjusted goodness of fit index; RMSEA = root mean-square error of approximation; SRMR = standardized root mean square.

Iteration 2. Evaluation of the modification indices for error variances (theta-delta) and the content of those respective items revealed multiple items that could be strong candidates for elimination, which was expected to not only improve fit but remove redundancy and cross loading, as well as address poor discrimination. Model fit indices illustrated adverse errors for the following items: values (EP2, Lea1), behaviors (Ene1, Ena1, Ena3), resources (Peo2, Pro1), processes (Ide1, Ide3, Sha3, Cap1, Cap2), climate (Saf2, Col2, Sim2), and success (Ext2, Ext3, Ind2, Ent1). Each of these items was reviewed in both languages to determine if the item content appeared to be duplicative, difficult to understand, or difficult to interpret or generalize among multiple industries or organizational levels, or if there were other factors that could have been present, such as survey fatigue, etc. Table 39 summarizes the issues identified. The decision regarding whether to eliminate items or allow errors to correlate was considered based on Kline's (2011) checklist of mistakes in respecification (p. 356-366). Items with higher error variances, with a greater number of possible wording issues (Table 39), and where lesser theory could be identified, were considered for removal. Four items, indicated by an asterisk in Table 36, were removed for the second iteration of model specification, and the results are shown in the second row of Table 38.

Table 39

Content Issues Identified for Variant Items

Factor	Item	Possible Content Issue(s)
Values	EP2*	Double barreled; abstract wording
	Lea1**	Abstract wording; unclear literature support
	Cre2	Good item, but low reliability estimates (Table 33)
Behaviors	Ene1**	Double barreled; abstract wording
	Ena1	Abstract wording; unclear literature support
	Ena2**	Unclear literature support
	Ena3*	Abstract wording; level specific; unclear literature support
Resources	Peo2	Abstract; level specific; low reliability estimates (Table 33)
	Pro1	Duplicative language with Eng1
Processes	Ide1	Abstract wording; possibly duplicative with Saf3 and Ide2
	Ide3	Abstract wording; possibly duplicative with Ind3
	Sha3	Abstract wording
	Cap1*	Abstract wording; double barreled
	Cap2	Abstract wording; low factor loading
Climate	Saf2	Unclear literature support
	Col2**	Double barreled
	Sim2	Double barreled; low reliability estimates (Table 33)
Success	Ext2	Duplicative with Ext3; abstract wording; industry specific
	Ext3*	Duplicative with Ext2; abstract wording; industry specific
	Ind2	Double barreled; low factor loading; unclear literature support
	Ent1	Organization level or functional role specific

Note: *items removed in second iteration; **items removed in the third iterations

Results for the second six-factor model demonstrated acceptable levels for model fit, χ^2 = 38,397.666, *df* = 1,160, *CFI* = 0.898, *AGFI* = 0.996, *SRMR* = 0.032, *RMSEA* = 0.057 (0.057; 0.058) (Table 38), a result strikingly similar to the first iteration. Each of the standardized factor loadings were greater than 0.60 (Hair, Black, Babin, & Anderson, 2010), but AVE and SIC values (AVE_{Values} = 0.514, $AVE_{Behaviors}$ = 0.508, $AVE_{Resources}$ = 0.573, $AVE_{Processes}$ = 0.523, $AVE_{Climate}$ = 0.645, $AVE_{Success}$ = 0.565) still did not exceed the corresponding SIC values, again lacking evidence of discrimination among factors. To continue to investigate opportunities to improvement inter-factor discrimination, one final specification was considered.

Iteration 3. The third specification included the removal of additional items that demonstrated inter-factor cross loading, as identified through modification indices or standardized residuals. The content of each of these cross-loading items was examined, and items that were well-written and are critical to the theory of a culture of innovation were not removed. Only four items included questionable item content (Table 39) – Lea1, Ene1, Ena2, and Col2 – and were therefore removed for the final iteration.

Results for the third six-factor model demonstrated acceptable levels for model fit, χ^2 = 36,074.666, *df* = 974, *CFI* = 0. 891, *AGFI* = 0. 995, *SRMR* = 0. 033, *RMSEA* = 0. 061 (0.060; 0.061) (Table 38). Each of the standardized factor loadings exceeded 0.60 (Hair, Black, Babin, & Anderson, 2010), with the exception of Engage 1 at 0.521, and standardized path coefficients ranged from 0.521 to 0.833 (Figure 13, Table 40) and the amount of variance explained ranged from R^2 = 0.271 to 0.693 (Table 40). High structure coefficients for each of the three latent factors, which ranged from 0.440 to 0.791 (Table 40), corroborated multiple indirect relationships across the factors (Graham, Guthrie, & Thompson, 2003), and again failed to provide evidence for discrimination among factors, as the AVE values for each of the six factors (AVE_{Values} = 0.511, $AVE_{Resources}$ = 0.565, $AVE_{Behaviors}$ = 0.514, $AVE_{Processes}$ = 0..511, $AVE_{Climate}$ = 0.591, $AVE_{Success}$ = 0.565) also did not exceed the corresponding SIC values (Table 41).

Stage 2

As results from each of the previous analyses illustrated an opportunity to identify a model that demonstrates evidence for both convergent and discriminant validity, as well as reliability for multiple groups, the third research question was investigated in the second stage of the analysis. A plausible alternative factor structure of culture of innovation was sought, as well as information regarding the extent to which an alternative factor structure would demonstrate score reliability for multiple organizational groups. To accomplish this, exploratory factor analysis (EFA) procedures were conducted to identify a new plausible factor structure that would explain the greatest amount of variance in the model, produce a clean item pattern that would yield the best model fit, and reduce cross loading among factors (Henson & Roberts, 2006; Costello & Osborne, 2011; Farrell & Rudd, 2009). The steps that were used to iterate, identify, and propose a clean factor structure were conducted based on recommendations by Kieffer (1998), and were as follows: 1) identify the number of factors to retain; 2) conduct the factor analysis, fixing the solution to the appropriate number of factors; 3) interpret the results; 4) identify and select a single item to delete, if necessary; and 5) repeat the process, starting first with the next analysis to determine the number of factors to retain.

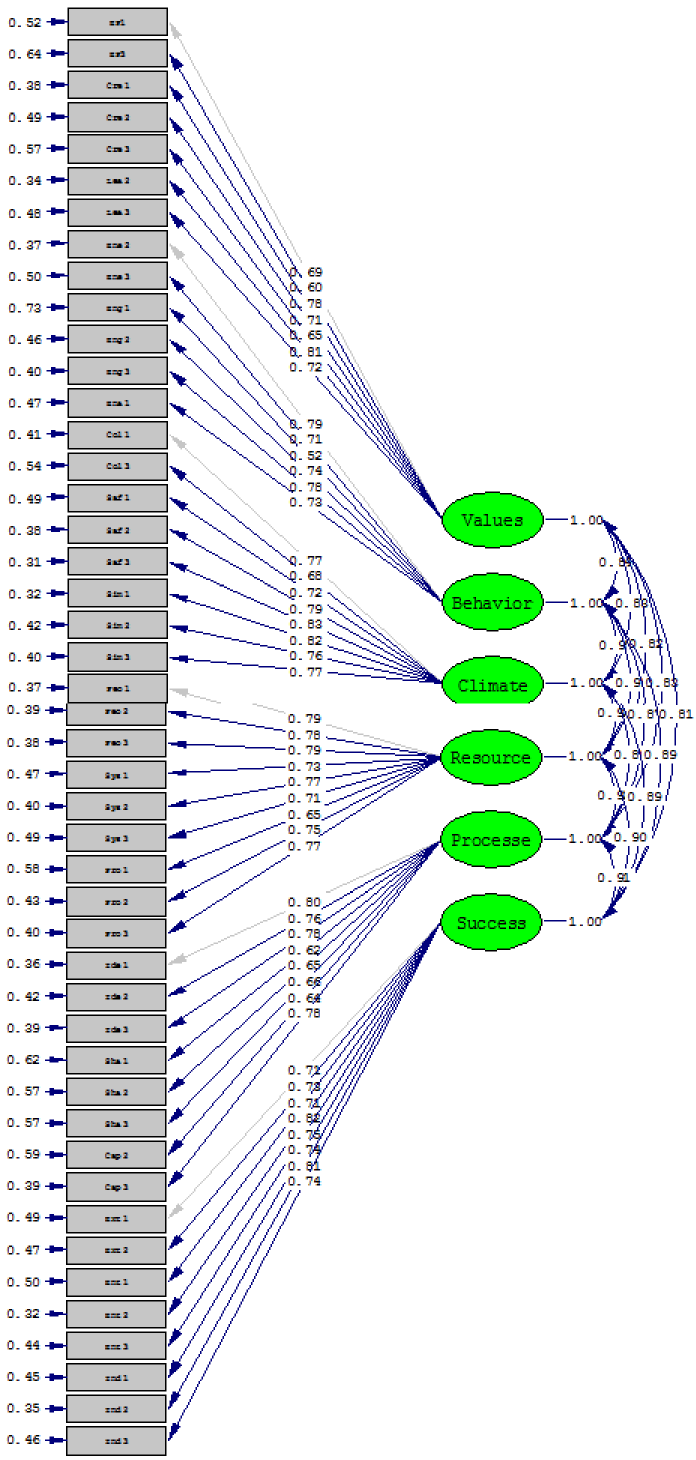

Figure 13. Standardized solution for culture of innovation (integrated model).

Table 40

Pattern Matrix for Culture of Innovation (Integrated Model)

Item	UC	EV	PC	R^2	Structure Coefficients					
					Val	Res	Beh	Pro	Cli	Suc
EP1	1.000	0.522 (0.013)	0.691	0.478	.	0.583	0.571	0.564	0.571	0.559
EP3	0.868 (0.012)	0.640 (0.014)	0.600	0.360	.	0.506	0.496	0.490	0.496	0.485
Cre1	1.135 (0.011)	0.384 (0.013)	0.785	0.616	.	0.663	0.648	0.641	0.649	0.635
Cre2	1.030 (0.013)	0.493 (0.014)	0.712	0.507	.	0.601	0.588	0.581	0.589	0.576
Cre3	0.944 (0.012)	0.574 (0.013)	0.653	0.426	.	0.551	0.539	0.533	0.540	0.528
Lea2	1.178 (0.012)	0.337 (0.013)	0.814	0.663	.	0.687	0.672	0.664	0.673	0.659
Lea3	1.047 (0.012)	0.477 (0.013)	0.724	0.523	.	0.611	0.598	0.591	0.599	0.586
Peo1	1.000	0.372 (0.012)	0.793	0.628	0.647	0.719	0.734	.	0.726	0.717
Peo2	0.989 (0.007)	0.385 (0.012)	0.784	0.615	0.640	0.711	0.725	.	0.718	0.709
Peo3	0.996 (0.007)	0.377 (0.012)	0.789	0.623	0.644	0.716	0.730	.	0.723	0.713
Sys1	0.920 (0.007)	0.469 (0.013)	0.729	0.531	0.595	0.661	0.674	.	0.668	0.659
Sys2	0.974 (0.007)	0.404 (0.012)	0.772	0.596	0.630	0.700	0.714	.	0.707	0.698
Sys3	0.900 (0.008)	0.491 (0.013)	0.714	0.509	0.583	0.648	0.660	.	0.654	0.645
Pro1	0.818 (0.008)	0.580 (0.013)	0.648	0.420	0.529	0.588	0.599	.	0.594	0.586
Pro2	0.952 (0.007)	0.431 (0.012)	0.754	0.569	0.615	0.684	0.697	.	0.691	0.682
Pro3	0.974 (0.007)	0.404 (0.012)	0.772	0.596	0.630	0.700	0.714	.	0.707	0.698
Ene2	1.000	0.370 (0.012)	0.794	0.630	0.670	.	0.754	0.720	0.693	0.707
Ene3	0.893 (0.008)	0.498 (0.013)	0.709	0.502	0.598	.	0.674	0.643	0.619	0.631
Eng1	0.656 (0.010)	0.729 (0.013)	0.521	0.271	0.440	.	0.495	0.473	0.455	0.464
Eng2	0.927 (0.007)	0.458 (0.013)	0.736	0.542	0.621	.	0.699	0.668	0.643	0.655
Eng3	0.979 (0.007)	0.396 (0.012)	0.777	0.604	0.656	.	0.738	0.705	0.678	0.692
Ena1	0.918 (0.008)	0.469 (0.013)	0.729	0.531	0.615	.	0.693	0.661	0.636	0.649
Ide1	1.000	0.356 (0.012)	0.803	0.644	0.664	0.701	0.711	0.736	.	0.728
Ide2	0.945 (0.007)	0.425 (0.012)	0.758	0.575	0.627	0.662	0.672	0.694	.	0.687
Ide3	0.974 (0.007)	0.388 (0.012)	0.782	0.612	0.647	0.683	0.693	0.716	.	0.708
Sha1	0.770 (0.009)	0.618 (0.013)	0.618	0.382	0.511	0.540	0.548	0.566	.	0.560
Sha2	0.814 (0.009)	0.573 (0.013)	0.653	0.427	0.540	0.570	0.579	0.598	.	0.592
Sha3	0.816 (0.008)	0.571 (0.013)	0.655	0.429	0.542	0.572	0.580	0.600	.	0.593
Cap2	0.800 (0.009)	0.588 (0.013)	0.642	0.412	0.531	0.560	0.569	0.588	.	0.582
Cap3	0.969 (0.007)	0.395 (0.012)	0.778	0.605	0.643	0.679	0.689	0.713	.	0.705
Col1	1.000	0.408 (0.012)	0.769	0.592	0.635	0.731	.	0.711	0.681	0.684
Col3	0.879 (0.008)	0.543 (0.013)	0.676	0.457	0.558	0.642	.	0.625	0.599	0.602
Saf1	0.931 (0.008)	0.487 (0.013)	0.716	0.513	0.591	0.680	.	0.662	0.634	0.637
Saf2	1.023 (0.007)	0.381 (0.012)	0.787	0.619	0.650	0.748	.	0.728	0.697	0.700
Saf3	1.082 (0.007)	0.307 (0.012)	0.833	0.693	0.688	0.791	.	0.771	0.738	0.741

(table continues)

Table 40 *(continued)*

Item	UC	EV	PC	R^2	*Structure Coefficients* Val	Res	Beh	Pro	Cli	Suc
Sim1	1.070 (0.007)	0.323 (0.012)	0.823	0.677	0.680	0.782	.	0.761	0.729	0.732
Sim2	0.993 (0.007)	0.417 (0.012)	0.764	0.583	0.631	0.726	.	0.707	0.677	0.680
Sim3	1.004 (0.008)	0.403 (0.012)	0.772	0.597	0.638	0.733	.	0.714	0.684	0.687
Ext1	1.000	0.492 (0.013)	0.713	0.508	0.577	0.635	0.635	0.645	0.646	.
Ext2	1.022 (0.008)	0.470 (0.013)	0.728	0.530	0.589	0.648	0.648	0.658	0.660	.
Ent1	0.992 (0.010)	0.500 (0.013)	0.707	0.500	0.572	0.629	0.629	0.639	0.641	.
Ent2	1.155 (0.009)	0.322 (0.012)	0.823	0.678	0.666	0.732	0.732	0.744	0.746	.
Ent3	1.046 (0.009)	0.444 (0.013)	0.745	0.556	0.603	0.663	0.663	0.673	0.675	.
Ind1	1.044 (0.010)	0.447 (0.013)	0.744	0.553	0.602	0.662	0.662	0.673	0.674	.
Ind2	1.135 (0.010)	0.346 (0.012)	0.809	0.654	0.654	0.720	0.720	0.731	0.733	.
Ind3	1.034 (0.010)	0.457 (0.013)	0.737	0.543	0.596	0.656	0.656	0.666	0.668	.

*$p < .05$, UC = unstandardized coefficients; EV = error variance; PC = pattern coefficients.

Table 41

Intra-construct Correlations, SIC, AVE, and CR

	Values	Resources	Behaviors	Processes	Climate	Success	**AVE**	**CR**
Values	1.000	0.666	0.712	0.684	0.682	0.654	**0.511**	**0.879**
Resources	0.816	1.000	0.823	0.839	0.856	0.817	**0.565**	**0.921**
Behaviors	0.844	0.907	1.000	0.762	0.903	0.792	**0.514**	**0.862**
Processes	0.827	0.916	0.873	1.000	0.785	0.821	**0.511**	**0.892**
Climate	0.826	0.925	0.950	0.886	1.000	0.792	**0.591**	**0.920**
Success	0.809	0.904	0.890	0.906	0.890	1.000	**0.565**	**0.912**

Note: Values below the diagonal are estimates of intra-construct correlations, and values above the diagonal are squared intra-construct correlations (SIC).

As it is known that the eigenvalue-greater-than-one rule has been shown to under- or over-estimate the number of factors that should be extracted (Zwick & Velicer, 1986), the Minimum Average Partial test and parallel analysis test (Henson & Roberts, 2006; O'Connor, 2000; Velicer, 1976), were conducted and interpreted in tandem. Also, theory and prior research have indicated that the factors relate to one another, so a principal axis factoring method was selected over the principal components analytic method, with the direct oblimin strategy of rotation and a delta value set to zero (Costello & Osborne, 2011). At each iteration of the analysis, multiple criteria were used to determine whether to remove or delete items based on the pattern matrix, such as items that did not load by at least 0.32 on any factor, or items that cross-loaded on more than one factor with a value greater than 0.32 (Costello & Osborne, 2011). Items with communality coefficients (h^2) less than 0.40 (Costello & Osborne, 2011) were considered in tandem with an examination of factor loadings and related item content, but evaluation of communalities was not used in isolation to remove items, as the goal was to retain the highest number of items possible.

To identify a clean, simple solution, a total of 14 iterations of exploration were completed. A parallel analysis and the minimum average partial (MAP) test were first conducted at each iteration to determine the number of factors to retain. Results from the parallel test produced the recommended extraction of a substantially high number of factors at each iteration (approximately 12 or more factors each time) and therefore the MAP results were interpreted to determine how many factors to retain, which was five factors for all 14 iterations. Table 42 presents a summary of each step completed in order to arrive at a simple structure.

The final solution that best fit the data according to the factor pattern is shown in Table 43. The principal axis factor analysis with the final 41 items in five factors explained a total of 59.82% of the variance, where five factors produced eigenvalues greater than one, but the first factor alone explained a total of 50.09% of that variance. With the exception of entrepreneurial 3, shape 3, and simplicity 2, each of the communality coefficients (h^2) were greater than 0.5, illustrating a desired amount of variance of each items with its corresponding factor (Costello, 2009). While a five-factor solution was identified, analysis of the structure coefficients indicates that most of the items still highly related not only to the factor on which it was intended to load, but also moderately on the other factors (Table 43), illustrating the concern with common method variance across all items. This was also illustrated through moderate to high inter-factor correlations (in absolute values) among factors, $r_{1,2}$ = 0.635, $r_{1,3}$ = 0.717, $r_{1,4}$ = 0.745, $r_{1,5}$ = 0.313, $r_{2,3}$ = 0.636, $r_{2,4}$ = 0.660, $r_{2,5}$ = 0.291, $r_{3,4}$ = 0.664, $r_{3,5}$ = 0.307, $r_{4,5}$ = 0.331, which were particularly high between the first and second factors.

Table 42

Steps to Complete Factor Analysis

Iteration	Factors retained	Item removed	Rationale
1	5		
2	5	Ind1	Highest loading = 0.264; abstract; fatigue
3	5	Peo3	Highest loading = 0.247; abstract; level specific
4	5	Ind2	Highest loading = 0.273; abstract; fatigue
5	5	Ide1	Highest loading = 0.292; double-barrelled
6	5	Sys3	Highest loading = 0.294; level specific
7	5	Ide2	Highest loading = 0.287; abstract; level specific
8	5	Ind3	Highest loading = 0.295; abstract; fatigue
9	5	Cre2	Good item, but cross-loads on two factors = 0.356, 0.441; duplicative with EP1; could be worded as “Our leaders provide us the freedom to pursue new opportunities.”
10	5	Cap2	Cross-loads on two factors = 0.471, 0.323; abstract; level specific
11	5	Sim1	Highest loading = 0.315; abstract; double-barrelled
12	5	Eng1	Cross-loads on two factors = 0.585, 0.322; double-barrelled about leadership and time
13	5	Saf3	Cross-loads on two factors = 0.345, 0.336; abstract; double-barrelled
14	5	Saf2	Highest loading = 0.276; abstract; relevance

Table 43

Pattern Matrix and Communality

	Pattern Matrix					Structure Matrix					
	1	2	3	4	5	1	2	3	4	5	h^2
Entrepreneurial 1		.651				.465	.724	.552	.519	.105	.561
Entrepreneurial 2		.709				.477	.729	.498	.480	.156	.538
Entrepreneurial 3		.570				.444	.617	.428	.418	.190	.387
Creativity 1		.656				.551	.775	.555	.601	.231	.617
Creativity 3		.735				.434	.718	.428	.476	.291	.527
Learning 1		.702				.477	.727	.462	.500	.288	.536
Learning 2		.646				.623	.785	.590	.582	.197	.648
Learning 3		.691				.527	.745	.480	.526	.290	.566
People 1				.677		.644	.646	.598	.812	.196	.691
People 2	.555					.703	.505	.542	.603	.129	.524
Systems 1	.512					.713	.515	.570	.626	.274	.532
Systems 2	.605					.766	.551	.607	.636	.254	.601
Projects 1	.556					.739	.619	.553	.636	.257	.590
Projects 2	.665					.721	.459	.558	.558	.124	.539
Projects 3	.678					.749	.508	.562	.592	.131	.579
Energize 1				.827		.689	.593	.618	.877	.190	.786
Energize 2				.792		.653	.593	.585	.843	.203	.722
Energize 3				.781		.708	.611	.616	.877	.249	.780
Engage 2	.453					.708	.590	.570	.634	.344	.553
Engage 3				.688		.655	.544	.550	.800	.384	.662
Enable 1				.715		.680	.560	.571	.828	.375	.705
Enable 2				.803		.607	.539	.566	.822	.378	.690
Enable 3				.747		.613	.560	.587	.810	.339	.665
Ideate 3	.424					.672	.534	.565	.593	.373	.503
Shape 1	.469					.717	.615	.617	.595	.365	.577
Shape 2	.459					.680	.490	.585	.577	.401	.517
Shape 3	.467					.623	.457	.516	.501	.404	.442
Capture 1	.424					.680	.547	.577	.595	.414	.530
Capture 3	.508					.742	.554	.656	.608	.365	.598
Collaboration 1	.463					.742	.575	.675	.621	.407	.622
Collaboration 2					.340	.586	.591	.606	.652	.549	.601
Collaboration 3					.381	.577	.602	.600	.647	.584	.625

(table continues)

Table 43 *(continued)*

	Pattern Matrix					Structure Matrix					
	1	2	3	4	5	1	2	3	4	5	h^2
Safety 1					.357	.606	.618	.631	.653	.570	.637
Simplicity 2					.345	.512	.480	.497	.551	.513	.453
Simplicity 3	.392					.697	.550	.628	.612	.488	.594
External 1			.717			.596	.524	.778	.527	.259	.609
External 2			.859			.598	.530	.841	.538	.245	.708
External 3			.832			.610	.534	.841	.563	.263	.708
Enterprise 1			.600			.575	.520	.729	.577	.253	.547
Enterprise 2			.537			.713	.596	.793	.644	.318	.678
Enterprise 3			.578			.601	.555	.744	.604	.248	.578
Trace	20.926	1.794	1.515	1.144	1.113						
Total Variance	50.09%	3.32%	2.90%	1.79%	1.72%						

Note: absolute values of factor loadings are shown; loadings less than 0.32 left blank; h^2 = *communality*

Regardless of moderate to high factor correlations, it was expected that the simple structure identified through the exploratory factor analysis would yield a better fit over the original structure as well as reduce cross loading among factors, (Henson & Roberts, 2006; Costello & Osborne, 2011; Rao & Weintraub, 2013). The principal axis factoring produced a solution that grouped items together in a surprising yet meaningful way. For example, people 1 loaded onto the factor that resembled the original behaviors factors, which is a logical pairing for an item that states "We have committed leaders who are willing to be champions of innovation." In a similar manner, engage 2, an item formerly tapping the behaviors factor, loaded higher on the factor that resembles the original resources factor, stating "In our organization, people at all levels proactively take initiative to innovate," which may hint in content that those resources or systems are diffused throughout the organization, and may therefore be more similar to the former resources and processes items. Simplicity 3 loaded higher on this factor as well, suggesting that "Our people know exactly how to get started and move initiatives through the organization," which may involve those structures or processes that have been established to facilitate innovative activity. As the exploratory analysis yielded these findings and others, the following model (Figure 14) was proposed as a plausible alternative factor structure of a culture of innovation using the second half of the dataset, which would therefore be tested for additional evidence for convergent and discriminant validity as well as reliability for organizational groups.

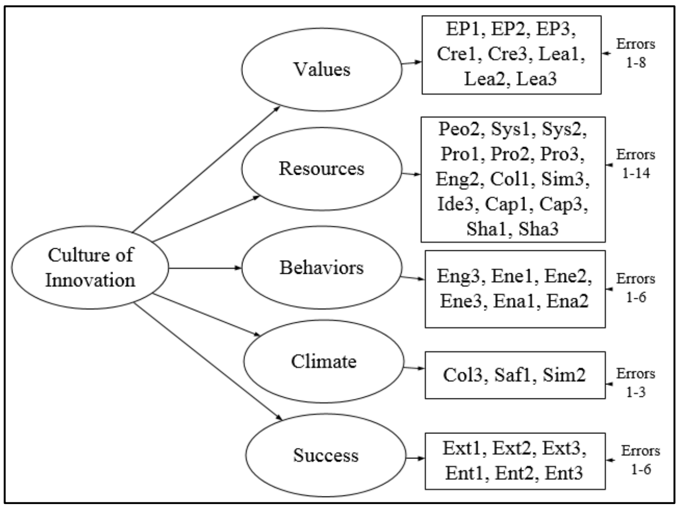

Figure 14. Proposed factor structure for culture of innovation (alternate model).

Cross-validation

To evaluate the extent to which the alternate factor structure of culture of innovation demonstrated evidence for convergent and discriminant validity and reliability, confirmatory factor analytic procedures and score reliability estimates were conducted using the second half of the dataset (n_2 = 9,921) to ensure that the changes are valid across new samples (Byrne, Shavelson, & Muthén,1989).

Data screening. The data screening procedures completed for the first half of the data set were also conducted using the second half to ensure accuracy and reliability of the results. Item descriptives were analyzed for each of the models' items using SPSS version 22 (IBM Corp., 2013) and are shown in Table 44. Most of the values also demonstrated a negative skew, indicating a preference for general agreement higher than the mean for the scales. While the large sample size (n_2 = 9,921) drove standard errors low, leading to highly inflated *z*-scores for skewness, this was not determined as problematic (Field, 2009), even though many of the individual items exceeded the recommended thresholds of the absolute value of ±3.0 (Kline, 2011). No items exceeded Kline's (2011) recommended threshold of ±20.0 for *z*-kurt. These findings showed, similar to the first half of the data set, the item distributions were appropriate for continued analysis.

Pearson item correlations for all items were evaluated to assess relationships for the alternative instrument (Table 45). Each of the item-correlations within the newly proposed factors produced a statistically significant result at the $p < .01$ level, which again was most likely a function of the large sample size (n_2 = 9,921) and were moderate to high within each factor (Hair, Black, Babin, & Anderson, 2010). Also, the assumption of multivariate normality was assessed using LISREL 9.2 (SSI, 2015) based upon Mardia's recommendations (Mardia, 1985; SSI, 2015). Extreme, statistically significant values for *z*-skew and *z*-kurt showed that the model did not meet the criteria for multivariate normality (z_{skew} = 140.809, p<.001, z_{kurt} = 143.388, p<.001, χ^2 = 40,387.421, p<.001; Mardia, 1985), which Kline (2011) affirmed may occur in large samples. Therefore, it was again determined that an unweighted least squares method (ULS) of estimation was necessary for this analysis (Forero, Maydeu-Olivares, & Gallardo-Pujol, 2009).

Table 44

Item Descriptives

Block	Item	Mean	*SD*	skew	z-skew	kurt	z-kurt
Values	Entrepreneurial 1	3.851	0.960	-0.742	-30.174	0.268	5.456
	Entrepreneurial 2	3.447	0.962	-0.365	-14.860	-0.263	-5.355
	Entrepreneurial 3	3.259	0.988	-0.233	-9.472	-0.418	-8.505
	Creativity 1	3.540	0.998	-0.505	-20.557	-0.206	-4.193
	Creativity 3	3.484	1.077	-0.402	-16.342	-0.531	-10.809
	Learning 1	3.535	0.962	-0.430	-17.487	-0.204	-4.144

(table continues)

Table 44 *(continued)*

Block	Item	Mean	*SD*	skew	z-skew	kurt	z-kurt
	Learning 2	3.292	1.024	-0.226	-9.204	-0.515	-10.480
	Learning 3	3.321	1.091	-0.296	-12.030	-0.653	-13.276
Behaviors	People 1	3.352	1.143	-0.377	-15.344	-0.632	-12.843
	Engage 3	3.178	1.030	-0.290	-11.776	-0.431	-8.764
	Energize 1	3.217	1.119	-0.311	-12.635	-0.656	-13.341
	Energize 2	3.198	1.133	-0.267	-10.852	-0.710	-14.431
	Energize 3	3.102	1.078	-0.197	-7.997	-0.609	-12.395
	Enable 1	3.115	1.010	-0.226	-9.184	-0.424	-8.613
	Enable 2	3.315	1.027	-0.413	-16.795	-0.348	-7.078
	Enable 3	3.343	1.023	-0.439	-17.859	-0.289	-5.869
Resources	People 2	2.919	1.108	0.004	0.158	-0.752	-15.296
	Systems 1	3.021	1.064	-0.123	-4.991	-0.560	-11.381
	Systems 2	3.107	1.027	-0.154	-6.275	-0.565	-11.485
	Projects 1	2.850	1.101	0.040	1.641	-0.741	-15.074
	Projects 2	2.978	1.091	-0.044	-1.772	-0.670	-13.634
	Projects 3	2.953	1.120	-0.052	-2.131	-0.773	-15.719
	Engage 2	2.797	1.027	0.150	6.103	-0.571	-11.614
	Collaboration 1	2.948	1.043	-0.043	-1.733	-0.611	-12.422
	Simplicity 3	3.022	1.000	-0.094	-3.821	-0.537	-10.929
	Ideate 3	3.126	0.989	-0.232	-9.443	-0.330	-6.711
	Capture 1	2.807	1.109	0.051	2.081	-0.769	-15.648
	Capture 3	3.000	1.031	-0.084	-3.425	-0.523	-10.641
	Shape 1	2.998	0.989	-0.055	-2.242	-0.482	-9.794
	Shape 2	3.118	1.010	-0.171	-6.971	-0.479	-9.749
	Shape 3	2.984	0.970	-0.105	-4.290	-0.281	-5.723
Success	External 1	3.337	1.037	-0.285	-11.610	-0.414	-8.414
	External 2	3.270	1.043	-0.216	-8.797	-0.376	-7.652
	External 3	3.255	1.013	-0.206	-8.366	-0.246	-4.997
	Enterprise 1	3.446	1.040	-0.432	-17.583	-0.262	-5.327
	Enterprise 2	3.240	1.012	-0.229	-9.295	-0.374	-7.601
	Enterprise 3	3.496	0.988	-0.414	-16.852	-0.157	-3.200
Climate	Collaboration 2	3.358	1.001	-0.380	-15.462	-0.301	-6.128
	Collaboration 3	3.451	1.011	-0.452	-18.396	-0.264	-5.376
	Safety 1	3.451	0.976	-0.508	-20.654	-0.079	-1.611
	Simplicity 2	3.086	1.068	-0.164	-6.663	-0.656	-13.345

Table 45

Inter-item Correlations

Values	EP1	EP2	EP3	Cre1	Cre3	Lea1	Lea2	Lea3
EP1	1.000							
EP2	.637	1.000						
EP3	.425	.483	1.000					
Cre1	.594	.553	.486	1.000				
Cre3	.438	.461	.407	.509	1.000			
Lea1	.473	.454	.389	.546	.585	1.000		
Lea2	.555	.531	.463	.610	.508	.608	1.000	
Lea3	.458	.495	.438	.545	.591	.541	.608	1.000

Behaviors	Peo1	Eng3	Ene1	Ene2	Ene3	Ena1	Ena2	Ena3
Peo1	1.000							
Eng3	.635	1.000						
Ene1	.742	.667	1.000					
Ene2	.696	.644	.801	1.000				
Ene3	.733	.693	.795	.786	1.000			
Ena1	.648	.754	.695	.673	.712	1.000		
Ena2	.651	.689	.687	.657	.700	.743	1.000	
Ena3	.648	.685	.684	.664	.698	.705	.758	1.000

Resources	Peo2	Sys1	Sys2	Pro1	Pro2	Pro3	Eng2	Col1	Sim3	Ide3	Cap1	Cap3	Sha1	Sha2	Sha3
Peo2	1.00														
Sys1	.549	1.00													
Sys2	.592	.649	1.00												
Pro1	.545	.548	.577	1.00											
Pro2	.504	.504	.542	.577	1.00										
Pro3	.559	.517	.584	.606	.636	1.00									
Eng2	.527	.537	.563	.589	.500	.537	1.00								
Col1	.547	.536	.571	.563	.499	.550	.609	1.00							
Sim3	.495	.525	.543	.554	.466	.491	.584	.599	1.00						
Ide3	.462	.497	.524	.528	.481	.489	.522	.543	.533	1.00					
Cap1	.476	.510	.520	.548	.461	.473	.557	.575	.564	.499	1.00				
Cap3	.508	.523	.547	.556	.542	.525	.558	.623	.571	.537	.624	1.00			
Sha1	.504	.495	.531	.567	.485	.514	.567	.598	.555	.598	.584	.631	1.00		
Sha2	.471	.488	.524	.505	.469	.485	.521	.561	.534	.535	.539	.568	.589	1.00	
Sha3	.417	.449	.460	.470	.405	.430	.467	.496	.487	.538	.520	.521	.544	.513	1.00

(table continues)

Table 45 *(continued)*

Success	Ext1	Ext2	Ext3	Ent1	Ent2	Ent3
Ext1	1.000					
Ext2	.712	1.000				
Ext3	.673	.752	1.000			
Ent1	.546	.565	.596	1.000		
Ent2	.611	.622	.646	.682	1.000	
Ent3	.582	.594	.623	.587	.642	1.000

Climate	Col2	Col3	Saf1	Sim2
Col2	1.000			
Col3	.663	1.000		
Saf1	.649	.718	1.000	
Sim2	.514	.522	.520	1.000

Note: all correlations are statistically significant at $p < .01$.

Iteration 1. An initial CFA model was conducted to identify the best fit for the alternate factor structure (Table 46). Results for the first run of the five-factor model (Figure 14) with 41 items approached a desirable model fit, χ^2 = 36,871.422, *df* = 769, *CFI* = 0.880, *AGFI* = 0.994, *SRMR* = 0.037, *RMSEA* = 0.069 (0.069; 0.070). However, to increase model fit, additional model specifications were considered, as squared interfactor correlations exceeded the individual AVE values for each factor, demonstrating lesser evidence for discriminant validity. To attempt to increase AVE values and decrease cross-loading, it was identified through an examination of the modification indices and standardized residual values that multiple items could be candidates for deletion, such as people 1, collaboration 2, enable 3, and shape 3. Examination of item content for the indicators of collaboration 2, enable 3, and shape 3 revealed existing issues, as determined in previous analyses (see Table 39), and were deleted. While people 1 did not present apparent content issues, it was also deleted, as it cross-loaded with multiple items across multiple factors – a surprising yet meaningful result.

Iteration 2. A second CFA model was completed using the remaining 37 items (Table 46). A strikingly similar result was produced, where the model still approached an acceptable model fit, χ^2 = 29,024.467, *df* = 619, *CFI* = 0.893, *AGFI* = 0.995, *SRMR* = 0.035, *RMSEA* = 0.068 (0.068; 0.069), where each of these values met acceptable thresholds, except for the *CFI*, which was just beneath the desired threshold of 0.900. Even with the elimination of four items with significant interfactor cross-loading, SIC values exceeded at each iteration corresponding AVE values, indicating that the factors still did not discriminate. Based on this repeated finding, and the identification of high structure coefficients, it was determined that discrimination would most likely not be achieved without significantly reducing the number of items in the model. Therefore, a final iteration was considered to improve model fit where errors would be allowed to correlate. An analysis of the modification indices, coupled with an evaluation of content similarity, indicated a significant improvement in estimates if the errors of the following pairs of items correlated – entrepreneurial 1 and entrepreneurial 2, learning 1 and creativity 3, systems 1 and people 2, projects 2 and projects 3, and enterprise 2 and enterprise 3.

Iteration 3. A final CFA was conducted with the remaining 37 variables, allowing the errors of the four following pairs to correlate – entrepreneurial 1 and entrepreneurial 2, learning 1 and creativity 3, systems 1 and people 2, projects 2 and projects 3, and enterprise 2 and enterprise 3 (Table 46). The model demonstrated an acceptable model fit, χ^2 = 21,984.960, *df* = 614, *CFI* = 0. 919, *AGFI* = 0. 996, *SRMR* = 0. 032, *RMSEA* = 0. 060 (0. 060; 0. 060), and each of these values met acceptable thresholds. Each of the standardized factor loadings exceeded 0.60 (Hair et al., 2010) (Figure 15), but the AVE values for each of the six factors (AVE_{Values} = 0.507, $AVE_{Behaviors}$ = 0.566, $AVE_{Resources}$ = 0.573, $AVE_{Success}$ = 0.533, and $AVE_{Climate}$ = 0.640) did not exceed corresponding SIC values, although these relationships were closer to thresholds than in previous analyses (Table 47). Standardized path coefficients ranged from 0.608 to 0.869, where an increase of one unit in the latent factor of values, for example, would produce an increase of

0.703 on EP1. The amount of variance explained for each item ranged from R^2 = 0.370 to 0.756 (Table 48). High structure coefficients for each of the three latent factors, which ranged from 0.458 to 0.796 (Table 48), corroborated multiple indirect relationships across the factors (Graham, Guthrie, & Thompson, 2003) and again failed to provide evidence for discrimination among factors.

Table 46

CFA Results for Culture of Innovation (Alternate)

Model	χ^2	*df*	*CFI*	*AGFI*	*RMSEA*	*RMSEA* CI_{90}	*SRMR*
5 factor, 41 variables	36,871.422*	769	0.880	0.994	0.069	(0.069; 0.070)	0.037
5 factor, 37 variables	29,024.467*	619	0.893	0.995	0.068	(0.068; 0.069)	0.035
5 factor, 37 variables, corr errors	21,984.960*	614	0.919	0.996	0.060	(0.060; 0.060)	0.032

Note. *$p < .001$. χ^2=Satorra-Bentler (1988) scaled chi-square; CFI = comparative fit index; AGFI = adjusted goodness of fit index; RMSEA = root mean-square error of approximation; SRMR = standardized root mean square.

Table 47

Intra-construct Correlations, SIC, AVE, and CR

	Values	Behaviors	Resources	Success	Climate	**AVE**	**CR**
Values	1.000	0.585	0.672	0.650	0.569	**0.507**	**0.891**
Behaviors	0.765	1.000	0.832	0.726	0.659	**0.566**	**0.887**
Resources	0.820	0.912	1.000	0.865	0.745	**0.573**	**0.882**
Success	0.806	0.852	0.930	1.000	0.889	**0.533**	**0.872**
Climate	0.754	0.812	0.863	0.943	1.000	**0.640**	**0.842**

Note: Values below the diagonal are estimates of intra-construct correlations, and values above the diagonal are squared intra-construct correlations (SIC).

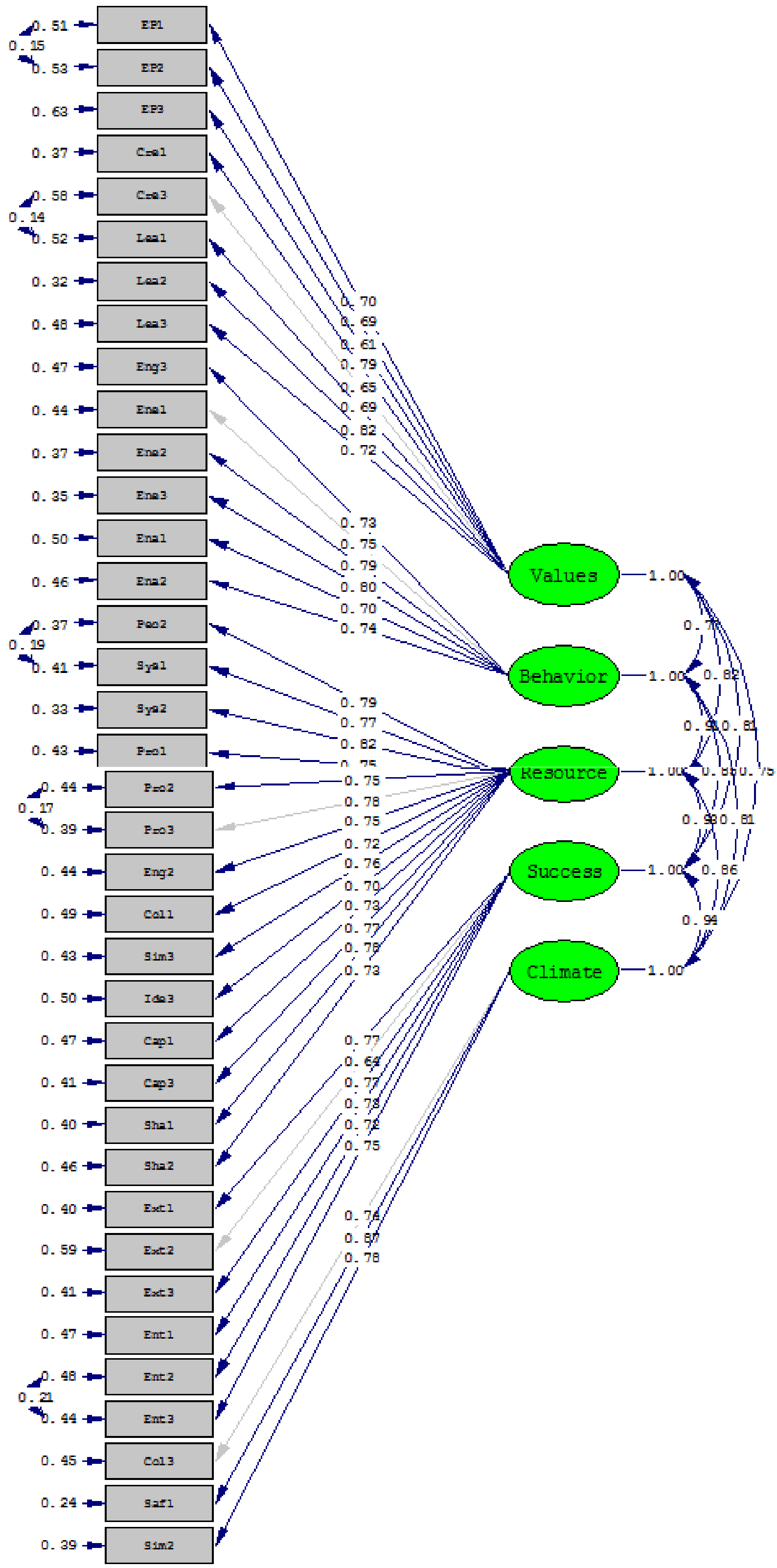

Figure 15. Standardized solution for culture of innovation (alternate model).

Table 48

Pattern and Structure Coefficients for Culture of Innovation (Alternate)

				Structure Coefficients					
Item	UC	EV	PC	Values	Behaviors	Resources	Success	Climate	R^2
EP1	1.086 (0.015)	0.505 (0.013)	0.703	.	0.538	0.576	0.567	0.530	0.495
EP2	1.058 (0.015)	0.530 (0.014)	0.685	.	0.524	0.562	0.552	0.516	0.470
EP3	0.939 (0.015)	0.630 (0.014)	0.608	.	0.465	0.499	0.490	0.458	0.370
Cre1	1.226 (0.015)	0.369 (0.013)	0.794	.	0.607	0.651	0.640	0.599	0.631
Cre3	1.000	0.580 (0.014)	0.648	.	0.496	0.531	0.522	0.489	0.420
Lea1	1.066 (0.013)	0.523 (0.013)	0.690	.	0.528	0.566	0.556	0.520	0.477
Lea2	1.270 (0.015)	0.323 (0.013)	0.823	.	0.630	0.675	0.663	0.621	0.677
Lea3	1.113 (0.013)	0.480 (0.013)	0.721	.	0.552	0.591	0.581	0.544	0.520
Eng3	0.977 (0.009)	0.469 (0.013)	0.729	0.558	.	0.693	0.661	0.636	0.531
Ene1	1.000	0.444 (0.013)	0.746	0.571	.	0.709	0.677	0.651	0.556
Ene2	1.061 (0.008)	0.374 (0.012)	0.791	0.605	.	0.751	0.717	0.691	0.626
Ene3	1.077 (0.009)	0.355 (0.012)	0.803	0.614	.	0.763	0.728	0.701	0.645
Ena1	0.944 (0.010)	0.504 (0.013)	0.704	0.539	.	0.669	0.639	0.615	0.496
Ena2	0.989 (0.009)	0.456 (0.013)	0.738	0.565	.	0.701	0.669	0.644	0.544
Peo2	1.017 (0.006)	0.375 (0.012)	0.791	0.649	0.751	.	0.732	0.701	0.625
Sys1	0.985 (0.006)	0.412 (0.012)	0.767	0.629	0.729	.	0.709	0.680	0.588
Sys2	1.053 (0.006)	0.329 (0.012)	0.819	0.672	0.778	.	0.758	0.726	0.671
Pro1	0.970 (0.007)	0.430 (0.012)	0.755	0.619	0.717	.	0.698	0.669	0.570
Pro2	0.966 (0.006)	0.435 (0.012)	0.752	0.617	0.714	.	0.696	0.666	0.565
Pro3	1.000	0.395 (0.012)	0.778	0.638	0.739	.	0.720	0.689	0.605
Eng2	0.962 (0.006)	0.440 (0.012)	0.748	0.613	0.711	.	0.692	0.663	0.560
Col1	0.921 (0.007)	0.487 (0.013)	0.716	0.587	0.680	.	0.662	0.634	0.513
Sim3	0.973 (0.007)	0.427 (0.012)	0.757	0.621	0.719	.	0.700	0.671	0.573
Ide3	0.905 (0.008)	0.504 (0.013)	0.704	0.577	0.669	.	0.651	0.624	0.496
Cap1	0.935 (0.007)	0.470 (0.012)	0.728	0.597	0.692	.	0.673	0.645	0.530
Cap3	0.986 (0.007)	0.412 (0.012)	0.767	0.629	0.729	.	0.709	0.680	0.588
Sha1	0.999 (0.007)	0.396 (0.012)	0.777	0.637	0.738	.	0.719	0.688	0.604
Sha2	0.941 (0.007)	0.464 (0.012)	0.732	0.600	0.695	.	0.677	0.649	0.536
Ext1	1.210 (0.013)	0.404 (0.012)	0.772	0.622	0.700	0.714	.	0.707	0.596
Ext2	1.000	0.593 (0.013)	0.638	0.514	0.579	0.590	.	0.584	0.407
Ext3	1.201 (0.012)	0.413 (0.012)	0.766	0.617	0.695	0.709	.	0.702	0.587
Ent1	1.145 (0.013)	0.467 (0.013)	0.730	0.588	0.662	0.675	.	0.669	0.533
Ent2	1.129 (0.013)	0.481 (0.013)	0.720	0.580	0.653	0.666	.	0.660	0.519
Ent3	1.168 (0.013)	0.445 (0.013)	0.745	0.600	0.676	0.689	.	0.682	0.555
Col3	1.000	0.448 (0.013)	0.743	0.560	0.649	0.658	0.681	.	0.552
Saf1	1.170 (0.009)	0.244 (0.012)	0.869	0.655	0.759	0.770	0.796	.	0.756
Sim2	1.055 (0.009)	0.386 (0.013)	0.783	0.590	0.684	0.694	0.717	.	0.614

*$p < .05$; UC = unstandardized coefficients; EV = error variance; PC = pattern coefficients.

Score Reliability. While a lack of evidence for discriminant validity was identified, estimates of score reliability, as measured by coefficient alpha, were computed for the second half of the dataset (*n_2* = 9,921) for each of the factors in the alternate model, and by countries, industries, employee levels, functional roles, and the languages of instrument administration. Estimates were only computed for groups that had a minimum sample size of 30. Tables 49 through 51 illustrate that all these estimates exceeded Nunnally's (1978) recommended threshold of 0.70, with many of them higher than 0.90 for the alternate model, surpassing the estimates identified by the original model and in previous literature (e.g. Aiman-Smith et al., 2005; Anderson & West, 1998; Dobni, 2008; Kuščer, 2013; Remneland-Wikhamn & Wikhamn, 2011; and Tohidi, Seyedaliakbar & Mandegari, 2012). Confidence intervals for score reliability estimates are shown in Appendix C.

Table 49

Factor Score Reliability Estimates and Estimates by Country

Factor	α	1	2	3	4	5	6	7	8	9	10
Values	**.894**	.887	.886	.888	.872	.872	.866	.870	.868	.820	.861
Resources	**.944**	.934	.946	.943	.930	.944	.956	.924	.950	.886	.969
Behaviors	**.949**	.947	.947	.943	.927	.950	.949	.904	.950	.902	.929
Success	**.910**	.900	.890	.924	.909	.927	.912	.878	.921	.881	.924
Climate	**.854**	.837	.849	.846	.831	.833	.878	.809	.890	.761	.921

Note: *α* = alpha coefficient for *n_2* = 9,921, 1 = Spain, 2 = Chile, 3 = Colombia, 4 = United States, 5 = Panama, 6 = El Salvador, 7 = Portugal, 8 = Mexico, 9 = Germany, 10 = Scotland.

Table 50

Factor Score Reliability Estimates by Industry

Factor	1	2	3	4	5	6	7	8	9	10
Values	.896	.911	.906	.889	.891	.881	.867	.861	.846	.863
Resources	.953	.957	.939	.949	.930	.924	.928	.932	.919	.932
Behaviors	.952	.957	.951	.942	.943	.950	.919	.936	.927	.937
Success	.929	.914	.915	.908	.903	.890	.835	.921	.866	.853
Climate	.871	.875	.852	.863	.825	.819	.822	.843	.788	.843
	11	12	13	14	15	16	17	18	19	
Values	.890	.849	.857	.893	.870	.879	.878	.834	.779	
Resources	.918	.934	.922	.932	.929	.905	.930	.923	.888	
Behaviors	.941	.932	.927	.936	.934	.945	.940	.942	.930	
Success	.910	.896	.898	.851	.875	.831	.913	.851	.892	
Climate	.797	.830	.833	.831	.842	.759	.844	.802	.801	

Note: 1 = Financial and insurance, 2 = Telecommunications, 3 = Professional services, 4 = Industrial machinery and equipment, 5 = Health care and social services, 6 = Aerospace and defense, 7 = Food and beverages, 8 = Construction and building materials, 9 = Industrial metals and mining; 10 = Automobile and parts, 11 = Oil and chemicals, 12 = Energy – electricity and gas, 13 = IT – software and electronics, 14 = Retail, 15 = Education, 16 = Public and state administration; 17 = Transport and logistics, 18 = Pharmaceuticals, 19 = Biotechnology and research.

Table 51

Estimates by Organizational Level, Functional Role, and Language

Factor	Staff	Man	Exec/Dir	Ops	Com	Sup	Oth	R&D	Span	Eng
Values	.897	.892	.884	.894	.900	.894	.876	.884	.896	.874
Resources	.949	.934	.939	.945	.946	.943	.939	.929	.945	.932
Behaviors	.952	.944	.944	.950	.947	.950	.929	.945	.951	.925
Success	.915	.901	.908	.910	.910	.918	.903	.891	.911	.904
Climate	.864	.835	.842	.852	.860	.861	.834	.830	.856	.833

Note: Man = Manager, Exec/Dir = Executive or director, Ops = Operations, Com = Commercial, Sup = Support, Oth = Other, R&D = Research and development, Span = Spanish, Eng = English.

CHAPTER 5

DISCUSSION AND RECOMMENDATIONS

This chapter will summarize and discuss the findings yielded from the current investigation, as well as offer recommendations and implications for future research and practice. The first section will summarize and discuss the current findings and conclusions from this present study. The next section will present recommendations for theory and practice, as well as offer opportunities for improvement in the measurement and analysis of culture of innovation for practitioners. The final section will analyze the impact of the study's limitations and delimitations on the findings, which may inform recommendations for future research.

Summary of Findings

The purpose of this study was to assess the construct validity and reliability of the Innovation Quotient instrument (Rao & Weintraub, 2013). This study employed multiple data analytic strategies to examine the hypothesized factor structure of each of the six measurement models within the instrument by estimating model fit, inter-item relationships, evidence for discriminant validity, and reliability across groups for each of the models. It was determined that those six measurement models, though showing adequate fit using the first half of the dataset (n_1 = 9,860) did not produce evidence for discriminant validity or consistently demonstrate score reliability for all organizational groups, and therefore additional measurement models were explored. As it was expected that common method variance may have played a role within each model, reducing factor discrimination, an integrated measurement model consisting of all 54 variables was investigated, in which each of the previous six measurement models were specified as six first-order factors within one global measure. Once it was determined that this six-factor, integrated model also illustrated acceptable model fit but poor discrimination across the factors, an alternate factor structure was investigated using exploratory factor analytic procedures.

The exploratory factor analysis, conducted via cross-validation using the second half of the dataset (n_2 = 9,921), produced a five-factor model consisting of 41 variables, but was reduced to 37 variables, with some item errors allowed to correlate. This short-form, so to speak, of the Innovation Quotient instrument demonstrated acceptable model fit as well but still did not discriminate across the five factors, as indicated by average variance extracted values falling below the related factors' squared interconstruct correlations. Therefore, it was concluded that the alternate measurement model demonstrated evidence for convergent validity and reliability for the organizational groups of countries, industries, employee levels, functional roles, and the languages of instrument administration but did not produce evidence for discriminant validity. Interconstruct correlations consistently produced values too high for appropriate factor differences to be detected, which may threaten the validity of findings in future studies in which relationships are investigated (Farrell, 2010; Lissitz & Samuelsen, 2007). An integration of the findings of the original confirmatory factor analysis, coupled with the exploratory factor analysis and validation on an independent dataset, provided preliminary evidence that the five-factor model does fit the data. However, additional work is needed to validate and improve the psychometric properties of the item inventory and final instrument.

Recommendations for Theory and Practice

Throughout each step of the current investigation, many surprising yet meaningful findings were identified at the measurement, factor, and item levels that may have implications for future theory and practice.

The measurement level. While few modern methodologists would advocate for the analysis of goodness of fit indices alone as the sole evidence for assessment instrument validity, the results of this present study illustrate quite emphatically that model fit should be accompanied by other analytic strategies to validate instrumentation. A total of 32 confirmatory factor analyses were conducted for this present study, with ten of them producing results that were either non-positive definite or provided results for which errors could not be computed. Of these 32 analyses, all but three demonstrated desirable goodness fit, as measured by a value of greater than 0.9 for the *CFI* and greater than 0.95 for the *AGFI,* and the final three tests of the integrated model of culture of innovation approached acceptable fit with a minimum value of *CFI* of 0.891 (Table 35). Each of the analyses also demonstrated *RMSEA* values with an upper bound confidence interval that did not exceed 1.0. However, none of the 32 models produced evidence for discriminant validity, an expected result for factors theorized to be related when evaluating relationships using structural models. The only minor exception to this finding was the discrimination between ideate and capture in the original model for processes, in which the AVE for ideate (AVE = 0.672, CR = 0.860) exceeded the squared interfactor correlation between ideate and capture ($SIC_{Ideate,Capture} = 0.615$) (Table 24). Of considerable note is the finding that an alternative factor model of culture of innovation better fit the data than the original model, which was due to the elimination of items with content issues, or the respecification of items due to better alignment to reference point, such as people 1 loading better onto behaviors than resources. Even when a higher order factor was included in each of the original six models as a way to control for the lack of factor discrimination, model fit was not improved or reduced, rendering the exact nature of the relationships for each model unclear.

Lehmann's (1975) list of limitations of interpreting goodness of fit measures – including imperfect model operationalization, measurement model mis-specification, spurious correlations, stochastic influences, and measurement/scale problems – certainly were exemplified in this present study. Lehmann's (1975, p. 741) observation that "when such consistency bias is present, the goodness of fit measures among the affected variables are artificially increased" is one plausible explanation for why goodness of fit indices were identified regardless of the fact that factorial discrimination was not, a finding echoed by Hayduk (2014), who also offered that “a research commitment to understanding the world’s causal structure, combined with clear examples of factor mismodeling should spur diagnostic assessment of significant factor model failures” (p. 905). This result carries significant implications for a better understanding of the latent factor and its subsequent effects, which can be used to find a model that better illustrates the cause and effect relationships that facilitate innovation.

The factor level. In order to identify an alternate factor structure, an exploratory factor analysis was conducted, which produced a five-factor solution. It was identified that while five factors were extracted due to the results of the Minimum Average Partial (MAP) test, one of those five explained a cumulative 50.09% of the total variance extracted (Table 40). While it is certainly important to consider the extent to which this high amount of variance explained was due to an unknown common factor, as Harman’s (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003) test may have indicated, additional structures produced by the pattern matrix (Table 40) may also shed light on this critical factor. There were a total of 15 items that were retained in the model that loaded moderately onto that factor, which most closely resembled the original resources and processes factors, which the EFA collapsed. In particular there were seven items that loaded on the factor greater than 0.5, which included the following – people 2, “We have access to innovation experts who can support our projects”; systems 1, “We have the right recruiting and hiring systems in place to support a culture of innovation”; systems 2, “We have good collaboration tools to support our innovation efforts”; projects 1, “We give people dedicated time to pursue new opportunities”; projects 2, “We have dedicated finances to pursue new opportunities”; projects 3, “We have dedicated physical and/or virtual space to pursue new opportunities"; and capture 3, "We rapidly allocate resources to scale initiatives that show market promise". While common method issues may have confounded the weights of these items to that first factor, an evaluation of the structure matrix indicated that these seven items had the highest relationships to the first factor, regardless of whether it is a common method factor, at r = .703, .713, .766, .739, .721, .749, and .742, respectively. This finding was corroborated in the CFA using the second dataset, where high standardized factor loadings (>0.7) for each of these items were identified for its latent factor. Therefore, the theme and/or pattern across the content of each of these items – that they each relate to the resources an organization should have in place to make innovation possible – explain high levels of variance that may be a useful finding to practitioners interested in identifying key actions they may take to create a culture of innovation.

The consideration of the resources that facilitate innovativeness – the innovation experts, recruiting and hiring systems, collaboration tools, dedicated finances, dedicated time to pursue opportunities, and the physical and virtual space – has surfaced in the innovation literature in general (e.g. Google's '20% time'; Gersch, 2013), but has yet to be included in many of the most heavily cited instruments that measure a culture of innovation (Table 4). Constructs such as support for innovation (Aiman-Smith et al., 2005), implementation context (Dobni, 2008), structure and process (Humphreys et al., 2005), forefront of technology (Susanj, 2000), the external environment (Tohidi, Seyedaliakbar, & Mandegari, 2012), and related ideas have been measured, but an opportunity exists to better identify the specific resources that are critical to the success of innovative efforts and measure the extent to which those resources are present within organizations.

A secondary observation that emerged is the nature of the high relationships among each of the factors (Table 44) but particularly between resources and behaviors ($r_{Resources,Behaviors}$ = 0.912), resources and success ($r_{Resources,Success}$ = 0.930), and success and climate ($r_{Success,Climate}$ = 0.943), which each exceeded 0.9. Structure coefficients (Table 44) were high across all factors, but were the highest among the items of resources with the behaviors factor, followed closely by the success factor, which has elsewhere been hypothesized to be an outcome of innovative activities and behaviors (Rao & Chuan, 2013). Considering the relationship among these factors, additional learning may be warranted for both practitioners and researchers to investigate how specific leadership behaviors are employed to remove obstacles and enable the allocation of Resources to pursue innovative solutions, or how leadership behaviors affect respondents' perceptions of success.

Item content level. The Innovation Quotient (Rao & Weintraub, 2013) instrument was selected for this present study due to its user-friendliness and comprehensiveness in addressing some of the key factors that contribute to a culture of innovation, as identified in the previous literature (see Chapter Two). However, while these building blocks, or factors, were amply supported by the literature, the items themselves had not been tested to identify the extent to which they accurately measure these critical factors. Throughout each step in the current study, any subtle issues with item content, such as items that were abstractly worded, double-barreled, or required specialized knowledge available only to specific organizational levels (i.e. specific to senior leaders or strategists), produced item level errors or cross-loadings that reduced overall model fit or factor discrimination. Other items may not have loaded highly on any of the five factors, which may have also contributed to some of the overall error in the model. Some of the items that generated such noise are summarized in Table 39 or in the EFA portion of Chapter

Four. However, a brief review of the content of each of the 54 items in the inventory reveals multiple content issues that future researchers or users of the instrument may wish to remedy (Appendix C.3). Some of these remedies may include the following:

1. Clarify the object of the measurement or frame of reference: For many of the items in the Innovation Quotient instrument, it is unclear what object is being measured by the descriptors. For example, in entrepreneurial 1's "we have a burning desire to explore opportunities and to create new things", it is unclear to what unit the respondent must associate the "we", or by what frame of reference the participant must respond to the descriptor – whether it be one's own local team, the division, or the entire organization. Likewise, in energize 3 the participant must respond to "our leaders model the right innovation behaviors for others to follow", but it is unclear whether the participant is being asked to evaluate his or her own direct supervisor, division or unit leader, or the senior most leaders of the organization. By providing reference materials, such as a glossary, that clarify the terms included in the items, greater accuracy could be ensured (Kasunic, 2005; Leung, 2001).
2. Clarify which items are best suited for each level of the organization and validate those items with those audiences: While the instrument's items demonstrated appropriate levels of reliability across different organizational areas, levels, and industries for n_2, the inventory of items in the Innovation Quotient contained some items that may be better suited for specific areas. A content analysis of many the items that were removed from either the six-factor or the alternate five-factor models demonstrated that many included content knowledge or expertise that only a few people in the organization would know – specifically division or senior leaders. For

example, in external 3 or xystems 3, it is reasonable to expect that only leaders may know the extent to which, “our innovation efforts have led us to better financial performance than others in our industry,” and “we are good at leveraging our relationships with suppliers and vendors to pursue innovation,” but many front line employees may not. Likewise in people 3, “we have the internal talent to succeed in our innovation projects” may be an item to which certain human resources or senior leader teams may confidently be able to respond. On the other side of the spectrum, there are many items that would be useful for leaders to know how front line staff or middle managers would respond, such as to creativity 2, “our workplace provides us the freedom to pursue new opportunities”, or any of the items that evaluate “our leaders” as a source of leadership and action toward innovation. Therefore, future researchers may choose to investigate the development of level-specific tools that can assess those factors that contribute to innovation at the relevant level of the organization, which may be useful to practitioners and leaders who seek to measure and evaluate this construct within their organizations (Kasunic, 2005).

3. Clarify the key content for each factor and vary the question stems to tap those factors: It was determined in the current investigation that common method variance was present across the entire instrument, with a total of 50.12% variance explained for all 54 items, and greater than 50% variance explained within each of the six original, hypothesized factors (Table 12). A review of the item content in both the Spanish and English languages demonstrates that a majority of the items begin with similar language – “we” and “our leaders” in English and various forms of the “nosotros” and “nuestros líderes” in Spanish. By identifying the key nugget of the

item, and varying the language to address it, respondents may be forced to mentally reload each item anew, reducing cognitive load and improving accuracy (Kasunic, 2005).

Limitations, Delimitations, and Recommendations for Future Research

The current investigation's limitations and delimitations may limit the generalizability of the findings, many of which can be monitored and addressed in future research.

Limitations

There were two key limitations identified in Chapter 1 that may have affected the generalizability of the results. The first limitation was the consideration and use of a newly-developed instrument that was based on evidence that factors of a culture of innovation relate with each other and predict innovation in organizations. However, the instrument had yet to be validated beyond its initial use by the author. The second limitation was the use of cross-sectional survey administration for each of the 54 items on the instrument. These limitations certainly manifested themselves in the final results, where each of the six original measurement models failed to produce evidence for divergent validity due to high squared inter-factor correlations, some of which were possibly due to the common method variance identified in the model (Tables 15, 18, 21, 24, 27, and 30).

Common method variance. Common method designs can threaten the accuracy of the findings by presenting the inconsistency in reference points, model error in observer effects, hide the sensitivity of the construct, dispositional characteristics, or situational characteristics (Donaldson & Grant-Vallone, 2002). Sources of common method variance in survey instruments may include common rater effects (consistently motifs, social desirability, leniency biases, acquiescence, mood states), item characteristic effects (item social desirability, item demand and ambiguity, common scales, and positive and negatively worded items), item context effects (item printing effects, item embeddedness, context-induced mood, scale length, and grouping of items on the questionnaire), and measurement context effects (predictor and criterion variables measured at the same point, location, and medium) (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003).

Researchers who have studied common method variance have articulated its effects on inter-item relationships, and have made recommendations for how to reduce those effects on the validity of findings, which include both instrument design methods and statistical controls (Lindell & Whitney, 2001; Meade, Watson, & Kroustalis, 2007; Podsakoff, MacKenzie, Lee, & Podsakoff, 2003). While some design methods proposed by Lindell and Whitney (2001) would not apply to this present study (such as reverse coding to address acquiescence, or reducing items to address boredom or fatigue), other recommendations could be applied, such as the reduction of items with similar wording or stems, or the inclusion of a marker variable intended to detect relationships to theoretically irrelevant behaviors. To this list Podsakoff, MacKenzie, Lee, and Podsakoff (2003) add the procedural remedies of collecting data from different sources, separating the predictors and criterion variables, protecting anonymity and reduce apprehension, counterbalancing the question order, and improving the wording of the scale items, such as removing double-barreled language, avoiding vague concepts, keeping questions simple, and defining terms. Also, Little & Rhemtulla (2013) recommended the use of planned missing data using multiform designs to reduce the cost of administration, participant fatigue, and therefore increase instrument validity and statistical power. Finally, ensuring a more heterogeneous sampling strategy, and avoiding expected similarity in response patterns, can help alleviate issues with common variance. However, when such better practices cannot be established, statistical controls can be put in place to alleviate the issues produced by common methods. These statistical controls include the following: 1) the use of Harman's (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003) single factor test to evaluate if common method variance is present within the model; 2) conducting partial correlation procedures to control for biases; 3) controlling for the effects of a directly measured latent methods factor by allowing items to load on their theoretical constructs in addition to a common latent factor; 4) controlling for the effects of an unmeasured latent methods factor by allowing items to load on their theoretical constructs in addition to a common latent factor, and then interpreting the structural relationships with and without the latent factor; and 5) using the multiple method factors, or a confirmatory factor analysis of the MTMM model (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003).

None of the instruments evaluated in the review of the literature and considered for this study (Table 4) addressed common method variance. This present study attempted to correct for such affects by testing for common method variance using Harman's test, as well as including a common latent factor within the model, which often produced nonpositive definite results. Future researchers, however, may wish to employ both survey design and sampling remedies, as well as statistical controls, to evaluate, reduce, and better interpret common method effects.

Delimitations

Multiple constraints, or delimitations, were placed upon the study. First, while multiple measures of culture of innovation have surfaced in the literature, this study employed the Innovation Quotient (2013) instrument due its alignment with the literature in organizational culture, its comprehensiveness in integrating the scope of literature in the field of innovation, and its accessibility and user-friendliness to a wide audience of varying educational backgrounds and abilities. While the comprehensive nature of the instrument was one of the key criteria used to identify the instrument, it also became apparent through the assessment of model fit that comprehensiveness also increased the inclusion of measurement error into the model, which in turn negatively affected discriminant validity.

Discriminant validity. Discriminant validity is evident when a set of variables that theoretically measure different constructs indeed present intercorrelations that are not too high (Kline, 2011). According to Farrell and Rudd (2009), "if discriminant validity is not established, then conclusions made regarding relationships between constructs under investigation may be incorrect. For example, the strength of a relationship could be overestimated, or a relationship may be confirmed when in fact there is no real relationship" (p. 6). When issues with discriminant validity persist – or when squared inter-construct correlations (SIC) among factors exceed the average variance extracted (AVE) of the respective individual factors – remedies should be applied to increase evidence for the discriminant validity (Fornell & Larcker, 1981). Some of these remedies might include using stratified sampling procedures, increasing the AVE through deletion of items with high error variances, creating item subsets if theory warrants, and using the multitrait multimethod matrix if mixed method designs are possible (Fornell & Larcker, 1981).

As future researchers will wish to examine the structural relationships among relevant factors that contribute to a culture of innovation, or those factors themselves, discriminant validity must be examined to ensure conclusions from those findings can reasonably be made. Future researchers also may wish to reduce factor cross loading by reducing the total number of items to measure the key constructs, balancing comprehensiveness with parsimony.

The second delimitation placed upon the investigation was the use of secondary data to evaluate the key research question, where multiple best practices in survey administration (discussed in Chapter 1) were not guaranteed. One of these issues that may have threatened the results was the aggregation of data across multiple organizational groups, and particularly across the administration languages of both Spanish and English. For this present study, the data used to assess the measurement models were pooled because practitioners typically analyze performance in aggregate, but reliability estimates across many groups indicated inconsistencies of item-relatedness for n_1. Inconsistency as a threat to validity has already been identified by previous researchers, who noted differences in the factors of a culture of innovation, as well as the items used to measure those factors, among groups such as industries, countries, employee levels, and functional roles (e.g. Aiman-Smith et al., 2005; Birken et al., 2013; Çakar & Ertürk, 2010; Kaufman, Tsangar, & Vrontis, 2012; Kuščer , 2013; Hoffman, 1999; Kesting & Parm Ulhøi, 2010; Lee, Chen, Tsui, & Yu, 2014; McAdam, Keogh, Reid, & Mitchell, 2007; Moosa & Panurach, 2008; O'Connor, Roos, & Vickers-Willis, 2007; Sun, Wong, Zhao, & Yam, 2012; Susanj, 2000). Therefore, a recommended next step for the current instrument and other related instruments is to assess the property of measurement invariance.

Measurement invariance. As results from this investigation and previous findings recommend that greater attention be paid to understanding performance within organizational subcultures, an opportunity exists for researchers and organizational leaders to assess measurement model fit across multiple groups. In order to ensure that the items can be interpreted to mean the same thing to all groups of participants, the researcher or analyst who collects and reports the results must ensure a few key prerequisites are met, such as use of same scales, and controlling for item artifacts caused by item wording, ordering, and meaning – a property known as *measurement invariance* (Eid & Rauber, 2000). To date, a literature search using the terms *culture of innovation AND measurement invarianc*e produces few results and demonstrated that previous researchers deploying instruments of culture of innovation have not investigated measurement invariance.

The investigation of measurement invariance is to study the extent to which the factors that constitute the construct(s) of interest in the investigation remain the same for each of the groups for which it is intended to indicate performance. Vandenburg and Lance (2000) presented some of the key considerations that guide the study of measurement invariance: 1) the extent to which respondents from different cultures interpret a measure in a similar way; 2) the extent to which rating sources define values similarly on identical dimensions; 3) the extent to which other individual differences affect responses on an instrument; 4) or the extent to which the intervention of measurement itself affects how a respondent rates over time. Such an assessment of invariance has demonstrated its usefulness in organizational sciences, and can therefore aid in the understanding of the meaning and interpretation of cultural measures, particularly measures of perception, beliefs, or attitudes for culture of innovation (e.g., Alam, 2010; Nimon & Reio, 2011; Vandenberg & Lance, 2000; Wu, Li, & Zumbo, 2007). Once the design and deployment of the current instrument is improved using best practices, and a fitting factor structure is identified, future researchers may wish to test for measurement invariance for each of the demographic variables or organizational groups for which additional comparisons might be made.

Conclusion

The purpose of this study was to assess the construct validity and reliability of the Innovation Quotient instrument (Rao & Weintraub, 2013). Using a dataset obtained from the instrument's author, it was determined that the six original measurement models each demonstrated adequate model fit, but did not produce desirable evidence for divergent validity for each of the first-order factors within each of the six models, or consistent reliability for multiple organizational groups. An integrated measurement model consisting of six factors aligned to the theorized building blocks of a culture of innovation was also tested but also did not discriminate well across these factors. Through a final exploratory factor analysis, an alternate model was proposed, which identified a total of 37 items across five factors in alignment with the previous blocks stated by Rao and Weintraub (2013) – values, behaviors, resources, success, and climate. This model was tested in an independent dataset using a final confirmatory factor analysis, which demonstrated adequate model fit when correlating errors and reliability across multiple organizational groups, but did not discriminate among the five factors.

Some key implications for future theory were presented, which included an increased attention to the factors of resources and behaviors as key constructs in measuring culture of innovation, and the identification of the individual items that better operationalize each of the key factors of innovation culture. Key implications for practitioners who deploy a measure of culture of innovation in their organizations included greater clarification of the object of measurement, use of alternative short forms that vary by organizational level or role in the organization, and other administration methods to reduce common method variance, such as the use of item randomization, planned missing data, and avoiding abstract or double-barreled items. Additional opportunities for additional research included the identification of fewer items that measure the key constructs as a way to temper factor discrimination, identification of an alternate model to increase model fit and reliability while avoiding multicollinearity, and testing for measurement invariance across organizational groups among which practitioners may wish to compare item and factor level performance. This study contributes to the body of knowledge regarding the measurement of a culture of innovation, and exemplifies the importance of adherence to best practice in instrument design, deployment, and analysis.

APPENDIX A

PERMISSIONS

Appendix A.1: Permission to use Innovation Quotient Instrument

From: Rao, Jay <raoj@babson.edu> Sent: Wed 12/3/2014 1:4

To: Danks, Shelby

Cc: Weintraub, Joseph

Subject: RE: Request: Use of Building Blocks of Innovation Survey and Initial Results

Hi Shelby,

It was good to chat with you just now.

As I mentioned when we spoke, you can use our instrument only for the purpose of your Ph.D. dissertation.

Please get in touch with me in Jan. and hopefully our database will be more robust at that time for you to do some analysis.

Regards,
Jay

Jay Rao, Professor, Innovation & Strategy

INNOVATION REVEALS THE UNKNOWN, REDEFINES THE KNOWN & RENEWS THE WORN!

From: Danks, Shelby Sent: Wed 12/3/2014 1:33

To: Rao, Jay (raoj@babson.edu)

Cc:

Subject: Request: Use of Building Blocks of Innovation Survey and Initial Results

Dear Dr. Jay Rao and Dr. Joseph Weintraub:

My name is Shelby Danks, and I am a doctoral student in the Applied Technology and Performance Improvement department at the University of North Texas in Denton, TX. In my research I am investigating the factors that contribute to a culture of innovation in a healthcare setting, and would specifically like to assess the extent to which our measures of culture of innovation are invariant between groups, such as between clinical and nonclinical work units, and between leaders and front line employees.

I have identified that your *Innovation Quotient* survey, published in the Spring 2013 MIT Sloan Management Review, would be useful for my research needs, as well as for helping organizations move to the next level in their efforts to understand their culture of innovation. I am writing to request your permission to use the *Innovation Quotient* survey/instrument. I am planning to administer your instrument (with slight language modifications) within a large healthcare system. I would be happy to share with you the results of the study.

In addition I would like to ask if you would be willing to share with me your results that demonstrate evidence for the validity and reliability of your instrument. Would you be willing to present some of the results you obtained from the 15 companies you originally investigated?

Thank you very much for replying to my request. Please feel free to contact me if you require further information.

Respectfully yours,

Shelby Danks, MSEd | Program Manager, Journey to Excellence

Appendix A.2: Permission to use Dataset

InnoQuotient

Dear Friend(s),

InnoQuotient is owned and managed by academics. This License Agreement has not been drawn up by lawyers. We work on the basis of trust, faith, integrity, good will and reciprocity—all the goodness in humans. So, we hope this document is just a formality.

Thanks You.

Jay Rao and Joe Weintraub

License Agreement

This License Agreement ("Agreement") is made on **April 29, 2015** between **InnoQuotient LLC** ("Licensor") of **Needham, MA** and **SHELBY DANKS** ("Licensee") of **Arlington, TX** for a license to use **InnoQuotient: Culture of Innovation Assessment** (the "Product") and the resulting data (the "Data") collected through the use of the Product.

The parties agree to the following:

1. **The purpose** of this agreement is to grant the Licensor the possession and control of the Product, the Data and any results from the analysis of the Data for the relation of academic learning and mutual collaboration between the Licensor and the Licensee.

2. **License:** Licensor grants the Licensee a non-exclusive license to use the Product and the Data as per this Agreement only. All other rights to the Product, including copyright and other intellectual property rights relating to the Product are retained by the Licensor. The Service clauses are listed below.

3. **Permitted Uses:** Licensee may only use the Product and the Data as follows:

A. Use the dataset to conduct tests to validate the psychometric properties of the instrument, etc., and test measurement invariance between subgroups specified in the dataset
B. To publish the results externally, without the names of the firms in the database.
C. Use and process the Data in collaboration with the Licensor to identify trends and prove hypothesis
D. The licensee must not share the data nor the results from the analysis of the data without the written consent from the Licensor
E. The Licensee must disclose every use of the Data and every use or publication resulting from the analysis of the Data will have to be previously approved by the Licensor

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F. The fee charged to a company for the use of the Product via the Licensee will be specified on a case by case basis, according to the Licensor's judgment.
G. As a diagnostic tool to assess and evaluate the Licensee's Customer's Innovation Culture;
H. To use the Product only within the Licensee's Customers' functions, departments, regions, and wholly-owned subsidiaries;
I. This agreement will be valid during 1 year.

4. **Prohibited Uses:** Licensee and its customers are prohibited from using the Product as follows:

A. Using any aspect of the Product as part of a trade-mark, design-mark, trade name;
B. Incorporating the Product in any way that results in a re-distribution or reuse of the Product or is otherwise made available in a manner such that a third party can extract or access or reproduce the Product;
C. Removing any notice of copyright, trade-mark or other proprietary right from any place where it is on or embedded in the Product;
D. Sub-license, re-sell, rent, lend, assign, gift or otherwise transfer or distribute the Product or the rights granted under this agreement;
E. Use the Product to make personnel decisions of hiring, firing, promotion, demotions, re-assignments. If used in such a manner, the Licensee is fully liable for all outcomes of such decisions.

5. **Term:** The grant of this license is effective as of the signing of this Agreement and shall continue in effect for a period of **One-Year**.

6. **Liability:** The Licensor is not liable for any of the following:

A. damages, claims, losses, awards, or injuries incurred by any third party, including reasonable attorney's fees, which arise from any alleged use and/or breach of this Agreement by the Licensor. This liability shall survive the termination of this Agreement.
B. The outcomes and/or results of decisions—resource allocations, personnel appointments/changes—made by the Licensor based on the results of the Product.
C. The Licensee´s Employer   is not liable for any claim, damage, looses, award or injuries incurred by any activity related to this agreement

InnoQuotient

By signing this Agreement the parties acknowledge they have read the entire Agreement and fully understand the terms, conditions and obligations of this Agreement.

Licensor
InnoQuotient LLC.

Name: Jay Rao / Joe Weintraub	
Title: Principal(s), InnoQuotient LLC	
Address:	
Tel:	

Date: 29th April 29, 2015

Licensee
Shelby Danks

Name: Shelby Danks	
	Applied Technology in Performance Improvement College of Information University of North Texas 3940 North Elm, Suite A-160 Denton, TX 76207-7102 USA

Date: 29 - Apr - 2015

Innovation Strategy Culture of Innovation Coaching for Creativity Leading Change

APPENDIX B

IRB DOCUMENTS

B.1 IRB Certificate of Completion

Certificate of Completion

The National Institutes of Health (NIH) Office of Extramural Research certifies that **Shelby Danks** successfully completed the NIH Web-based training course "Protecting Human Research Participants".

Date of completion: 11/27/2011

Certification Number: 810422

B.2 IRB Letter of Approval

Date: August 28, 2015 at 3:03:36 PM CDT
Subject: IRB 15-343

The UNT Institutional Review Board has jurisdiction to review proposed "research" with "human subjects" as those terms are defined in the federal IRB regulations. The phrase "human subjects" is defined as follows:

> "A living individual about whom an investigator (whether professional or student) conducting research obtains (1) Data through intervention or interaction with the individual, or (2) Identifiable private information.

Since the data you will be obtaining has been totally de-identified, then your use of that data falls outside the scope of the "human subjects" definition and UNT IRB review and approval is not required.

We appreciate your efforts, however, to comply with the federal regulations and sincerely thank you for your IRB application submission!

Thank You,

Jordan Harmon | Research Compliance Analyst II
Office of Research Integrity and Compliance

APPENDIX C

CONFIDENCE INTERVALS FOR SCORE RELIABILITIES

Appendix C.1. Confidence Intervals for Score Reliability Estimates and Factor Estimates by Country for n_1

Model	*α*	Factor	α	1	2	3	4	5	6	7	8	9
Values	.901, .906	Entrepreneurial	.773, .788	.782, .801	.736, .770	.676, .746	.691, .776	.683, .776	.647, .754	.571, .795	.500, .781	.619, .834
		Creativity	.746, .763	.715, .741	.711, .749	.681, .749	.752, .821	.682, .775	.652, .758	.743, .877	.567, .810	.717, .876
		Learning	.814, .826	.795, .813	.783, .812	.816, .855	.707, .788	.793, .854	.790, .854	.773, .892	.733, .883	.696, .867
Resources	.901, .906	People	.702, .721	.674, .703	.700, .739	.693, .759	.640, .739	.680, .774	.667, .768	.647, .831	.619, .833	.535, .797
		Systems	.804, .817	.778, .797	.798, .824	.785, .831	.705, .786	.804, .861	.805, .864	.724, .869	.796, .910	.602, .826
		Projects	.812, .825	.787, .806	.758, .789	.815, .855	.840, .884	.823, .875	.869, .909	.798, .904	.617, .832	.777, .903
Behaviors	.947, .950	Energize	.917, .923	.913, .921	.908, .920	.891, .914	.870, .906	.909, .935	.906, .935	.876, .941	.889, .951	.782, .905
		Engage	.831, .842	.808, .825	.834, .856	.807, .848	.767, .831	.817, .871	.799, .860	.791, .900	.783, .905	.586, .819
		Enable	.884, .892	.875, .886	.876, .893	.869, .897	.781, .842	.897, .927	.877, .914	.799, .904	.832, .926	.661, .852
Processes	.919, .923	Ideate	.855, .864	.839, .853	.852, .871	.822, .860	.756, .823	.879, .915	.851, .896	.815, .912	.752, .891	.735, .884
		Shape	.778, .792	.733, .757	.818, .842	.755, .807	.613, .719	.789, .851	.737, .817	.739, .876	.763, .896	.563, .809
		Capture	.852, .862	.836, .851	.826, .849	.864, .893	.743, .814	.854, .897	.854, .898	.782, .896	.782, .904	.716, .876
Climate	.903, .909	Collaboration	.821, .833	.811, .828	.788, .816	.771, .820	.769, .833	.778, .843	.798, .859	.766, .888	.717, .876	.735, .884
		Safety	.776, .791	.753, .775	.763, .794	.684, .752	.769, .832	.791, .852	.711, .798	.710, .862	.460, .763	.675, .858
		Simplicity	.760, .776	.734, .758	.733, .768	.689, .755	.700, .782	.750, .823	.690, .784	.722, .867	.604, .826	.387, .732
Success	.920, .925	External	.873, .881	.851, .865	.843, .864	.893, .916	.824, .873	.905, .933	.901, .931	.757, .884	.850, .934	.805, .915
		Enterprise	.836, .847	.834, .849	.773, .803	.819, .857	.821, .871	.814, .869	.817, .873	.750, .881	.647, .845	.615, .832
		Individual	.831, .842	.825, .840	.808, .833	.793, .837	.756, .823	.835, .883	.785, .850	.777, .894	.782, .904	.640, .843

Note: *α* = alpha coefficient, 1 = Spain, 2 = Chile, 3 = Colombia, 4 = United States, 5 = Panama, 6 = El Salvador, 7 = Portugal, 8 = Mexico, 9 = Germany.

Appendix C.2. Confidence Intervals for Score Reliability Estimates by Industry for n_1

Factor	1	2	3	4	5	6	7	8	9	10
Entrepreneurial	.745, 778	.784, .825	.799, .841	.727, .785	.796, .843	.761, .817	.705, .787	.638, .743	.592, .712	.697, .794
Creativity	748, .780	.733, .784	.775, .822	.736, .792	.672, .748	.700, .771	.680, .769	.637, .742	.570, .696	.615, .738
Learning	837, .858	.818, .852	.797, .840	.775, .823	.752, .810	.779, .831	.742, .814	.682, .774	.737, .814	.685, .785
People	.737, .771	.719, .772	.669, .738	.654, .728	.624, .711	.656, .737	.616, .723	.578, .700	.572, .698	.640, .755
Systems	.835, .856	.810, .846	.806, .847	.783, .829	.744, .803	.733, .796	.746, .817	.702, .788	.683, .776	.657, .766
Projects	.843, .863	.824, .858	.789, .833	.809, .850	.751, .809	.728, .792	.753, .822	.707, .792	.679, .773	.641, .755
Energize	.920, .930	.920, .935	.925, .941	.908, .928	.897, .921	.903, .926	.858, .897	.862, .902	.861, .902	.867, .909
Engage	.845, .865	.845, .874	.815, .854	.820, .858	.784, .834	.780, .832	.771, .835	.722, .802	.742, .818	.733, .818
Enable	.902, .915	.889, .910	.880, .905	.854, .885	.852, .886	.870, .900	.787, .846	.793, .853	.821, .873	.829, .884
Ideate	.870, .887	.869, .894	.836, .870	.835, .870	.853, .887	.812, .856	.825, .874	.754, .825	.771, .838	.750, .829
Shape	.810, .835	.841, .871	.730, .787	.780, .827	.730, .793	.654, .735	.702, .785	.649, .751	.649, .752	.593, .723
Capture	.888, .902	.867, .892	.833, .868	.823, .861	.786, .835	.817, .860	.770, .834	.732, .809	.697, .786	.782, .852
Collaboration	.829, .852	.816, .850	.825, .861	.808, .849	.758, .814	.811, .855	.735, .809	.683, .775	.718, .801	.759, .835
Safety	.786, .814	.784, .825	.759, .809	.752, .805	.723, .787	.764, .819	.731, .806	.584, .704	.714, .798	.592, .722

(table continues)

Appendix C.2 *(continued)*

Factor	1	2	3	4	5	6	7	8	9	10
Simplicity	.779, .808	.784, .825	.727, .784	.767, .817	.696, .767	.696, .767	.674, .765	.586, .706	.631, .739	.564, .703
External	.920, .931	.857, .884	.854, .885	.862, .891	.825, .865	.837, .875	.737, .810	.824, .875	.814, .868	.697, .794
Enterprise	.851, .870	.824, .857	.838, .872	.831, .867	.801, .847	.812, .856	.733, .807	.756, .827	.755, .827	.731, .817
Individual	.844, .864	.854, .882	.833, .868	.804, .846	.790, .838	.803, .849	.732, .806	.679, .772	.715, .799	.737, .821
	11	12	13	14	15	16	17	18	19	
Entrepreneurial	.760, .840	.604, .745	.688, .799	.784, .861	.580, .735	.757, .850	.713, .821	.623, .780	.448, .811	
Creativity	671, .781	.638, .767	.687, .798	.746, .836	.562, .723	.587, .744	.571, .733	.588, .759	.544, .844	
Learning	758, .838	.697, .805	.722, .821	.795, .868	.690, .804	.745, .842	.740, .838	.676, .811	.568, .852	
People	.634, .756	.648, .773	.604, .746	.666, .785	.443, .648	.446, .657	.623, .765	.529, .725	.383, .789	
Systems	.683, .789	.682, .795	.752, .841	.758, .844	.680, .798	.649, .782	.702, .815	.593, .762	.504, .830	
Projects	.743, .829	.786, .862	.765, .849	.816, .882	.678, .796	.596, .750	.714, .822	.761, .861	.578, .855	
Energize	.890, .927	.884, .925	.886, .926	.842, .898	.847, .903	.892, .933	.883, .927	.860, .918	.849, .948	
Engage	.791, .861	.781, .859	.725, .823	.809, .877	.708, .816	.744, .841	.684, .803	.737, .847	.512, .833	

(table continues)

Appendix C.2 *(continued)*

	11	12	13	14	15	16	17	18	19
Enable	.875, .917	.856, .907	.757, .844	.790, .865	.814, .882	.876, .923	.804, .878	.789, .877	.636, .875
Ideate	.796, .864	.799, .870	.796, .869	.793, .867	.837, .897	.767, .856	.774, .860	.732, .844	.621, .870
Shape	.664, .776	.593, .738	.686, .798	.694, .803	.634, .769	.649, .782	.655, .786	.634, .786	.315, .765
Capture	.790, .860	.751, .839	.725, .823	.788, .864	.699, .810	.777, .862	.810, .882	.711, .832	.538, .842
Collaboration	.788, .859	.773, .854	.701, .808	.780, .859	.759, .848	.712, .822	.797, .874	.729, .842	.260, .747
Safety	.740, .827	.739, .832	.628, .761	.641, .769	.690, .804	.672, .797	.710, .820	.724, .839	.419, .801
Simplicity	.711, .807	.635, .765	.622, .757	.706, .811	.655, .782	.599, .751	.629, .769	.546, .735	.143, .707
External	.831, .887	.786, .862	.777, .856	.799, .871	.785, .864	.780, .864	.833, .896	.776, .869	.674, .888
Enterprise	.791, .861	.795, .868	.713, .815	.695, .804	.783, .863	.761, .852	.778, .862	.704, .827	.667, .886
Individual	.797, .865	.816, .882	.758, .844	.803, .873	.773, .857	.789, .869	.752, .846	.727, .841	.555, .848

Note: 1 = Financial and insurance, 2 = Telecommunications, 3 = Professional services, 4 = Industrial machinery and equipment, 5 = Health care and social services, 6 = Aerospace and defense, 7 = Food and beverages, 8 = Construction and building materials, 9 = Industrial metals and mining; 10 = Automobile and parts, 11 = Oil and chemicals, 12 = Energy – electricity and gas, 13 = IT – software and electronics, 14 = Retail, 15 = Education, 16 = Public and state administration; 17 = Transport and logistics, 18 = Pharmaceuticals, 19 = Biotechnology and research.

Appendix C.3. Confidence Intervals for Score Reliability Estimates by Organizational Level, Functional Role, and Language for n_1

Factor	Staff	Man	Exec/Dir	Ops	Com	Sup	Oth	R&D	Span	Eng
Entrepreneurial	.775, .794	.762, .790	.746, .794	.769, .792	.754, .789	.772, .805	.734, .786	.749, .799	.774, .790	.708, .769
Creativity	.744, .766	.729, .761	.776, .818	.741, .767	.731, .769	.719, .760	.768, .814	.701, .761	.744, .762	.745, .799
Learning	.810, .826	.800, .824	.831, .863	.807, .826	.825, .850	.814, .841	.745, .796	.797, .838	.819, .831	.739, .794
People	.712, .736	.660, .701	.681, .740	.707, .736	.696, .739	.681, .727	.679, .743	.642, .714	.705, .726	.643, .718
Systems	.809, .825	.777, .804	.806, .842	.803, .823	.815, .842	.783, .814	.761, .808	.736, .789	.807, .821	.731, .788
Projects	.822, .837	.776, .803	.800, .838	.799, .819	.814, .841	.792, .822	.842, .873	.730, .784	.808, .821	.836, .871
Energize	.917, .924	.915, .925	.907, .925	.913, .922	.918, .930	.918, .930	.871, .896	.910, .928	.920, .926	.868, .896
Engage	.841, .854	.807, .830	.796, .834	.833, .850	.843, .866	.805, .834	.790, .831	.767, .814	.834, .845	.765, .814
Enable	.889, .899	.874, .889	.847, .876	.887, .898	.883, .900	.879, .897	.814, .851	.859, .888	.889, .897	.799, .841
Ideate	.861, .872	.835, .855	.839, .869	.860, .874	.850, .872	.858, .878	.812, .849	.782, .826	.859, .868	.775, .822
Shape	.787, .804	.756, .785	.731, .781	.785, .806	.799, .828	.752, .788	.710, .767	.674, .739	.784, .799	.649, .723
Capture	.855, .867	.841, .860	.829, .861	.853, .868	.861, .881	.846, .868	.795, .835	.799, .840	.857, .867	.765, .814
Collaboration	.825, .840	.800, .824	.811, .846	.827, .844	.795, .825	.807, .835	.800, .839	.784, .827	.822, .835	.777, .824
Safety	.782, .800	.761, .790	.736, .785	.766, .790	.769, .802	.769, .802	.762, .809	.745, .796	.776, .791	.749, .802
Simplicity	.757, .778	.737, .769	.781, .822	.751, .776	.768, .801	.735, .773	.739, .791	.712, .770	.763, .779	.697, .760
External	.876, .887	.855, .873	.870, .894	.870, .883	.873, .891	.870, .889	.855, .884	.843, .875	.873, .882	.848, .880
Enterprise	.837, .851	.824, .845	.826, .859	.833, .850	.830, .855	.834, .858	.808, .846	.799, .839	.838, .849	.805, .846
Individual	.836, .849	.808, .831	.825, .857	.834, .851	.829, .853	.819, .845	.768, .814	.811, .849	.835, .846	.754, .806

Note: Man = Manager, Exec/Dir = Executive or director, Ops = Operations, Com = Commercial, Sup = Support, Oth = Other, R&D = Research and development, Span = Spanish, Eng = English.

Appendix C.4. Confidence Intervals for Score Reliability Estimates and Factor Estimates by Country for n_2

Factor	α	1	2	3	4	5	6	7	8	9	10
Values	**.891,**	.882,	.879,	.876,	.853,	.852,	.844,	.825,	.815,	.737,	.772,
	.897	.891	.893	.899	.889	.890	.866	.906	.910	.884	.924
Resources	**.943,**	.932,	.943,	.937,	.920,	.936,	.949,	.900,	.931,	.837,	.951,
	.946	.937	.949	.948	.939	.952	.963	.945	.966	.926	.983
Behaviors	**.948,**	.944,	.943,	.936,	.914,	.945,	.940,	.857,	.939,	.845,	.908,
	.951	.949	.949	.948	.935	.959	.956	.923	.970	.931	.969
Success	**.908,**	.896,	.883,	.915,	.895,	.915,	.897,	.835,	.888,	.824,	.874,
	.913	.904	.897	.931	.922	.937	.926	.913	.947	.923	.959
Climate	**.849,**	.829,	.839,	.828,	.803,	.805,	.855,	.736,	.841,	.638,	.863,
	.859	.844	.858	.862	.855	.858	.897	.865	.927	.849	.958

Note: *α* = alpha coefficient for n_2 = 9,921, 1 = Spain, 2 = Chile, 3 = Colombia, 4 = United States, 5 = Panama, 6 = El Salvador, 7 = Portugal, 8 = Mexico, 9 = Germany, 10 = Scotland.

Appendix C.5. Confidence Intervals for Score Reliability Estimates by Industry for n_2

Factor	1	2	3	4	5	6	7	8	9	10
Values	.889,	.903,	.897,	.878,	.878,	.865,	.847,	.839,	.822,	.839,
	.902	.919	.915	.900	.904	.895	.885	.881	.868	.885
Resources	.950,	.953,	.933,	.944,	.922,	.915,	.917,	.922,	.907,	.921,
	.956	.960	.945	.954	.938	.933	.938	.942	.931	.943
Behaviors	.950,	.953,	.946,	.936,	.936,	.943,	.906,	.926,	.916,	.926,
	.955	.961	.955	.948	.949	.956	.930	.945	.937	.947
Success	.924,	.906,	.906,	.898,	.891,	.875,	.810,	.909,	.844,	.826,
	.933	.922	.923	.918	.914	.903	.859	.933	.885	.877
Climate	.863,	.862,	.835,	.847,	.801,	.794,	.793,	.816,	.751,	.812,
	.880	.886	.867	.878	.846	.843	.848	.867	.820	.870

	11	12	13	14	15	16	17	18	19
Values	.870,	.820,	.829,	.871,	.842,	.853,	.850,	.793,	.635,
	.908	.875	.883	.913	.895	.903	.904	.869	.881
Resources	.904,	.921,	.907,	.919,	.915,	.885,	.914,	.905,	.819,
	.931	.945	.936	.944	.943	.923	.944	.939	.939
Behaviors	.931,	.919,	.912,	.923,	.920,	.933,	.926,	.928,	.885,
	.951	.944	.940	.948	.947	.955	.952	.954	.962
Success	.893,	.876,	.877,	.820,	.847,	.794,	.891,	.814,	.818,
	.924	.915	.917	.879	.899	.864	.931	.883	.942
Climate	.757,	.794,	.796,	.793,	.805,	.701,	.803,	.749,	.652,
	.832	.861	.865	.864	.874	.808	.878	.847	.896

Note: 1 = Financial and insurance, 2 = Telecommunications, 3 = Professional services, 4 = Industrial machinery and equipment, 5 = Health care and social services, 6 = Aerospace and defense, 7 = Food and beverages, 8 = Construction and building materials, 9 = Industrial metals and mining; 10 = Automobile and parts, 11 = Oil and chemicals, 12 = Energy – electricity and gas, 13 = IT – software and electronics, 14 = Retail, 15 = Education, 16 = Public and state administration; 17 = Transport and logistics, 18 = Pharmaceuticals, 19 = Biotechnology and research.

Appendix C.6. Confidence Intervals for Score Reliability Estimates by Organizational Level, Functional Role, and Language for n_2

Factor	Staff	Man	Exec/Dir	Ops	Com	Sup	Oth	R&D	Span	Eng
Values	.892, .900	.886, .898	.873, .894	.889, .899	.893, .907	.886, .901	.863, .888	.872, .895	.892, .899	.861, .887
Resources	.948, .951	.930, .937	.933, .944	.943, .948	.942, .949	.939, .947	.933, .944	.922, .936	.944, .947	.925, .939
Behaviors	.950, .953	.941, .948	.939, .949	.948, .953	.943, .951	.947, .954	.922, .936	.940, .950	.949, .952	.917, .932
Success	.912, .918	.895, .906	.900, .916	.906, .914	.904, .916	.912, .923	.893, .912	.879, .901	.908, .914	.894, .914
Climate	.858, .870	.825, .845	.827, .857	.845, .859	.849, .869	.851, .871	.815, .850	.811, .847	.851, .861	.813, .851

Note: Man = Manager, Exec/Dir = Executive or director, Ops = Operations, Com = Commercial, Sup = Support, Oth = Other, R&D = Research and development, Span = Spanish, Eng = English.

REFERENCES

Aiman-Smith, L., Goodrich, N., Roberts, D., & Scinta, J. (2005). Assessing your organization's potential for value innovation. *Research-Technology Management, 48*(2), 37-42.

Alam, I. (2010). Does service innovation process differ across cultures? *Asia Pacific Journal of Marketing and Logistics, 22*(4), 460-472. http://dx.doi.org/10.1108/13555851011090501

Allaire, Y., & Firsirotu, M. E. (1984). Theories of organizational culture. *Organization Studies*, *5*(3), 193-226. http://dx.doi.org/10.1177/017084068400500301

Anderson, N. R., & West, M. A. (1998). Measuring climate for work group innovation: Development and validation of the team climate inventory. *Journal of Organizational Behavior*, *19*(3), 235-258. http://dx.doi.org/10.1002/(SICI)1099-1379(199805)19:3%3C235::AID-JOB837%3E3.0.CO;2-C

Anthony, K. U. (2014). *How leadership facilitates an innovative organizational culture and an independent ethical climate: The role of being risk-taking and integrative*. Paper presented at International Conference on Global Trends in Academic Research. Bali, Indonesia. Retrieved from http://www.researchgate.net/profile/Anthony_Kuo/publication/272821848_How_Leadership_Facilitates_an_Innovative_Organizational_Culture_and_an_Independent_Ethical_Climate_The_Role_of_Being_Risk-Taking_and_Integrative/links/54f01a860cf2432ba6582365.pdf

Bakovic, T., Lazibat, T., & Sutic, I. (2013). Radical innovation culture in Croatian manufacturing industry. *Journal of Enterprising Communities: People and Places in the Global Economy, 7*(1), 74-80.

Baldrige Performance Excellence Program. (2013). *Criteria for performance excellence:*

2013-2014. Gaithersburg, MD: National Institute of Standards and Technology, U.S. Department of Commerce. Retrieved from http://www.nist.gov/baldrige/publications/criteria.cfm

Balsano, T. J., Goodrich, N. E., Lee, R. K., Miley, J. W., Morse, T. F., & Roberts, D. A. (2008). Identify your innovation enablers and inhibitors. *Research Technology Management, 51*(6).

Baregheh, A., Rowley, J., & Sambrook, S. (2009). Towards a multidisciplinary definition of innovation. *Management Decision*, *47*(8), 1323-1339. http://dx.doi.org/10.1108/00251740910984578

Bellot, J. (2011). Defining and assessing organizational culture. In*Nursing forum*, *46*(1), 29-37. http://dx.doi.org/10.1111/j.1744-6198.2010.00207.x

Birken, S. A., Lee, S. Y. D., Weiner, B. J., Chin, M. H., & Schaefer, C. T. (2013). Improving the effectiveness of health care innovation implementation: Middle managers as change agents. *Medical Care Research and Review*, *70*(1), 29-45. http://dx.doi.org/10.1177/1077558712457427

Birken, S. A., Lee, S. Y., & Weiner, B. J. (2012). Uncovering middle managers' role in healthcare innovation implementation. *Implement Sci*ence, *7*(1), 28.

Brettel, M., & Cleven, N. J. (2011). Innovation culture, collaboration with external partners and NPD performance. *Creativity and Innovation Management, 20*(4), 253-272. http://dx.doi.org/10.1111/j.1467-8691.2011.00617.x

Brophey, G., & Brown, S. (2009). Innovation practices within small to medium-sized mechanically-based manufacturers. *Innovation: Management, Policy & Practice*, *11*(3), 327-340. http://dx.doi.org/10.5172/impp.11.3.327

Brown, T.A. (2006). *Confirmatory factor analysis for applied research.* New York: The Guilford Press.

Byrne, B. M., Shavelson, R. J., & Muthén, B. (1989). Testing for the equivalence of factor covariance and mean structures: The issue of partial measurement invariance. *Psychological bulletin*, *105*(3), 456. http://dx.doi.org/10.1037/0033-2909.105.3.456

Çakar, N. D., & Ertürk, A. (2010). Comparing innovation capability of small and medium-sized enterprises: Examining the effects of organizational culture and empowerment. *Journal of Small Business Management*, *48*(3), 325-359.

Chen, W. J. (2011). Innovation in hotel services: Culture and personality. *International Journal of Hospitality Management*, *30*(1), 64-72. http://dx.doi.org/10.1016/j.ijhm.2010.07.006

Christensen, C. M., Anthony, S. D., & Roth, E. A. (2004). *Seeing what's next: Using the theories of innovation to predict industry change.* Boston, MA: Harvard Business Press.

Christensen, C.M, Grossman, J.H., & Hwang, J. (2009). *The innovator's prescription: A disruptive solution for health care.* New York, NY: McGraw-Hill.

Cole, R. E. (2002). From continuous improvement to continuous innovation. *Total Quality Management*, *13*(8), 1051-1056. http://dx.doi.org/10.1080/09544120200000001

Cooke, R. & Rousseau, D. (1988). Behavioral norms and expectations: A quantitative approach to the assessment of organizational culture. *Group and Organizational Studies, 13*(3), 245-273. http://dx.doi.org/10.1177/105960118801300302

Costello, A. B. (2009). Getting the most from your analysis. *Pan*, *12*(2), 131-146.

Costello, A. B., & Osborne, J. W. (2011). Best practices in exploratory factor analysis: four recommendations for getting the most from your analysis. *Practical Assessment in*

Research and Evaluation, 2005; 10. *Retrieved from http://pareonline.net/pdf/v10n7.pdf*

Creswell, J. W. (2013). *Research design: Qualitative, quantitative, and mixed methods approaches*. Thousand Oaks, CA: Sage Publications, Inc.

Cronbach, L. J., & Meehl, P. E. (1955). Construct validity in psychological tests. *Psychological Bulletin*, *52*(4), 281. http://dx.doi.org/10.1037/h0040957

Crossan, M. M., & Apaydin, M. (2010). A multi-dimensional framework of organizational innovation: A systematic review of the literature. *Journal of Management Studies*, *47*(6), 1154-1191. http://dx.doi.org/10.1111/j.1467-6486.2009.00880.x

Curran, P. J., West, S. G., & Finch, J. F. (1996). The robustness of test statistics to nonnormality and specification error in confirmatory factor analysis. *Psychological Methods, 1*(1), 16. http://dx.doi.org/10.1037/1082-989X.1.1.16

Den Hertog, P., Van der Aa, W., & de Jong, M. W. (2010). Capabilities for managing service innovation: Towards a conceptual framework. *Journal of Service Management, 21*(4), 490-514.

Denison, D. R. (1996). What is the difference between organizational culture and organizational climate?: A native's point of view on a decade of paradigm wars. *Academy of Management Review*, *21*(3), 619-654. http://dx.doi.org/10.5465/AMR.1996.9702100310

Dobni, C. B. (2008). Measuring innovation culture in organizations: The development of a generalized innovation culture construct using exploratory factor analysis. *European Journal of Innovation Management*, *11*(4), 539-559. http://dx.doi.org/10.1108/14601060810911156

Donaldson, S. I., & Grant-Vallone, E. J. (2002). Understanding self-report bias in organizational behavior research. *Journal of Business and Psychology, 17*(2), 245-260.

Dopson, S., Fitzgerald, L., & Ferlie, E. (2008). Understanding change and innovation in healthcare settings: Reconceptualizing the active role of context. *Journal of Change Management, 8*(3-4), 213-231. http://dx.doi.org/10.1080/14697010802133577

Dougherty, D., & Hardy, C. (1996). Sustained product innovation in large, mature organizations: Overcoming innovation-to-organization problems. *Academy of Management Journal, 39*(5), 1120-1153. http://dx.doi.org/10.2307/256994

Dyer, J., Gregersen, H., & Christensen, C.M. (2011). *The innovator's DNA: Mastering the five skills of disruptive innovators.* Boston, MA: Harvard Business Review Press.

Eid, M., & Rauber, M. (2000). Detecting measurement invariance in organizational surveys. *European Journal of Psychological Assessment*, *16*(1), 20. http://dx.doi.org/10.1027//1015-5759.16.1.20

Enzing, C. M., Batterink, M. H., Janszen, F. H., & Omta, S. O. (2011). Where innovation processes make a difference in products' short-and long-term market success. *British Food Journal, 113*(7), 812-837. http://dx.doi.org/10.1108/00070701111148379

Farrell, A. M. (2010). Insufficient discriminant validity: A comment on Bove, Pervan, Beatty, and Shiu (2009). *Journal of Business Research, 63*(3), 324-327. http://dx.doi.org/10.1016/j.jbusres.2009.05.003

Farrell, A. M., & Rudd, J. M. (2009). Factor analysis and discriminant validity: A brief review of some practical issues. Anzmac. Retrieved from http://andrewmfarrell.com/fr_anzmac_2009.pdf

Field, A. (2009). *Discovering statistics using SPSS* (3rd ed.). London, UK: Sage Publications.

Forero, C. G., Maydeu-Olivares, A., & Gallardo-Pujol, D. (2009). Factor analysis with ordinal indicators: A Monte Carlo study comparing DWLS and ULS estimation. *Structural Equation Modeling, 16*(4), 625-641. http://dx.doi.org/10.1080/10705510903203573

Fornell, C. & Larcker, D.F. (1981). Evaluating structural equation models with unobserved variables and measurement error. *Journal of Marketing Research, 18*, 39-50.

Francis, D. L. (2000). *Assessing and improving innovation capabilities in organizations.* (Doctoral thesis, Center for Research in Innovation Management. Brighton, University of Brighton, UK).

Garrard, J. (2011). *Health sciences literature review made easy: The matrix method.* Sudbury, MA: Jones & Bartlett.

George, M. L., Works, J., & Watson-Hemphill, K. (2005). *Fast innovation: Achieving superior differentiation, speed to market, and increased profitability.* New York: McGraw-Hill.

Gersch, K. (2013, August 21). Google's best new innovation: Rules around '20% time'. *Forbes*. Retrieved from http://www.forbes.com/sites/johnkotter/2013/08/21/googles-best-new-innovation-rules-around-20-time/

Goldberg, L. R., & Velicer, W. F. (2006). Principles of exploratory factor analysis. In S. Strack (Ed.), *Differentiating normal and abnormal personality: Second edition*. New York, NY: Springer. (pp. 209-237).

Goldstein, J. (2008). Complexity science applied to innovation: Theory meets praxis. *The Innovation Journal: The Public Sector Innovation Journal, 13*(3), 1-16.

Graham, J. M., Guthrie, A. C., & Thompson, B. (2003). Consequences of not interpreting structure coefficients in published CFA research: A reminder. *Structural Equation Modeling*, *10*(1), 142-153. http://dx.doi.org/10.1207/S15328007SEM1001_7

Grimm, L. G., & Yarnold, P. R., eds. (2000). *Reading and understanding MORE multivariate* *statistics*. Washington, DC: American Psychological Association.

Hair, J. F. Black, W.C., Babin, B.J., & Anderson, R.E. (2010). *Multivariate data analysis* (7th ed.). Upper Saddle River, NJ: Prentice Hall.

Hambrick, D. C. & Mason, P. A. (1984). Upper echelons: The organization as a reflection of its top managers. *Academy of Management Review, 9,* 193–206. http://dx.doi.org/10.5465/AMR.1984.4277628

Handy, C. B. (1996). *Beyond certainty: The changing worlds of organizations*. Boston, MA: Harvard Business Press.

Harvard Business School (2014a). *Forum on health care innovation.* Retrieved from http://forumonhealthcareinnovation.org/#about-the-forum-on-health-care-innovation

Harvard Business School (2014b). *5 imperatives: Addressing healthcare's innovation challenge.* Retrieved from http://www.hbs.edu/healthcare/pdf/Forum-on-Healthcare-Innovation-5-Imperatives.pdf

Hatch, M. J. (1993). The dynamics of organizational culture. *The Academy of Management Review, 18*(4), 657-693. http://dx.doi.org/10.5465/AMR.1993.9402210154

Hayduk, L. (2014). Seeing perfectly fitting factor models that are causally misspecified: Understanding that close-fitting models can be worse. *Educational and Psychological Measurement, 74*(6), 905-926. http://dx.doi.org/10.1177/0013164414527449

Henson, R. K., & Roberts, J. K. (2006). Use of exploratory factor analysis in published research common errors and some comment on improved practice. *Educational and Psychological Measurement*, *66*(3), 393-416. http://dx.doi.org/10.1177/0013164405282485

Herrmann, A., Gassmann, O., & Eisert, U. (2007). An empirical study of the antecedents for radical product innovations and capabilities for transformation. *Journal of Engineering and Technology Management, 24*(1), 92-120. http://dx.doi.org/10.1016/j.jengtecman.2007.01.006

Hoe, S.L. (2011). Measuring an organization's innovation climate: A case study from Singapore. *Development and Learning in Organizations, 25*(6), 13-15. http://dx.doi.org/10.1108/14777281111173342

Hoffman, R. C. (1999). Organizational innovation: Management influence across cultures. *Multinational Business Review, 7*, 37-49.

Hoffman, R. C., & Hegarty, W. H. (1993). Top management influence on innovations: Effects of executive characteristics and social culture. *Journal of Management, 19*(3), 549-574. http://dx.doi.org/10.1177/014920639301900303

Hofstede, G. (1998). Attitudes, values and organizational culture: Disentangling the concepts. *Organization Studies, 19*(3), 477-493. http://dx.doi.org/10.1177/017084069801900305

Hofstede, G., Neuijen, B., Ohayv, D. D., & Sanders, G. (1990). Measuring organizational cultures: A qualitative and quantitative study across twenty cases. *Administrative Science Quarterly, 35*(2), 286-316. http://dx.doi.org/10.2307/2393392

Huizingh, E. K. (2011). Open innovation: State of the art and future perspectives. *Technovation, 31*(1), 2-9. http://dx.doi.org/10.1016/j.technovation.2010.10.002

Humphreys, P., McAdam, R., & Leckey, J. (2005). Longitudinal evaluation of innovation implementation in SMEs. *European Journal of Innovation Management, 8*(3), 283-304. http://dx.doi.org/10.1108/14601060510610162

Hurley, R. F., & Hult, G. T. M. (1998). Innovation, market orientation, and organizational learning: An integration and empirical examination. *The Journal of Marketing,* 42-54. http://dx.doi.org/10.2307/1251742

IBM Corp. Released 2013. IBM SPSS Statistics for Windows, Version 22.0. Armonk, NY: IBM Corp.

Kasunic, M. (2005). *Designing an effective survey*. Pittsburgh, PA: Carnegie-Mellon University Software Engineering Inst.

Kaufman, H.R., Tsangar, H., & Vrontis, D. (2012). Innovativeness of European SMEs: Mission not yet accomplished. *Ekonomska istraživanja*, *25*(2), 333-360.

Kesting, P., & Parm Ulhøi, J. (2010). Employee-driven innovation: Extending the license to foster innovation. *Management Decision, 48*(1), 65-84. http://dx.doi.org/10.1108/00251741011014463

Kieffer, K. M. (April, 1998). *Some comments on analytic traditions in EFA as against CFA: An analysis of selected research reports.* Paper presented at the Annual Meeting of the American Educational Research Association, San Diego, CA.

Kimberlin, C. L., & Winterstein, A. G. (2008). Validity and reliability of measurement instruments used in research. *American Journal of Health Syst Pharm*, *65*(23), 2276-2284. http://dx.doi.org/10.2146/ajhp070364

Kleinschmidt, E. J., De Brentani, U., & Salomo, S. (2007). Performance of global new product development programs: A resource-based view. *Journal of Product Innovation Management*, *24*(5), 419-441. http://dx.doi.org/10.1111/j.1540-5885.2007.00261.x

Kline, R. B. (2011). *Principles and practice of structural equation modeling*. New York, NY: Guilford Publications.

Kumar, R. & Uzkurt, C. (2010). Can innovativeness be impacted by interpersonal influences and do cultural dimensions play a moderating role?: An investigation in the Turkish context. *Journal of Global Business Management*, *6*(2), 1.

Kuczmarski, T. D. (2003). What is innovation? And why aren't companies doing more of it? *Journal of Consumer Marketing, 20*(6), 536-541.

Kuščer, K. (2013). Determining factors of mountain destination innovativeness. *Journal of Vacation Marketing*, *19*(1), 41-54. http://dx.doi.org/10.1177/1356766712461404

Lawson, B., & Samson, D. (2001). Developing innovation capability in organizations: A dynamic capabilities approach. *International Journal of Innovation Management*, *5*(3), 377-400.

Lazarus, I. R., & Fell, D. (2011). Innovation or stagnation? Crossing the creativity gap in healthcare. *Journal of Healthcare Management/American College of Healthcare Executives*, *56*(6), 363.

Leavy, B. (2005). A leader's guide to creating an innovation culture. *Strategy & Leadership, 33*(4), 38-45. http://dx.doi.org/10.1108/10878570510608031

Lee, C. S., Chen, Y. C., Tsui, P. L., & Yu, T. H. (2014). Examining the relations between open innovation climate and job satisfaction with a PLS path model. *Quality & Quantity*, 1-18. http://dx.doi.org/10.1007/s11135-014-0029-4

Lehmann, D.R. in M.J. Schlinger (ed.) (1975). Validity and goodness of fit in data analysis. In Advances in Consumer Research. *Association for Consumer Research, 2,* 741-750.

Lemon, M. & Sahota, P. S. (2004). Organizational culture as a knowledge repository for increased innovative capacity. *Technovation, 24*(6), 483-498. http://dx.doi.org/10.1016/S0166-4972(02)00102-5

Leung, W. C. (2001). How to design a questionnaire. *Student BMJ, 9*(11), 187-189.

Lindell, M. K., & Whitney, D. J. (2001). Accounting for common method variance in cross-sectional research designs. *Journal of Applied Psychology, 86*(1), 114. http://dx.doi.org/10.1037/0021-9010.86.1.114

Lissitz, R. W., & Samuelsen, K. (2007). A suggested change in terminology and emphasis regarding validity and education. *Educational Researcher*, *36*(8), 437-448. http://dx.doi.org/10.3102/0013189X07311286

Little, T. D., & Rhemtulla, M. (2013). Planned missing data designs for developmental researchers. *Child Development Perspectives*, *7*(4), 199-204. http://dx.doi.org/10.1111/cdep.12043

Mardia, K.V. (1985). Mardia's test of multinormality. In S. Kotz & N.L. Johnson (Eds.), *Encyclopedia of Statistical Sciences*, *5*, 217-221. New York: Wiley.

Martens, J. (2013). Stories of innovation: Roles, perspectives, and players. *European Journal of Training and Development, 38*(1/2), 40-53.

McAdam, R., Keogh, W., Reid, R. S., & Mitchell, N. (2007). Implementing innovation management in manufacturing SMEs: A longitudinal study. *Journal of Small Business and Enterprise Development*, *14*(3), 385-403. http://dx.doi.org/10.1108/14626000710773501

Meade, A. W., Watson, A. M., & Kroustalis, C. M. (2007, April). *Assessing common methods bias in organizational research.* Paper presented at the 22nd Annual Meeting of the Society for Industrial and Organizational Psychology, New York.

Messick, S. (1989). Validity. In R.L. Linn (Ed.), *Educational measurement* (3rd ed., pp. 13-103). New York: American Council on Education; Macmillan.

Moosa, N., & Panurach, P. (2008). Encouraging front-line employees to rise to the innovation challenge. *Strategy & Leadership, 36*(4), 4-9. http://dx.doi.org/10.1108/10878570810888704

National Audit Office. (2009). *Innovation: The perspective of front line staff*. Victoria, London: UK. Retrieved from http://www.nao.org.uk/wp-content/uploads/2009/03/080912_mori.pdf

Nimon, K., & Reio, T. G. (2011). Measurement invariance: A foundational principle for quantitative theory building. *Human Resource Development Review*, *10*(2), 198-214. http://dx.doi.org/10.1177/1534484311399731

Nunnally, J. C. (1978*). Psychometric theory* (2nd ed.). New York: McGraw-Hill.

O'Cass, A., & Ngo, L. V. (2007). Market orientation versus innovative culture: two routes to superior brand performance. *European Journal of Marketing*, *41*(7/8), 868-887. http://dx.doi.org/10.1108/03090560710752438

O'Connor, B. P. (2000). SPSS and SAS programs for determining the number of components using parallel analysis and Velicer's MAP test. *Behavior Research Methods, Instruments, & Computers*, *32*(3), 396-402.

O'Connor, G. C. (2008). Major innovation as a dynamic capability: A systems approach. *Journal of Product Innovation Management*, *25*(4), 313-330. http://dx.doi.org/10.1111/j.1540-5885.2008.00304.x

O'Connor, A., Roos, G., & Vickers-Willis, T. (2007). Evaluating an Australian public policy organization's innovation capacity. *European Journal of Innovation Management*, *10*(4), 532-558. http://dx.doi.org/10.1108/14601060710828817

O'Reilly, C. A. (1989). Corporations, culture and commitment: Motivation and social control in organizations. *California Management Review*, *31*, 9-25. http://dx.doi.org/10.2307/41166580

Osborne, J. W. (2008). *Best practices in quantitative methods*. Thousand Oaks, CA: Sage Publications.

Osborne, J. W. & Fitzpatrick, D C. (2012). Replication analysis in exploratory factor analysis: What it is and why it makes your analysis better. *Practical Assessment, Research & Evaluation, 17*(15). Retrieved from http://pareonline.net/getvn.asp?v=17&n=15.

O'Sullivan, D. & Dooley, L. (2009). *Applying innovation.* Thousand Oaks, CA: Sage Publications.

Panayides, P. (2006). Enhancing innovation capability through relationship management and implications for performance. *European Journal of Innovation Management, 9*(4), 466-483. http://dx.doi.org/10.1108/14601060610707876

Panuwatwanich, K., Stewart, R. A., & Mohamed, S. (2009). Validation of an empirical model for innovation diffusion in Australian design firms. *Construction Innovation: Information, Process, Management, 9*(4), 449-467. http://dx.doi.org/10.1108/14714170910995976

Patterson, M. G., West, M. A., Shackleton, V. J., Dawson, J. F., Lawthom, R., Maitlis, S., ... & Wallace, A. M. (2005). Validating the organizational climate measure: Links to managerial practices, productivity, and innovation. *Journal of Organizational Behavior, 26*(4), 379-408. http://dx.doi.org/10.1002/job.312

Perel, M. (2005). You can innovate in hard times. *Research Technology Management, 48*(4).

Podsakoff, P. M., MacKenzie, S. B., Lee, J. Y., & Podsakoff, N. P. (2003). Common method biases in behavioral research: a critical review of the literature and recommended remedies. *Journal of Applied Psychology*, *88*(5), 879. http://dx.doi.org/10.1037/0021-9010.88.5.879

Price Jr, J. (2014). U.S. military innovation: Fostering creativity in a culture of compliance. *Air & Space Power Journal*, *28*, 128-134.

ProQuest. (2014). Summon Service [computer website]. Ann Arbor, MI. http://www.proquest.com/products-services/The-Summon-Service.html

Quintane, E., Casselman, R. M., Reiche, B. S., & Nylund, P. A. (2011). Innovation as a knowledge-based outcome. *Journal of Knowledge Management*, *15*(6), 928-947.

Rao, J. (2014, October). Jay Rao: My approach. [Web log comment.] Retrieved from http://faculty.babson.edu/jayrao/my_approach.htm

Rao, J., & Weintraub, J. (2013). How Innovative is your company's culture? *MIT Sloan Management Review*, *54*(3), 28-37.

Rao, J. & Chuan, F. (2013). *The discipline and culture of innovation: A socratic journey*. Barcelona, Spain: Profit Editorial.

Remneland-Wikhamn, B., & Wikhamn, W. (2011). Open innovation climate measure: The introduction of a validated scale. *Creativity and Innovation Management*, *20*(4), 284-295. http://dx.doi.org/10.1111/j.1467-8691.2011.00611.x

Rothwell, R. (1992), Successful industrial innovation: Critical factors for the 1990s. *R&D Management*, *22*: 221–240. http://dx.doi.org/10.1111/j.1467-9310.1992.tb00812.x

Sarros, J. C., Cooper, B. K., & Santora, J. C. (2008). Building a climate for innovation through transformational leadership and organizational culture. *Journal of Leadership & Organizational Studies*, *15*(2), 145-158. http://dx.doi.org/10.1177/1548051808324100

Satorra, A., & Bentler, P. M. (1988). Scaling corrections for chi-square statistics in covariance structure analysis. *ASA 1988 Proceedings of the Business and Economic Statistics, Section* (308-313). Alexandria, VA: American Statistical Association.

Saunila, M., & Ukko, J. (2013). Facilitating innovation capability through performance measurement: A study of Finnish SMEs. *Management Research Review, 36*(10), 991-1010. http://dx.doi.org/10.1108/MRR-11-2011-0252

Schein, E.H. (1984). Coming to a new awareness of organizational culture. *Sloan Management Review, 25*(2), 3-16.

Schein, E. H. (1999). The corporate culture survival guide: Sense and nonsense about culture change. *Warren Bennis Signature Series*. San Francisco, CA: Jossey-Bass.

Schneider, B., Ehrhart, M. G., & Macey, W. H. (2013). Organizational climate and culture. *Annual Review of Psychology*, *64*, 361-388. http://dx.doi.org/10.1146/annurev-psych-113011-143809

Scientific Software International. [Computer Software] (2015). LISREL 9.2 for Windows. Obtained from http://www.ssicentral.com/lisrel/upgrade9.1.html

Scott, S. G., & Bruce, R. A. (1994). Determinants of innovative behavior: A path model of individual innovation in the workplace. *Academy of Management Journal*, *37*(3), 580-607. http://dx.doi.org/10.2307/256701

Scott, T., Mannion, R., Davies, H., & Marshall, M. (2003). The quantitative measurement of organizational culture in health care: A review of the available instruments. *Health Services Research*, *38*(3), 923-945. http://dx.doi.org/10.1111/1475-6773.00154

Shahin, A., & Zeinali, Z. (2010). Developing a relationship matrix for organizational learning and innovativeness with a case study in a manufacturing company. *International Journal of Business & Management, 5*(7). http://dx.doi.org/10.5539/ijbm.v5n7p187

Sharifirad, M. S., & Ataei, V. (2012). Organizational culture and innovation culture: exploring the relationships between constructs. *Leadership & Organization Development Journal, 33*(5), 494-517. http://dx.doi.org/10.1108/01437731211241274

Silva, A. (2014). How to become an innovative company: A case study. *International Journal of Innovation Science*, *6*(3), 177-182. http://dx.doi.org/10.1260/1757-2223.6.3.177

Skarzynski, P. & Crosswhite, D. (2014). *The innovator's field guide: Market-tested methods and frameworks to help you meet your innovation challenges.* San Francisco, CA: Jossey-Bass.

Slater, S. F., Mohr, J. J., & Sengupta, S. (2014). Radical product innovation capability: Literature review, synthesis, and illustrative research propositions. *Journal of Product Innovation Management, 31*(3), 552-566. http://dx.doi.org/10.1111/jpim.12113

Spanish Society for Quality. (2015). Participa en indice cultural de la innovacion. Retrieved from http://www.aec.es/web/guest/cultura-innovacion/indice-cultura-innovacion-2015

Steiber, A., & Alänge, S. (2013). A corporate system for continuous innovation: The case of Google Inc. *European Journal of Innovation Management, 16*(2), 243-264. http://dx.doi.org/10.1108/14601061311324566

Sun, H., Wong, S. Y., Zhao, Y., & Yam, R. (2012). A systematic model for assessing innovation competence of Hong Kong/China manufacturing companies: A case study. *Journal of Engineering and Technology Management, 29*(4), 546-565. http://dx.doi.org/10.1016/j.jengtecman.2012.03.005

Sušanj, Z. (2000). Innovative climate and culture in manufacturing organizations: differences between some European countries. *Social Science Information, 39*(2), 349-361. http://dx.doi.org/10.1177/053901800039002011

Switzer, G. E., Wisniewski, S. R., Belle, S. H., Dew, M. A., & Schultz, R. (1999). Selecting, developing, and evaluating research instruments. *Social Psychiatry and Psychiatric Epidemiology*, *34*(8), 399-409. http://dx.doi.org/10.1007/s001270050161

Tellis, G. J., Prabhu, J. C., & Chandy, R. K. (2009). Radical innovation across nations: the preeminence of corporate culture. *Journal of Marketing, 73*(1), 3-23. http://dx.doi.org/10.1509/jmkg.73.1.3

Tello, F. P., Moscoso, S., García, I.B., & Chaves, S.S. (2006). Training satisfaction rating scale: development of a measurement model using polychoric correlations. *European Journal of Psychological Assessment, 22*(4), 268-279.

Tello, F. P., Moscoso, S., García, I.B, & Abad, E. (2010). Polychoric versus Pearson correlations in exploratory and confirmatory factor analysis of ordinal variables. *Quality & Quantity*, *44*(1), 153-166. http://dx.doi/10.1007/s11135-008-9190-y

Terziovski, M. (2002). Achieving performance excellence through an integrated strategy of radical innovation and continuous improvement. *Measuring Business Excellence*, *6*(2), 5-14. http://dx.doi.org/10.1108/13683040210431419

Thakur, R., Hsu, S. H., & Fontenot, G. (2012). Innovation in healthcare: Issues and future trends. *Journal of Business Research*, *65*(4), 562-569. http://dx.doi.org/10.1016/j.jbusres.2011.02.022

Thompson, B. (2003). Understanding reliability and coefficient alpha, really. In Bruce Thompson, (Ed.), *Score reliability: Contemporary thinking on reliability issues*. Sage Publication, Thousand Oaks, CA.

Tohidi, H., Seyedaliakbar, S. M., & Mandegari, M. (2012). Organizational learning measurement and the effect on firm innovation. *Journal of Enterprise Information Management*, *25*(3), 219-245. http://dx.doi.org/10.1108/17410391211224390

Unger, B. N., Rank, J., & Gemünden, H. G. (2014). Corporate innovation culture and dimensions of project portfolio success: The moderating role of national culture. *Project Management Journal, 45*(6), 38-57. http://dx.doi.org/10.1002/pmj.21458

Vandenberg, R. J., & Lance, C. E. (2000). A review and synthesis of the measurement invariance literature: Suggestions, practices, and recommendations for organizational research. *Organizational Research Methods*, *3*(1), 4-70. http://dx.doi.org/10.1177/109442810031002

van Hamersveld, M. & de Bont, C. (Eds.). (2007). *Market research handbook.* West Sussex, England: John Wiley & Sons.

Velasco, E., Zamanillo, I., & Del Valle, T. G. (2013). Mobilizing company members' full innovative potential. *Human Factors and Ergonomics in Manufacturing & Service Industries, 23*(6), 541-559. http://dx.doi.org/10.1002/hfm.20341

Velicer, W. F. (1976). Determining the number of components from the matrix of partial correlations. *Psychometrika*, *41*(3), 321-327. http://dx.doi.org/10.1007/BF02293557

Vincent, L. (2005). Innovation midwives: Sustaining innovation streams in established companies. *Research-Technology Management, 48*(1), 41-49.

Weiss, D. S., & Legrand, C. (2011). *Innovative intelligence: The art and practice of leading sustainable innovation in your organization*. Toronto, Canada: John Wiley & Sons.

Wilhelm, P. G., & Wilhelm, J. P. (2012). Competitiveness, social networking and international culture variables as predictors of capacity for innovation: An empirical test. *American Society for Competitiveness, In Competition Forum*, *10*(1), 63.

Wu, A. D., Li, Z., & Zumbo, B. D. (2007). Decoding the meaning of factorial invariance and updating the practice of multi-group confirmatory factor analysis: A demonstration with TIMSS data. *Practical Assessment, Research and Evaluation, 12*(3), 1-26.

Xerri, M. J., & Brunetto, Y. (2011). Fostering the innovative behaviour of SME employees: A social capital perspective. *Research & Practice in Human Resource Management*, *19*(2), 43.

Zairi, M., & Al-Mashari, M. (2005). Developing a sustainable culture of innovation management: A prescriptive approach. *Knowledge and Process Management, 12*(3), 190-202. http://dx.doi.org/10.1002/kpm.229

Zwick, W. R., & Velicer, W. F. (1986). Comparison of five rules for determining the number of components to retain. *Psychological Bulletin*, *99*(3), 432. http://dx.doi.org/10.1037/0033-2909.99.3.432