

THE INFLUENCE OF TRANSFORMATIONAL LEADERSHIP AND DIVERSITY
CLIMATE ON USING TRIZ TO GENERATE IDEAS –
A CASE STUDY FROM UAE COMPANIES

by

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ABSTRACT

The rapidly changing dynamics in global industry are forcing companies to continually improve methods for harnessing the creativity of their employees and to use that creativity to drive innovation. Frequently, projects to develop new products fail at the end of the development process or during commercialization. These failures often have their origin at the very beginning of the development process, during the pre-development phase called the Fuzzy Front End (FFE). To manage this phase, there is a need to focus on idea and concept generation, for instance by using new techniques like the Theory of Inventive Problem Solving (TRIZ). To improve the pre-development activities in the FFE phase, there is a further need to understand how TRIZ methods interact with transformational leadership behaviors and team make-up to improve the effectiveness of the FFE. Prior work has shown that transformational leadership has positive impacts on organizational outcomes, including improved performance of research and development (R&D) functions. This research applied TRIZ problem-solving in several semi-government companies in the United Arab Emirates (UAE) and investigated the influence of leadership, diversity climate, knowledge management practices and organizational change variables, to measure participants' perception of being able to apply TRIZ in problem-solving. Measures of team performance during a two-day TRIZ session were also made using organization-specific challenges. A Structural Equation Model (SEM) was utilized to understand the relationships between the measured factors. Hypothesis analysis showed that transactional leadership did not support knowledge management practices while group and organizational diversity climates positively impacted knowledge management practices and participants' perception on being able to apply TRIZ. Transformational leadership, knowledge management practices, and organizational change positively impact participants' perception of being able to apply TRIZ. The implications are as follows: the full range of the leadership model along with group and organizational diversity climate strongly effect the relationship between knowledge management practices and participants' perception of being able to apply TRIZ. The presence of transformational leadership improved the participants' perception of being able to apply TRIZ in problem-solving. Workers' knowledge converted information into a general solution based on TRIZ training outcomes.

CHAPTER ONE

INTRODUCTION

This dissertation targets the importance of generating ideas and creating opportunities for organizations to survive in their industries. In most cases, organizations go through an iterative process of finding suitable solutions to improve their survival rate and satisfy customers' desires. It is clear that the need for small organizations to innovate is critical to surviving constant economic change. Therefore, this study examines approaches to innovation and how these approaches could be applied within organizations. Projects to develop new products often fail at the very beginning of the development process due to lack of clarity and direction, a period referred to as the Fuzzy Front End (FFE). Using approaches that help in removing the fuzziness from the pre-development, this study developed a problem-solving training session and measured the effect of these approaches. Workers inside targeted organizations participated in a problem-solving session in which they formed teams and created feasible solutions for the organization.

The background for this study will be addressed first by showing the need for organizations to innovate and then giving an introduction to innovation inside the targeted companies in United Arab Emirates (UAE) region. Secondly, an introduction to the dissertation sections will be given to better clarify the process of measuring, collecting and analyzing the data.

Innovation in Industrial Competition

Marketplace dynamics and socio-economic surroundings influence commercial enterprise in industries, forcing them to have to respond more quickly to change by increasing productivity. The organizations which succeed in this process are those which are able to generate innovative processes that specialize in creative product design (Chulvi, Ruiz-Lopez, & Vidal, 2011).

In the past, businesses provided high quality, low-cost products, and maximum customer service to satisfy the market. Nowadays, groups need to customize merchandise to satisfy a distinct sector of the market (Wang & Chen, 2012). Worldwide competition, including the emergence of the newest products and services, pressures companies to enhance innovation and solve problems (N. Anderson, De Dreu, & Nijstad, 2004). To remain competitive, companies need their employees to be able to not only reach their productivity goals but also to generate ideas for new product and designs (Dul & Ceylan, 2011). A worker's creativity is key to the production of novel and potentially useful ideas for fixing problems, especially when developing new products, offerings, methods, systems, or work methods (Amabile, 1988). The creativity of workers is considered an added value to an organization's resources (Madjar, Oldham, & Pratt, 2002; Shalley, Zhou, & Oldham, 2004).

Corporations need to personalize products and services to meet the expectations of their consumers and to unify their share of the market (Crawford & Benedetto, 2008; Wang & Chen, 2012; Yang & Shieh, 2010). With an intensely competitive environment, companies must incorporate customer preferences in the process of product positioning

and differentiation (Alptekin, 2012; Lai, Lin, Yeh, & Wei, 2006). Differentiation is defined as an introduction of tangible or intangible product or process characteristics that separate the firm from its competitors. Positioning is defined as ensuring that those characteristics are unique in a customer's mind (Kwong, Luo, & Tang, 2011; Wang, 2015). This idea of positioning is not always related to what the organization does with a product, but how it anticipates a customer need (Lilien & Rangaswamy, 2004).

Most workers find themselves in traditional organizations in which they are exposed to a formal structure, time constraints, strict regulations, repetitive tasks, and standardized work. These factors can reduce the desired creativity within workers. Organizations should support their workers by providing a healthy work environment which enhances the generating of new, useful and creative ideas (Amabile, 1996; Woodman, Sawyer, & Griffin, 1993).

Schentler, Lindner, and Gleich (2010) studied the levels of innovation performance in the industry, which they re-ordered and partly extended to cover all the major levels that can be shown in the innovation performance area. These levels are shown in Figure 1:

Project: The level of a single innovation project is evaluated through different stages from the initial concept draft until a prototype. Moreover, Arnold, Erner, Möckel, and Schläffer (2010) stated that it is difficult to estimate the market impacts of projects based on the degree of innovativeness assessments or other measurement approaches. The economic benefit of the innovation performance of a project inside a company cannot be known until a project has been taken to the market.

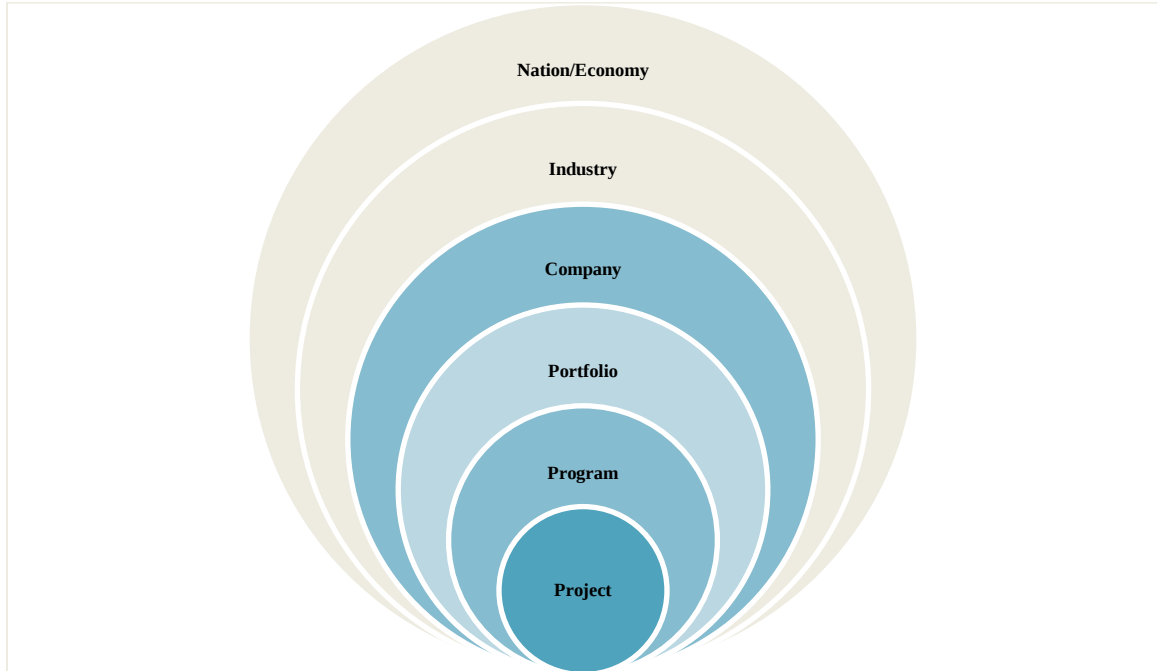


Figure 1: Level of Innovation Performance Measurement [Adopted from (Schentler et al., 2010)]

Program: At this higher level, projects can be grouped together to form a program that can be subjected to different measurements. Projects can be grouped together based on technical or topical similarities from the perspective of a management control system, it is more beneficial to rely on a program rather than a project because the program spreads out the risk associated with a single project. If a project that is highly innovative has been canceled, the negative impact can be offset by incremental shots that have a high chance of delivering the desired return. Employees should consider balancing high-risk endeavors with relatively secure projects; this will minimize the chances of a failed program.

Portfolio: All the innovative projects of one company are covered in one portfolio which measures two aspects at the multi-project level. The first aspect involves

aggregating all the projects and programs to assess the value of the overall portfolio currently under development. The second aspect involves evaluating the composition of the portfolio. Cooper, Edgett, and Kleinschmidt (2001) stated that the projected cash flow is not a sufficient measure; the balance between the projects in terms of time, technical complexity, expected market impact, and risk level is also needed.

Company: Every company has different project, program and portfolio levels. A distinctive category is thus required to indicate the performance assessment at the company level. This assessment will include an evaluation of all the innovation efforts and outcomes and will go beyond the mere sum of a company's revenue being generated by the newly introduced products or services. This assessment will focus on the whole company as an innovative business unit (Cooper, Edgett, & Kleinschmidt, 2004) or on a selected functional unit such as the dedicated R&D centers where the innovation is assisted (Schentler et al., 2010).

Other levels (Industry & Economy): beyond the focus on the innovation at a company level, there are also many approaches to measuring performance on an even higher level. Those assessments and approaches evaluate the innovation performance in the entire industry's geographical region, focusing on fewer indicators inside an individual firm and aggregating larger data. These results will be mainly used to inform public policy regarding that market (and alliances with other markets in sourcing and sub-sourcing).

Innovation in the United Arab Emirates (UAE)

Organizations in the UAE are still new at innovation. Research in innovation and management has been developed in several international industries, but a limited number of them have undertaken this innovation in emerging markets or developing countries. In addition, there is a very limited amount of research work that has occurred in the Gulf Cooperation Council, which includes the UAE region. Research is even more limited in the context of the United Arab Emirates (UAE) industry (Al-Kuwari, 2009). Al Hallami, Van Horne, and Huang (2013) have shown that the UAE is seeking partnerships with Asia and the West in the Research and Development (R&D) and technology sector to achieve their mission of diversifying the economy. This approach has created investment firms that focus on technology like the Advanced Technology Company (ATC) and Mubadala Development Company; a state-owned investment vehicle of the Abu Dhabi Government, established by the previous Minister of Education and Science Research Sheikh Nahyan Bin Mubarak, that seeks to diversify the state's portfolio.

The UAE is specially focusing on increasing innovation in the development of the infrastructure and information communication networks (Al Sadik & Elbadawi, 2012). Alsalami, Behery, and Abdullah (2014) stated that the UAE seeks to improve the performance of firms in its public sectors, by making significant changes in the management process that characterize public organizations. They also recommended that the UAE apply transformational leadership to increase the innovation inside those organizations.

Several initiatives, such as excellence awards and leadership programs, have been established by the UAE to stress the importance of innovation (Al Marashi & Bhinder, 2008). According to the global competency report, the UAE ranked 11th out of 134 countries in innovation and government procurements of advanced technology products (Schwab & Porter, 2008). The importance of innovation was shown in the transformation and evolution of Dubai (one of the seven emirates in the UAE). Dubai's leader Sheikh Mohammad Bin-Rashid AlMaktoum's vision for 2021, is that the UAE will show a significant growth in innovation capacity (Perry, 2011). His vision involves the promotion of creativity, energy, and intelligence to raise Dubai's standing in terms of innovation (Al-Banawi, 2012).

In the span of 35 years, Dubai has transformed from a traditional economy to a modern economy. From being a small fishing port to one of the fastest-growing cities in the world, its economy grew by almost 17% in 2009, four times the growth of the USA and twice the growth of China. Dubai is considered the miracle of the Middle East and the home of the best architecture in the world with an estimated \$221 Billion USD of projects (Al Marashi, 2010).

Dissertation Introduction

To respond to rapid changes in the market, organizations should transform their research and development departments into a source of product innovation that will satisfy customers' needs and expectations. Searching for powerful tools and methods to transform both the process and the products into a source of innovation would allow companies to gain competitive advantage. Nowadays, vendors and shareholders need to

review the old concept of innovation indicators inside their organizations and look for new concepts to measure their organization's effectiveness. Typical indicators remiss the strategic view of the organization by only showing financial indicators. These indicators provide a backward-looking view, evaluating workers' performance based only on financial returns.

The importance of this study is to show a systematic approach to training and measuring innovation approaches, as well as tools provided by the Theory of Inventive Problem Solving (TRIZ) for managing the Fuzzy Front-End (FFE) innovation stage. FFE is considered a pre-development stage during which ideas are explored before new products are developed. By applying TRIZ to the idea-generation process during Fuzzy Front-End innovation, the effects of leadership and diversity climate levels at the individual, group and organizational level can be investigated. This study will sought to improve innovation management through knowledge management practices and organizational change.

This study applied the principles of TRIZ and sought to understand user perception of this tool through a relationship model that investigates the variables of leadership, diversity climate, knowledge management practices, and organizational change. To understand each variable, this study first presents a review of the literature for each of the targeted variables, as well as the hypothesized relationship between these variables. Each variable was measured using a validated survey instrument. The methodology for collecting the data was developed during a training session for solving problems using TRIZ principles. The training session was held over two days during

which teams were formed and a formal leader was selected. Measurements of the targeted variables were obtained before and after the training session and all ideas were collected.

The instruments were further validated through a reliability test for the data collected. A demographic analysis and an explanation for team formation were presented along with the case study for each targeted company. Using structural equation modeling, the hypothesized variable relationship was analyzed. Additional analysis using correlation tables was developed to further show the linear relationship between the select variables.

CHAPTER TWO

REVIEW OF LITERATURE

In this chapter, previous research and development literature in innovation is presented. This review provides a foundation for the necessity of this study investigation with a clear overview of each topic. A framework of the literature findings is summarized in Figure 2:

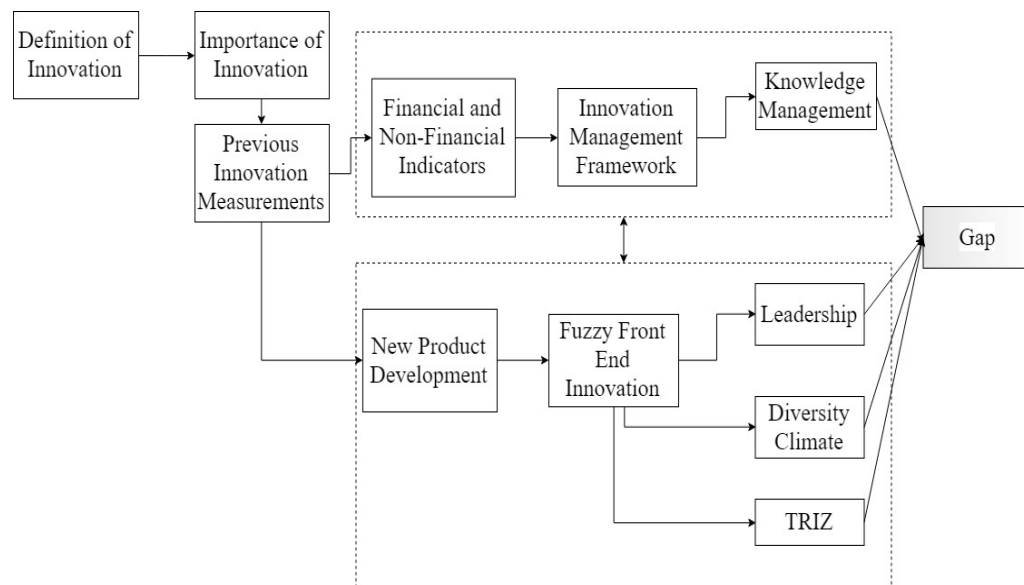


Figure 2: Literature Review Framework

Definition of Innovation

Various definitions of innovation have been proposed. Freeman and Soete (1997, p. 3) define innovation in industry as: “Industrial innovation includes the technical, design, manufacturing, management and commercial activities involved in the marketing of a new (or improved) product or the first commercial use of a new (or improved)

process or equipment.” Albury (2005, p. 3) provided a broader definition of innovation, stating: “Successful innovation is the creation and implementation of new processes, products, services and methods of delivery which result in significant improvements in outcomes, efficiency, effectiveness or quality.” This definition has grown to be the one most commonly used by researchers in innovation management (e.g. Adams, Bessant, & Phelps, 2006; Hartley, 2005).

Innovation can appear in various forms, not only as new products and processes, but also as new organizations, types of contracts, distribution channels, advertising messages and corporate identities. Innovation can be scaled as radical vs. incremental or continuous vs. discontinuous (Hauschildt & Salomo, 2011). Other researchers had developed more sophisticated multidimensional and continuous constructs to capture the complexity of the concept (e.g. Kock, 2007).

Previous researchers found various means to differentiate between product and process innovation. Product innovation includes all new outputs from an organization either as a product or as a service. Process innovation is centered on improving the efficiency and effectiveness of the production process (Totterdell, Leach, Birdi, Clegg, & Wall, 2002). Markides (2006) also differentiated organizational and business-related innovation by stating that organizational innovation affects the internal structure, culture, and system within companies and provides a potentially positive impact on financial performance. Business-related innovation is defined by “the discovery of a fundamentally different business model in an existing business” (Markides, 2006, p. 20).

The definition of innovation is considered a topic of interest in many works of literature (Zahra & Covin, 1994). Damanpour (1991) states that innovation is tied to organizational change, as organizations use innovation to influence internal or external changes. Innovation may involve a range of changes related to a new product, new materials, new process, new services, and new organizational forms, depending on the organization's resource, capabilities, strategies, and requirements (Ettlie and Reza, 1992). Baregheh et al. (2009) reviewed 60 definitions of innovation from research done in the various disciplines of business management, economics, organization studies, innovation and entrepreneurship, technology, science, engineering, knowledge management, and marketing. They proposed a general and integrative definition of organizational "innovation" that encompasses the different perspectives on, and aspects of, innovation, and captures its essence.

Based on the previous innovation measurements found in the literature, this study defined innovation in three forms: product, process, and organizational innovation. Product and process innovation can be studied through the new product and through fuzzy front-end innovation stages. The variables of TRIZ, leadership and diversity climate have been shown to affect the development stages and the end product (Koen et al., 2002). Organizational innovation can be studied in the form of the management framework. The variables of knowledge management and organization change have been shown to improve organizational innovation (Adams et al., 2006).

Importance of Innovation

For an organization to have competitive advantage and be able to respond to the rapid changes in the environment, the development of creativity and innovation is needed in today's complex business environment (Lapierre & Giroux, 2003). Many companies are searching for ways to transform their product development process into a source of innovation that can lead to competitive advantage (Hua, 2006). An essential mission of an organization is to measure the effectiveness of the complex approaches that influence the company's innovation abilities (Cordero, 1990). Organizations face real challenges, including internal uncertainties that change how they generate innovative ideas. If an organization successfully launches a new product, process or service in the market, it will have to be able to support long-term survival of the launch (Herstatt & Verworn, 2001).

Innovation growth is widely known in the academic and business worlds. A huge stress is placed on the need for organizations to innovate in order to achieve long-term success in the market (Nagano, Stefanovitz, & Vick, 2014). The definition of company growth is shifting from increased sales of typical products to the potential for development of new products. The lack of innovation has been shown to be an obstacle to an organization's growth (Yang, 2012). Previous literature has revealed that there is a lack of research focusing on the challenges faced by companies to increase their innovation capabilities (Galia & Legros, 2004; Segarra-Blasco, Garcia-Quevedo, & Teruel-Carrizosa, 2008). Companies have failed to apply innovation management principles to reduce or moderate the intensity of their obstacles (Hansen & Birkinshaw,

2007). More studies showed that there has been significant progress in organizational theory that focuses on innovation and integrated innovation management models (Tidd & Bessant, 2015).

Rothwell (1994) believes that, for small manufacturing companies especially, innovation and development activities can become the foundation of their -ability to survive and succeed in a rapidly changing and increasingly complex industrial environment, amid ever shortening product life cycles. These difficulties are overcome by using strategic integration and the development of collaborative networks. By using these solutions, small firms can acquire the essential resources and knowledge for innovation (Dickson & Hadjimanolis, 1998; Rothwell, 1994).

Measuring Innovation

Innovation can be measured in many ways. Managers must begin to evaluate their firm's performance in the marketplace to determine optimum productivity as well as technology trends ("Research management: An International journal dedicated to enhancing," 1982); evaluate their investment with reliable justifications (Brown & Svenson, 1988); and reward-motivated behavior (Werner & Souder, 1997). Cordero (1990) stated that performance should be evaluated in terms of resources and output, whereby resources are measured to determine efficiency and output is measured to determine the effectiveness.

Innovation Output Measures

Firms capture their output performance through quantitative and qualitative measures. Quantitative measures include market share which evaluates the market strength of the output (Rockwell & Particelli, 1982); percent of sales of the new product developed (Lawrence & Lorsch, 1986); the number of significant innovations in a period of time (Mansfield, 1969) and the rate of success of new products (Rockwell & Particelli, 1982).

Researches use qualitative measures such as profile analysis, scaled rating, checklisting, and Q-sorting. Profile analysis is a multivariate equivalent of repeated measures or mixed ANOVA which visually compares the dependent variables between groups over several time-points (Pastor, 2007). One of the modeling types, scaled rating, is similar to the profile analysis, but adds a numerical value to each facet. Another modeling type, the checklist, shares aspects with scale models, but adding numerical values to each facet (Embretson, 2013). A third modeling type, Q-sorting, is a process that each participant individually judges a statement and place the statements into a predetermined distribution pattern [e.g., normal distribution and ranking categories] (Andelin & Naismith, 1986; Cooper, 1978; Cordero, 1990; Krawiec, 1984; Souder & Mandakovic, 1986). Another approach is to evaluate overall performance by asking a panel of experts or by comparing the production profiles of several competitive organizations (George, 2005). Cordero (1990) showed that qualitative measures can also be used to evaluate individual and group performance. One familiar technique is to have first managers alone and then managers and peers determine ratings and rankings of the

overall performance based on several dimensions of technical performance (Edwards & McCarrey, 1973; Grasberg, 1959; McDonald, 1971; Pelz & Andrews, 1966).

Another approach to measuring innovation outcomes found in the literature is the Input-Process-Outputs-Outcomes model (Brown & Svenson, 1988). In this system, company innovation activity is considered as a system around the Research and Development (R&D) lab in which the input (funds, ideas, people, etc.) will lead to output (patents, products, processes, etc.). Those outputs will be picked up by manufacturing, marketing, and other business departments in the company and will then lead to further outputs, such as sales, product improvement and cost savings. This model focuses on firms developing a feedback loop and a systematic understanding of the innovation process.

Overall Company Performance

The most commonly used management tool for measuring innovation include the Performance Measurement Matrix (Daniel & Keegan, 1989), the Performance Pyramid (Cross, Lynch, & McNair, 1990), the Integrated Performance Measurement Systems (Bititci, Carrie, & McDevitt, 1997), the Performance Prism (Neely & Adams, 2001), Data Envelopment Analysis (Charnes, Cooper, & Rhodes, 1978), Quantum Performance Measurement (Hronec & Andersen, 1993), or a similar technique to quantum measurement called Productivity Measurement and Enhancement System (Pritchard, Harrell, DiazGranados, & Guzman, 2008). All of these management tools measures the overall company performance. In addition, one of the most widely used management model techniques is the Balanced Scorecard (Kaplan & Norton, 1995, 1996, 2001, 2005)

which allow managers to look at the business from four important perspectives: customers, financial, innovation & learning and internal business process. A special version of this, called the Innovation-Center Balanced Scorecard (Kerssens-van Drongelen & Cooke, 1997) measures company performance in terms of value added by innovation and also guarantee the alignment with the organization strategic objective.

The Innovation Center Balanced Scorecard developed by Kerssens-Van Drongelen and Cooke (1997) have provided four sectors for measuring overall company performance: financial, internal business (process), innovation & learning, and customer. This approach has a huge advantage in that it separates the Key Performance Indicators (KPI) into sets of leading and lagging indicators. However, this approach is still limited and incomplete due to categories such as strategic measures (goal satisfaction) or knowledge management (enlarging or exploiting a firm knowledge base). Both of these categories have a huge impact on innovation success (Cusumano & Nobeoka, 1998; Lynn, 1998).

Management Control and Financial Measure

Most organizations view the management control system as the most common method for supporting the implementation of strategy at the management level (Zizlavsky, 2014). Anthony (1965, p. 17) defined management control as “the process by which managers ensure that resources are obtained and used effectively and efficiently in the accomplishment of the organization’s objectives”. Management control systems focus on measuring cost efficiency and financial performance by using accounting information and excluding external aspects of the business that would not appear in standard

financials (Aureli, 2010). Zizlavsky (2014) added that financial indicators are indispensable for measuring and assessing the business performance of a company. Most firms inform managers how workers should create value and measure management performance accordingly. Kislingerová (2008) stated that financial analysis are influenced by unspecified factors and may reflect the results of the managerial decisions made in a previous period of time, not necessarily those of the current managers. Zizlavsky (2014) emphasized that financial indicators are very hard to combine correlate with an evolved internal company process and cannot be used to indicate evaluate other areas that are critical for the success of the company. Gleich (2001) further describes the limitation of financial indicators by stating that they do not align with corporate strategy, take a backward view, result in insufficient customer orientation and become misleading reference points for incentives.

Better Measures of Innovation

The degree of change occurring in the business world, through globalization, for instance, has increased the demand for customization, quality, and speed in product delivery and has revealed limitations in traditional management accounting. There is a need to review the old concepts and look for new options (Hayes & Abernathy, 2007; Johnson & Kaplan, 1991). Kerssens-van Drongelen, Harkink, Blomqvist, Ojanen, and Kuittinen (2004) have shown that traditional measuring and controlling approaches are focused on applying top-down KPI (Key Performance Indicators), so that upper management indicates staff creativity and motivation or lead subgroups into short-term goals and sub-optimization. Researchers have suggested changing the focus of business

performance measurements by adding non-financial indicators for assessing company success (Chakravarthy, 1986; Ittner & Larcker, 1998; Kaplan & Norton, 2005; Merchant, 1985; Meyer, 1994; Nanni, Dixon, & Vollmann, 1992; Neumann, Roberts, & Cauvin, 2008; Palmer, 1992; Vaivio, 1999).

There are many performance measurement trends shown in the literature. Zizlavsky (2014) stated that innovation is a continuous process and companies (tend to) create changes throughout the idea-development and product-design stages; this dynamic process is hard to measure. Bilderbeek (1999) stated that measuring the performance and contribution values of innovation has become a high concern for managers and executives Boston Consulting Groups analyzed performance measurement systems that focused on “continuous change” innovation and determined that globalization, organization structure, and leadership improves the innovation capability. Fiorentino (2010) implemented the system of innovation measurement inside general and sector companies and found that performance measurement should be designed in a way that they enable organizations to learn how to evaluate their internal and external environments. Zizlavsky (2014) stated that it is not enough to pick up a few areas inside the organization using random indicators and expect to have suitable information to manage innovation. In most cases, when innovation measurement is done, managers are overwhelmed with results that are not related to their department, rather the results are based on the performance of other departments (Davila, Epstein, & Shelton, 2012).

Most organizations only focus on input and output measurements in terms of spending, speed to market and number of products and ignore the process of innovation

(Cordero, 1990). Cebon, Newton, and Noble (1999) stated that there is a need for a generalized innovation framework for managers to evaluate the innovation process. One of the most applicable and holistic approaches to assessing innovation performance is the Innovation Management Area Framework (Adams et al., 2006). This framework is based on an intensive literature review that was proposed by both researchers in the academic field and organizations in the marketplace in order to understand the effectiveness of innovation actions (Barclay, 1992). One of the aspects under discussion is that the range and sequence of innovation activities may vary across organizations and projects, but their success is based upon certain factors; these factors make up the core of this measurement framework (Adams et al., 2006). The framework succeeds in shifting from success factors to innovation capability factors and has been accepted by mainstream management accounting programs (Adams, Neely, Yaghi, & Bessant, 2008; Dutta, 2012). Adams et al. (2006) describes seven areas for the framework model that captures the innovation performance inside a firm. This framework was established by conducting email surveys with global experts in measuring innovation. The framework list is shown in Figure 3.

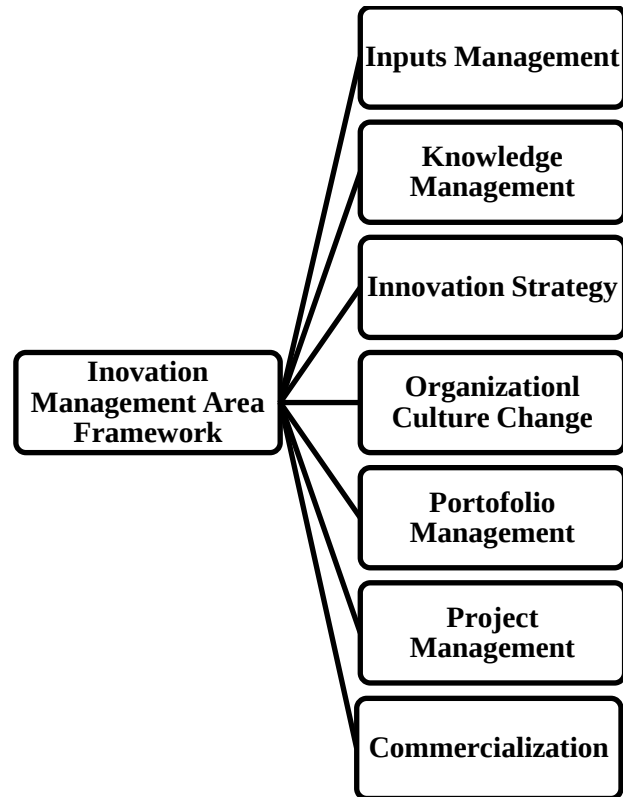


Figure 3: Innovation Management Area Framework [Adopted from (Adams et al., 2006)]

The innovation management area framework shows the importance of targeting specific areas within the organization to improve the overall performance. This study will focus on two areas in the innovation management framework: knowledge management and organizational change. Battisti & Stoneman (2010) showed that these two areas are highly correlated based on an inter-correlation analysis performed between all the variables in the innovation management framework.

New Product Development Stage

Innovation capability and new-product development represent very important tools for firms who want to survive and grow in today's highly competitive environment.

In conditions of constant market and technical changes, new product development allows firms to successfully adapt, renew and maintain their competitiveness (Brown & Eisenhardt, 1995). The capacity to innovate and the pace at which it occurs are dependent on the intensity of industry competition, technological change, strategic orientation, and organizational resources, and they directly affect the cost and success of a newly developed product (Kessler & Chakrabarti, 1996). Developing new products can often be a restrictive matter, as the cost of production and of marketing can be high and positive results are not predictable or certain (Herstatt & Verworn, 2001).

In their study regarding the critical success factors for the new-product development process, Cooper and Kleinschmidt (1987) reported that product advantage, internal organization, predevelopment planning, and market characteristics are the most important contributors. They emphasized the role of pre-development activities for new product development and also concluded that success is often greater in less competitive, large and growing markets.

The manner and effectiveness of executing the pre-development activities and the capability of defining a project or a product before the actual development are vital components for companies wanting to distinguish themselves from their competitors (Cooper, 1988). As argued by Kim and Wilemon (2002b), the efficient management of pre-development activities can lead to a competitive advantage. In fact, it may constitute a core competency for those companies that understand the importance of this early phase in the success of NPD.

Companies often perceive innovation as the origin of good profitability and performance. In order to advance their effectiveness in innovation, companies frequently create synergies in innovation between their product, the development process, and marketing strategies, and try to complement them with suitable management styles (Otero-Neira, Tapio Lindman, & Fernández, 2009). Moreover, internal and external orientation towards innovation and a combination of learning capabilities customer knowledge and technology can lead companies to higher performance rates (Salavou, 2005).

Fuzzy Front-End Innovation

The proficient execution of activities before the start of the formal NPD (New Product Development) process, activities such as identifying new product opportunities, generating new product ideas, developing a product concept, or planning the development project, is one of the key success factors of NPD (Evanschitzky, Eisend, Calantone, & Jiang, 2012). The Fuzzy Front End (FFE) is defined as the period between when an opportunity for a new product is first considered and when the product idea is judged ready to enter formal development (Kim & Wilemon, 2002a). It involves the activities that are undertaken before the decision to develop a new product is made. These activities are considered key to the innovation in the NPD stage (Cooper, 1999; Cooper & Kleinschmidt, 1995; Khurana & Rosenthal, 1997). In view of frequent product failures, it is important to identify predictive guidelines early in the NPD process so that better choices can be made and unnecessary costs avoided (Goldenberg, Lehmann, & Mazursky, 2001).

Khurana and Rosenthal (1997) referred to the pre-development stage as Fuzzy Front End, a crossroad of complex information processing, tacit knowledge, conflicting organizational pressures, and considerable uncertainty. In addition, the FFE stage is often ill-defined and characterized by ad-hoc decision-making in many firms, mistakes that should be avoided (Montoya-Weiss & O'Driscoll, 2000). It is broadly accepted that decisions made at this stage determine the path of the whole innovation process and set the firm's future competitiveness strategy (Cooper, 1999).

Herstatt and Verworn (2001) identified five stages in the process of innovation. FFE makes up the first two stages. Figure 4 portrays a model of the innovation process, highlighting the front end and its activities:

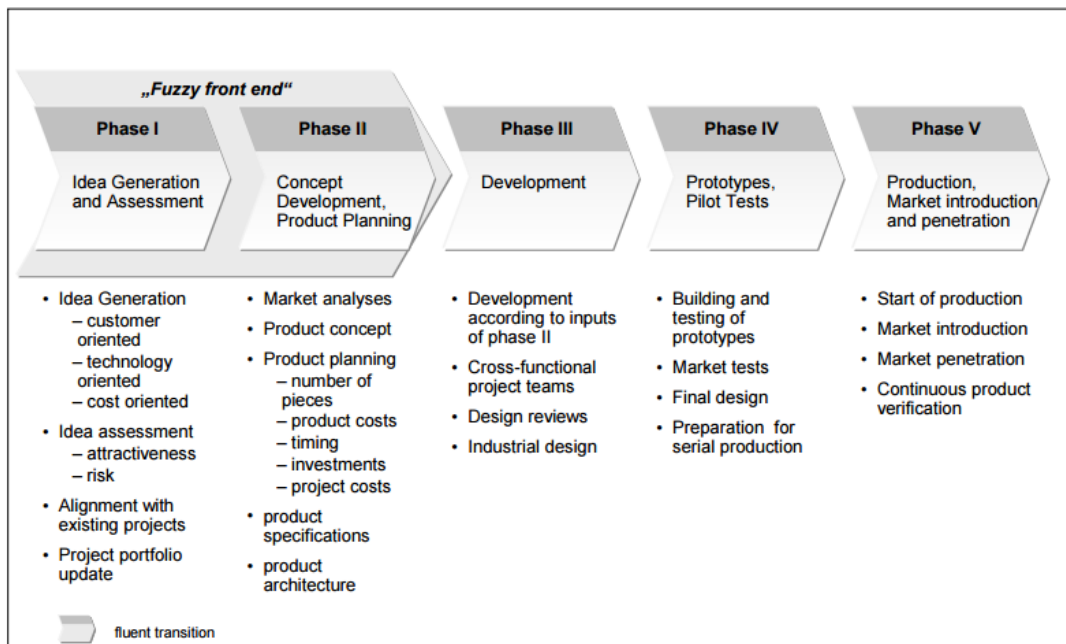


Figure 4: The Innovation Process, [Adopted from (Herstatt & Verworn, 2001)]

Although the effort toward a better understanding of the fuzzy front-end has been more concentrated during the last two decades, scholars of NPD have discussed “upfront activities” in a generic way for more than forty years (Crawford, 1980). We now clearly see that there are early and late activities comprising the fuzzy front end, regardless of the level of innovation (incremental or discontinuous). In the case of early fuzzy front-end activities, researchers speak of opportunity structuring and opportunity identification (Leifer, 2000; Urban, Hauser, & Urban, 1993), information collection/exploration (March, 1991), and “up-front homework” (Cooper, 1996). These activities, however, tended to be described in somewhat non-specific terms. Late fuzzy front-end activities are seen as involving aspects of idea generation and concept development (Cooper, 1990; Urban et al., 1993), continued information collection, and informal- or pre-screening (Crawford, 1980; Crawford & Di Benedetto, 2008) with possibly some initial fund allocation for exploring a new idea (Cooper, 1990; Cooper & Kleinschmidt, 1986).

Jetter (2003) demonstrated the challenges of uncertainty in the initial FFE phases as the product idea is being generated. The level of uncertainty affects whether the product will be adopted or not in the NPD phase. Figure 5 shows the challenges of uncertainty in FFE.

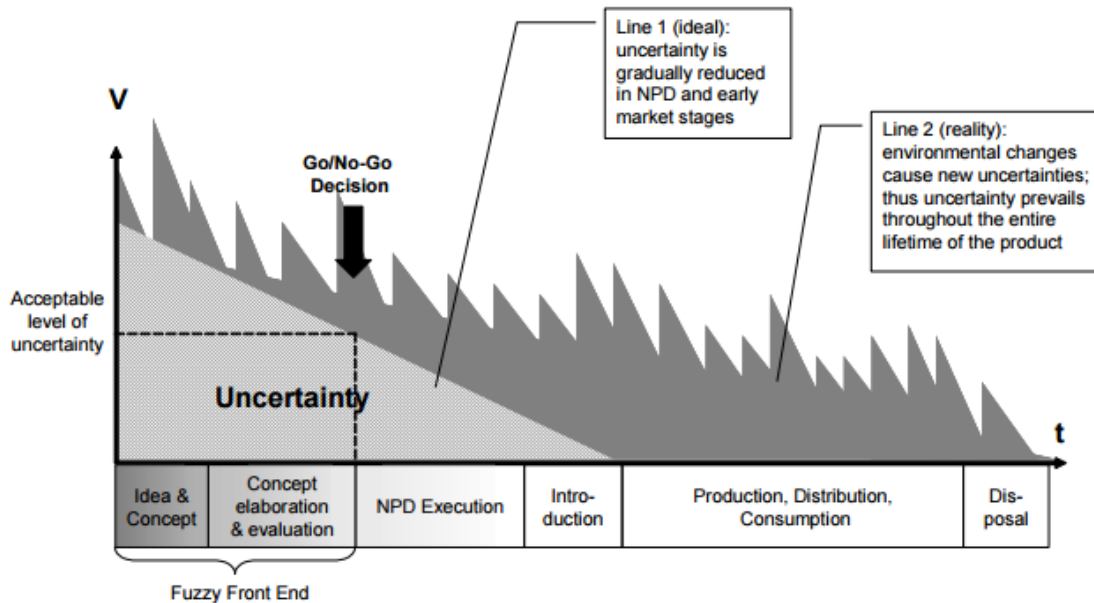


Figure 5: The Challenges of Uncertainty in FFE, [Adopted from (Jetter, 2003)]

Herstatt and Verworn (2001) emphasized the importance for organizations to have a clear approach in NPD in order to meet their customer expectations and have longevity in the industry. They specify that FFE can affect cost change and have a significant influence on organizational behavior. Others have shown different tools and methodologies to manage FFE inside organizations. Herstatt and Verworn (2001) listed three sub-phases for managing the FFE:

- Process-related aspect through use of a stage-gate approach: “front-loaded problem- solving, work breakdown structure breakdown, project scheduling, network diagramming, and a design structure matrix
- Idea and concept generation through using the Theory of Inventive Problem-Solving (TRIZ) and the lead- user method
- Concept testing through using the information acceleration method, or web-based conjoint analysis.

According to Koen et al. (2002) the FFE is one of the best stages to increase innovation performance. They conducted in-depth research regarding the concept of the front-end innovation, revealing the main differences between the front-end innovation and new product development. Moreover, they specify the main factors that create the best environment for front-end innovation. These environmental factors consist of categories like cooperation, business strategy, competition between firms and the maturity of the firm's technology. This research also points out the importance of aligning product innovation with these factors. Koen et al. (2002)) also explained that the main engine for front-end innovation are factors like leadership and a diverse climate (culture). They also specify the stages of front-end innovation, which are as follows:

1. Opportunity Identification: In this stage, the company identifies its weaknesses and limitations and how the company might convert them to technological or business strategy opportunities. These opportunities arise from challenges the company faces, such as competitive threats. These opportunities can lead to a new direction for the company or an upgrade to existing products.
2. Opportunity Analysis: This stage focuses on developing uncertain technologies and analyzing the market in order to translate the company's limitations into opportunities (business or technological) that may benefit the company. In this stage, a company concentrates its efforts to utilize focus groups, market studies, and scientific experiments to increase the attractiveness of this opportunity. This stage depends on the iterative process to innovate, through analysis of "what-if" scenarios.

3. Idea Genesis: This is the most important stage of the FFE, in which the idea is born and developed, and then converted into a solid opportunity for the firm. Many errors, validations, examinations, iterations, and changes happen in this stage, eventually resulting in a more completely developed idea. To enhance this activity, the firm should have clear contact with customers/ user of their product, have consistent communication with other cross-functional teams, and collaborate with other companies and institutions. This stage utilizes methods like brainstorming sessions and idea banks in order to create new or modified ideas for a given opportunity.
4. Idea Selection: This stage focuses on selecting different NPD ideas in order to achieve the best opportunities (business strategy or technological). Criteria for NPD selections can vary from one individual to another or one team to another based on perspective and experience; however, some of the selections can be formalized in a portfolio. A clear process must be outlined for selecting the best idea in order to gain competitive advantage, organizational capabilities, financial returns, and/or unique advantages.
5. Concept and Technology development: Before any decision-making takes place, there should be a clear procedure for concept development of the selected idea. Included in the concept development should be references or visuals to represent the NPD concept, as well as an outline of customer perspectives and the need for the concept in the industry market. The form which the development takes in this stage differs according to the nature of the opportunity, level of resources for the company,

organizational requirements and the business culture. Many industries consider this stage to be the initial stage for the new process/product development (NPPD).

Koen et al. (2002) made a huge contribution to the understanding of FFE with these five stages. They identified the best tools, techniques, and goals for each stage, aiding the process of innovation. Based on the identification and analysis of opportunities, the idea generation stage in the fuzzy front-end of innovation has been described as the birth and development of a new concrete idea. Koen et al.'s work also enhances the understanding of the idea selection stage through techniques like brainstorming and idea banks which help the organization to create opportunities. Often, new ideas can be built upon previous familiar ideas with improvements. According to Markham and Griffin (1998), ideas can be generated either by an individual or a team. Once an idea has been identified, many creative techniques can help to expand it. These techniques can be done by individuals or in brainstorming meetings or idea sessions.

Process Innovation

Innovation consists of two dynamic outcomes: changes in the specific product or service offered to the customer/client or changes to the mode or process by which they are created and delivered (Damanpour & Gopalakrishnan, 2001). Product and process innovation are two different concepts in the innovation literature (Cohen & Klepper, 1996; Utterback & Abernathy, 1975). Product innovation focuses on meeting customers preferences by designing a new or improved product, whereas process innovation relates to improving operations and the supply chain (OECD/Eurostat, 2005). Product innovation

helps firms achieve competitive advantage by differentiating their range of products from competitors, whereas process innovation helps firms to improve their efficiency (Porter, 2008). Therefore, product innovation is market-driven while process innovation is driven by efficiency and quality considerations (Damanpour & Gopalakrishnan, 2001).

To gain and sustain competitive advantage, firms need to have the capability to innovate in both product and processes (Pisano, 1997; Tushman & Nadler, 1986). Especially in manufacturing firms, there is a relationship between product and process innovation. Most new products cannot be developed and manufactured without innovation in process technology (Frishammar, Florén, & Wincent, 2010; Linton & Walsh, 2008).

Despite the major importance of process innovation for firm performance, relatively few academic studies have addressed this topic. Instead, most prior research has concentrated on product innovation, whereas process innovation has been largely neglected (Reichstein & Salter, 2006). Pisano and Shih (2012) state that process innovation helps firms to lower costs, increasing the financial margin for operations which enable improvement in product features and qualities. Previous research has shown that through process innovation firms can reap efficiency gains by means of cost reduction and increased production volumes (Kurkkio, Frishammar, & Lichtenthaler, 2011; Lim, Garnsey, & Gregory, 2006). In addition, process innovation can contribute to a reduction in the time required to develop products (Pisano, 1994, 1996). Process innovation may also directly add value to customers through improved product quality and reliability (Gopalakrishnan, Bierly, & Kessler, 1999).

Process innovation typically consists of both technological and organizational dimensions (Edquist, Hommen, & McKelvey, 2001; Reichstein & Salter, 2006). Firms can determine if innovation in one or both of these dimensions is necessary by considering whether the process involves technical elements, whether it relates only to the coordination of human resources, or if it involves both (Edquist et al., 2001). Technological process innovation takes the form of improvements in operation procedure, which consist of both enhanced manufacturing operations and improved service operations (Brown & Eisenhardt, 1995; Damanpour & Gopalakrishnan, 2001; Davenport, 1993).

The organizational dimension is important for companies that intend to follow strategic challenges (Higgins, 1995). Organizational process innovation means the implementation of a new organizational method in a business, for instance, through the arrangement within the workplace and with external relationships. Introducing a new process in the organization's procedure drives the work practices and production through facilitating learning and knowledge sharing within the company (OECD/Eurostat, 2005).

Firms can follow innovation strategies focusing either on product and process, but there is debate on whether they should try to do both. Until recently, industrial economics has advised firms to focus on one of the innovation types, product or process, due to differences in the requirements of the organizational structure (Bhoovaraghavan, Vasudevan, & Chandran, 1996). Nevertheless, researchers have sought to understand the interaction between product and process innovation. Kraft (1990) studied the interaction between product and process innovation in a sample of 56 German metalworking firms.

He found that when process innovation lead to product innovation, there was effective interaction. However, the reverse was not true: product innovation does not lead to process innovation. Evidence of significance between product and process is also found in other studies (Milgrom & Roberts, 1995; Reichstein & Salter, 2006).

Knowledge Management

Zahra and George (2002) defined Knowledge Management (KM) as the ability of an organization to acquire, utilize and extend information, and showed that this can be critical to the success of firms. In addition, Hull, Coombs, and Peltu (2000) specified that knowledge management emphasizes innovation competency in order to obtain and communicate information, and has various applications in idea generation, the capacity to adapt, and networking. Nonaka (2008) describes three areas of knowledge management: idea generation, knowledge repository (including management of implicit and explicit knowledge) and information flow (management of information gathering and networking). Cooper (1988) defined ideas as being the raw materials for innovation, where it is difficult to generate and screen ideas, the lack of knowledge management will have a significant impact on the success or failure of products.

Successful organizations come to understand why they must develop plans and devote time and energy to managing knowledge. This is because KM has been described as a key driver of organizational performance, (Bosua & Venkitachalam, 2013) and one of the most important resources for the survival and prosperity of organizations (Kamhawi, 2012; Teece, Pisano, & Shuen, 1997). Therefore managing and utilizing

knowledge effectively is vital for organizations to take full advantage of the value of the knowledge.

In order to manage knowledge effectively, attention must be paid to four key components: Knowledge, People, Processes and Technology (KP2T) (Desouza & Paquette, 2011). In essence, the focus of KM is to connect people, processes, and technology for the purpose of leveraging knowledge. Each of these components must be considered:

1. Knowledge basically refers to a collection/or a body of information, and is described as the essential element in knowledge management. As Desouza and Paquette (2011) made clear, without knowledge, there would be no knowledge management. Knowledge may be embedded in the form of theories, processes, systems, or voiced in the form of opinions, theories, ideas, and analysis. Knowledge includes the insights, understandings, and practical know-how that people possess. It is the fundamental resource that allows people to function intelligently. It can thus be stated that knowledge is an invisible or intangible asset and its acquisition involves complex cognitive processes of perception, learning, communication, association and reasoning (Epetimehin & Ekundayo, 2011).
2. The second component of KM is people. People are the source of knowledge, arising from their talents and experience, and the users of knowledge, as they think creatively and uniquely. As Drucker (1999) points out, workers (people) need to be able to seek out knowledge, experiment with it, learn from it, and even teach it to others as they innovate in order to promote new knowledge creation. Having a KM

program that emphasizes the importance of people is very important to organizational success.

3. Desouza and Paquette (2011) define processes, another KM component, as mechanical and logical artifacts that guide how work is conducted in organizations. Processes govern work in organizations and are critical to their functioning. A critical requirement for KM is to be able to understand and map work processes. Maps allow inputs, outputs, personnel, resources, and the work being conducted in a given process to be easily described. They depict what is really going on in an organization and reveal how well/efficiently tasks are being accomplished.
4. The last component of KM is technology. Technology refers to enabling tools that provide communication and knowledge capture in the form of online instant messaging applications and it is a critical enabler of a KM plan. Information and Communication Technologies (ICTs). facilitate collaboration between people and teams which are geographically dispersed through the rich and interactive forms of communication through the Internet. ICTs also facilitate KM activities through the codification of knowledge. Putting an ICT-based KM system in place does not in and of itself ensure that people will utilize it, however; the success of KM initiatives involves taking into account the socio-cultural factors which inhibit people's willingness to use technology and/or to share knowledge, factors such as conflict, trust, time or concerns about loss of power/status (Yih-Tong Sun & Scott, 2005).

Research has shown the importance of knowledge management for organizations. Pan and Scarbrough (1999) stated that knowledge management consists of a mixture of technical and social factors among people in an organization. They identified two key features in organizational knowledge that must be addressed. The first feature of organizational knowledge is that there are different types of knowledge that must be differentiated, specifically tacit and explicit knowledge. Explicit knowledge is systematic and easily communicated, but tacit knowledge resides in the worker's mind and they are often unaware of it. The second feature of organizational knowledge involves the KM structure within organizations that need to be recognized.

Simonin (1997) studied the impact of knowledge management on financial and non-financial performance. Changes in organizational practices such as implementing new knowledge management practices, do not necessarily result in changes in financial performance, at least not immediately (Kalling, 2003). On the other hand, knowledge management can affect the intermediate variables that could change financial performance over time (Choi & Lee, 2003).

Knowledge Management and Innovation

Hackbarth (1998) claimed that knowledge management increases organizational innovativeness and responsiveness. Alavi and Leidner (2001) showed a survey conducted in the European firm Klynveld Peat Marwick Goerdeler (KPMG) (Hurley, 1997). They found the company lost 43% of their clients and suppliers due to the loss of a key staff, 13% of the loss was due to the departure of a single employee. The results from 49% of the responses specified that the knowledge of best practices in a specific area were lost

when that employee left the company. Another survey from Cranfield University showed that 61% of the participants believe that the knowledge required for a job is available within an organization, but identifying, finding and measuring it can be difficult (Centre, Corporation, & Strategy, 1998). Another survey of KPMG knowledge management consultants showed that participants believed that the necessary knowledge will be more easily located if it has less impact on the organization's business. As organizations become aware of these obstacles, they are undertaking a systematic process to knowledge management by focusing on decision-making, creating a fast-response system for key issues, increasing profitability, improving productivity, creating new business opportunities, reducing cost, sharing best practices, increasing market share, increasing share price, and creating a more attractive work environment (Alavi & Leidner, 2001).

Effective knowledge management adds more value to the overall performance of the organization (Toften & Ottar Olsen, 2003). Gold and Arvind Malhotra (2001) claimed that a successful application of knowledge management enables firms to become innovative, helps in harmonizing its efforts better, and allows new products and developments to be better commercialized and become more adapted to market changes. Knowledge management has great importance to firm performance due to its contribution to innovation improvement, enhanced coordination of effort, better decision-making, and ultimately better financial results (Holsapple & Wu, 2008). Effective knowledge management means that there is an efficient use of resources that will result in better outcomes in innovation and financial performance (Darroch, 2005). An innovation survey conducted by the Ernest Young's Center for Business suggested that measuring the value

and performance of knowledge assets is the second most important activity that organizations should adopt after the activity of changing people's behaviors (Leana & Van Buren, 1999).

Metaxiotis, Ergazakis, and Psarras (2005) developed a survey which showed that executives recognize innovation as the most important attribute of knowledge management. Nonaka and Teece (2001) indicated that effective knowledge management can increase growth, drive individual and organizational learning, provide a competitive advantage and generate benefits for shareholders. Other advantages of knowledge management include lifelong learning within the organization, enhanced intellectual asset management, increased operation efficiency, time-to-market improvement and continuous product improvement (Demarest, 1997).

Chan, Chen, Hung, Tsai, and Chen (2017) investigated the influence of open innovation and team leadership on team performance. Based on 45 valid responses from a Taiwanese technical industry, they discovered that the most important innovation criterion for leaders is the innovation knowledge which helps a company outperform their competitors significantly. Other types of knowledge which were significant for leaders to possess were core knowledge (the basic knowledge required to enter the company) and advanced knowledge (knowledge required to compete with other companies in the industry).

Diversity

Diversity is defined as “an aggregate team-level construct that represents differences among members of an interdependent workgroup with respect to specific

personal attribute” (Joshi & Roh, 2009, p. 3). In line with past research, Jackson, May, and Whitney (1995) distinguished between task-oriented and relations-oriented aspects of diversity. Relations-oriented diversity attributes such as gender, race/ethnicity, and age are cognitively accessible, pervasive, immutable and are associated with social categorization processes (Fiske, 2000; Van Knippenberg, De Dreu, & Homan, 2004). Social categorizations-based processes, which manifest in intergroup bias and negative attitudes toward dissimilar others in a group may have negative performance consequences. In contrast, task-oriented diversity attributes, such as education, function, and tenure, are associated with skill-based and informational differences among workgroup members and are not necessarily immediately obvious (Jackson et al., 1995). However, once known, these task-oriented biases may also hamper the performance of a team. In principle, diversity thus refers to an almost infinite number of dimensions, ranging from age to nationality, from religious background to functional background, from task skills to relational skills, and from political preference to sexual preference. In practice, however, diversity research in industry has mainly focused on gender, age, race/ethnicity, tenure, educational background, and functional background (Milliken & Martins, 1996; Williams & O’Reilly III, 1998). A number of researchers have proposed the importance of recognizing the distinction between diversity dimensions, between social diversity—i.e., differences in readily detectable attributes such as sex, age, and ethnicity—and informational/functional diversity— i.e., differences in less visible attributes which are more job-related, such as functional and educational backgrounds,

and addressing them accordingly (Jackson, 1991; Jehn, Northcraft, & Neale, 1999; Milliken & Martins, 1996; Tsui & O'reilly, 1989).

Companies seeking to excel in innovation should recognize the potential for diverse groups to outperform homogeneous groups. The idea is that diverse groups are more likely to possess a broader range of task-relevant knowledge, skills, and abilities that are distinct and nonredundant and to have different opinions and perspectives regarding the task at hand. This not only gives diverse groups a larger pool of resources but may also have other beneficial effects. The need to reconcile conflicting viewpoints may force the group to more thoroughly process task-relevant information and may prevent the group from opting too easily for a course of action on which there seems to be consensus. In addition, exposure to diverging and potentially surprising perspectives may lead to more creative and innovative ideas and solutions (Ancona & Caldwell, 1992; Bantel & Jackson, 1989; De Dreu & West, 2001). Corroborating this analysis, some studies have found an association of diversity with increased task conflict (Jehn et al., 1999; Pelled, Eisenhardt, & Xin, 1999) and higher performance and innovation (Bantel & Jackson, 1989; Cox, Lobel, & McLeod, 1991; Jehn, Northcraft, & Neale, 1999).

Diversity and Innovation

Creativity requires the ability to think divergently, to see things from different perspectives, and to then combine previously unrelated processes, products, or materials into something new and better (Amabile, 1996). The generation of creative ideas is a result of cognitive and motivational processes within individuals, although the interactions within teams can foster it (Mumford & Gustafson, 1988). Indeed, taking a

“sensemaking” perspective, Drazin, Glynn, and Kazanjian (1999) argued that creativity is the process of engagement in creative acts that occurs in an iterative fashion between individuals and teams: “The iterative, interactive nature of group creativity requires that individuals first choose to engage in individual-level creativity” (p. 291).

Diversity research suggests that the value of team diversity resides in the increased range of knowledge, skills, and perspectives available within a team (Pelled et al., 1999; Williams & O’Reilly III, 1998). Thus, team diversity provides a valuable sources of workplace creativity (Amabile, 1996). Teams can be hubs of individual creativity that allow team members to combine information and perspectives from individuals with different knowledge, skills, thinking styles, and perspectives (Lipman-Blumen & Leavitt, 1999). An individual’s attitudes and cultural values have a direct effect on his/her communication behavior and decisions (Oetzel, 1998; van Knippenberg & Schippers, 2007). At the group level, the heterogeneity of the group influences the quality of both the interaction process and group performance (Shachaf, 2008). For example, during initial group formation, diversity is associated with higher turnover and lower group member cohesiveness (Van Knippenberg & Schippers, 2007) and reduced problem-solving performance (Watson, Kumar, & Michaelsen, 1993). Positive factors associated with diversity include increased personal satisfaction, heightened creativity and effectiveness, and heightened quality of idea generation (Rodriguez, 1998; Van Knippenberg & Schippers, 2007). Multi-level theorizing and investigation provide the opportunity to examine both individual- and group-level effects of diversity

simultaneously. They enable a rich understanding of how diversity is associated with intercultural communication and outcomes in workgroups.

Demographic diversity is likely to lead to social categorization. Cognitive diversity, on the other hand, is likely to promote creativity processes (e.g., information processing, combining different ideas, building on others' ideas, and experimenting with the ideas of those with different perspectives) by providing team members with a wide range of ideas, perspectives, knowledge, and values (Harrison, Price, Gavin, & Florey, 2002; Horwitz & Horwitz, 2007; Jehn et al., 1999; Joshi & Roh, 2009; Van Knippenberg, De Dreu, & Homan, 2004). Although demographic diversity is likely to cause relational conflicts (i.e., interpersonal emotional clashes), cognitive diversity is likely to boost task conflicts (i.e., disagreement on job-related issues) which can potentially lead toward creative solutions (Pelled et al., 1999). Thus, when an assignment requires creativity, cognitive team diversity relates more closely to creativity than demographic diversity does. A diversity climate, if positively perceived, is likely to provide individual members with more benefits than disadvantages because team members are more likely to value the various ideas, knowledge, and perspectives among team members. As diversity increases, as long as social categorization does not occur or is limited, the creativity within a team heightens (D. A. Harrison & Klein, 2007; Daan Van Knippenberg et al., 2004).

Diversity Climate

Mor Barak, Cherin, and Berkman (1998, p. 83) defined diversity climate as “employee behaviors and attitudes that are grounded in perceptions of the organizational

context related to women and minorities.” This definition has been broadly accepted and is seen referenced in most of the research on diversity climate (Buttner, Lowe, & Billings-Harris, 2010). Cox (1994) divided diversity climate into three levels (of factors): individual, inter-group and organizational. He stated that most models of diversity climate recognizes the interplay between the individual and the organizational situation in which the individual is embedded. Some of the dimensions of diversity climate include diversity in the workforce, the extent to which diverse input is valued in decision-making, hiring and promoting employees, fairness in feedback, provision of assignments based on skills and abilities only, and elimination of discrimination and bias (Cox, 1994; Barak et al., 1998). Thomas and Wise (1999) reported that racial/ethnic minority group members are more sensitive to the diversity of the climate than other individuals. Hicks-Clarke and Iles (2000) found that diversity climate perceptions affect employees’ work outcomes, including organizational commitment and job satisfaction.

Barak et al. (1998) identified only two dimensions to the perception of diversity climate, personal and organizational. The personal dimension is composed of two factors: personal comfort with diversity and personal valuing of diversity. The organizational dimension is also composed of two factors: organizational inclusion, which touches on training and programs designed to include women and minorities, and organizational fairness, which addresses discrimination and judgment issues (conflicts). Barak et al. (1998) specifically addressed how managers treat subordinates in hiring, promotions, making layoff decisions, giving feedback, and interpreting human resource policies. They discovered that gender and ethnic/racial factors play a big role in organizational fairness.

Measuring Diversity Climate in Organizations

Researchers have developed several assessments of diversity climate over the past two decades. Kossek and Zonia (1993), working in a university setting, defined diversity climate in terms of perceptions of organizational policies regarding resource allocation as a function of employee gender and ethnicity. Barak et al. (1998) developed the Diversity Climate Perception (DCP) scale to assess fairness; DCP subscales focus equality in treatment and fairness in allocation of various human resources and administrative practices and policies with respect to gender, ethnicity, religion, and age. The organizational inclusiveness subscale they developed addresses topics such as organizational support of diversity networks and mentoring programs, as well as adequacy of diversity climate training. Chrobot-Mason (2003) developed the Diversity Promise (DP) scale to measure the extent to which an organization honors its promises regarding diversity climate for employees of color. They also measured the extent to which the respondents valued each dimension of diversity climate and found that employees of color in one organization valued diversity promises as high as more general organizational promises, such as high pay based on performance, job security, and support with personal problems.

The personal value for diversity factor was assessed through questionnaires asking whether employees believe diversity is important and adds value to the organization (Barak et al., 1998). Kossek and Zonia (1993) found that women and racial/ethnic minorities place greater value on diversity. The personal comfort factor addresses issues that deal with ease in working with individuals of diverse background.

Barak et al. (1998) found that the personal comfort factor produces significantly difference results depending on race/ethnicity. Furthermore, they hypothesized that while an organization's efforts to support diversity would be important for people who value diversity, they would not be important for those who do not value diversity.

While Chrobot-Mason's DP scale addresses broader diversity climate issues, Barak's DCP asks more complex questions regarding treatment by the employee's immediate superior. Both the DP and DCP scales measure aspects of diversity climate and are empirically related to employee outcomes (Buttner et al., 2010; Stewart, Volpone, Avery, & McKay, 2011) and organizational performance outcomes (McKay, Avery, & Morris, 2008, 2009). Often, organizations exert effort to increase demographic diversity; however, they fail to fully integrate minority employees and encourage assimilation (Jayne & Dipboye, 2004; Thomas & Ely, 2001). An inclusive diversity climate leads to an increase in minority performance (McKay et al., 2008), group /organizational identification, employee retention and organizational commitment (González-Romá, Peiró, & Tordera, 2002). Parks, Knouse, Crepeau, McDonald, and Kupchick Jr (2008) investigated the relationship between diversity climate and factors of organizational commitment, trust in the organization and job satisfaction for Hispanic women in the military. They found that diversity climate had positive relationships with these outcomes. Overall, it is proven that diversity climate is beneficial for organizations in general

Theory of Inventive Problem Solving

Teoriya Resheniya Izobreatelskikh Zadatch (TRIZ) is translated from Russian as the Theory of Inventive Problem-Solving. This theory specializes in problem definition and providing tools and strategies for problem-solving. According to Savransky (2000), TRIZ is a knowledge-based systematic methodology of inventive problem-solving. Fey and Rivin (2005) describe TRIZ as a methodology for the effective development of new [technical] systems. TRIZ was introduced in the period from the 1950s to the 1980s, primarily in the former Soviet Union, and was at that time referred to as “Classical TRIZ.” In the 1990s, several European and American companies recognized the benefit of TRIZ (Moehrle, 2005b).

TRIZ is a set of principles that describe how technologies and systems evolve. It has been described by Gadd (2011) as a toolkit consisting of methods which cover all aspects of a problem, from understanding to solving. This toolkit is regarded by some as the most comprehensive, systematically organized methodology for invention and creative thinking (Livotov, 2008).

TRIZ possesses a considerable advantage over other methods applied to problem solving and innovation. Methods such as brainstorming, mind mapping, lateral thinking, morphological analysis, etc., have the ability to identify or uncover a problem and its root cause but lack the capability to actually point out solutions to the problem. TRIZ provides a way to identify problems and then offers direct solutions to them; the thoroughness of this approach instills the confidence that most (if not all) possible new solutions to the problem have been considered (Gadd, 2011). The main strength of the TRIZ method is

that it helps convert a specific problem to a general problem. By using the principle of contradiction-matrix parameters and the 40 principles of inventive problem solving, the general problem is then converted to a general solution. In the final step, the general solution will influence the creation of a specific solution for the targeted problem (Kazi, Teli, Gaikwad, & Talukdar, 2014). An outline of this approach is shown in Figure 6:

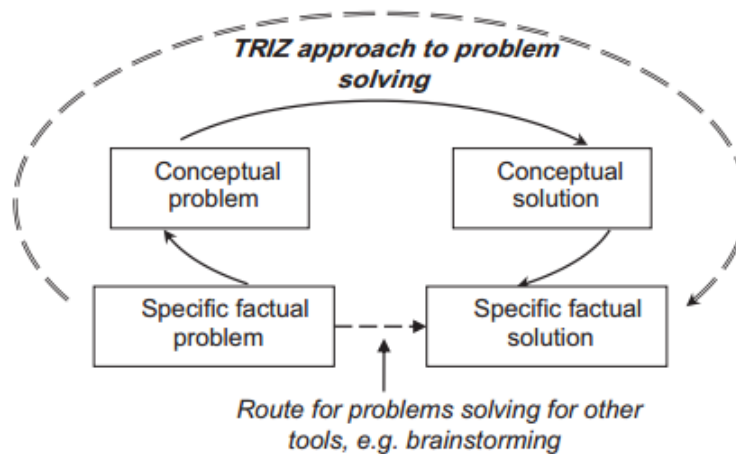


Figure 6: TRIZ Approach to Problem-Solving [Adopted from (Gadd, 2011; Savransky, 2000)]

Mann (2001) pointed out that the methodology of TRIZ focuses on adding value to natural creativity rather than replacing it. It seeks to help the user systematically identify and solve a given problem and convert it into an opportunity situation. In addition, it helps to extract the individual prospective elements from the overall structure. While TRIZ adds value to creativity, it is difficult to know the right model to use unless the specific context of a given situation is known. TRIZ has gaps in converting the general solution into a specific solution. Many TRIZ researchers are looking outside

TRIZ to improve creativity practices/ methods and integrate them together into one whole.

Mann (2001) provided an outline of the basics of TRIZ and showed how researchers can implement this inventive method as a problem-solving framework. After around 1500 person-years of TRIZ research, he concluded that TRIZ has four unique areas that differentiate this methodology from any other innovation problem-solving strategy (Altshuller, Shulyak, & Rodman, 1999). These four areas are:

1. Contradictions: Ilevbare, Probert, and Phaal (2013) defined contradictions as indicators of inventive problems arising from the apparent incompatibility of desired features within a system. Resolving the contradictions solves the problems. There are two major types of contradictions: technical contradictions and physical contradictions. Technical contradictions arise when an attempt to improve certain attributes or functions of a system leads to the deterioration of other attributes of that system. For example, the bigger, more powerful engine proposed for a car in order to increase its speed would contribute more weight to the car, which in turn would limit how fast it can travel, therefore negating the desired benefit of increased speed. Physical contradictions arise when there are inconsistent requirements for the physical condition of the same system. For instance, a system might have a function (or be in a state) which is both beneficial and adverse or unpleasant at the same time. For example, an umbrella's big size helps with protection from rain, but may make it too cumbersome to carry around, and therefore, the size requirements (big umbrella for protection and small umbrella for

convenience) present a physical contradiction. Most TRIZ researchers conclude their research by offering a systematic tool by which the problem can be clearly and comprehensively identified and then solution strategies offered. The most frequently applied tool is the contradiction matrix- a 39x39 matrix that contains 3 or 4 strategies for solving the design problems composed of 1482 contradiction types. The most important concept offered by TRIZ states that there is a way of eliminating these contradictions. A business contradiction matrix has also been constructed through TRIZ research.

2. **Ideality:** Nowadays, the evolution of technology trends towards ideality (discovering the best solution available), usually identified by researching the global database of patents. The ideality section of TRIZ encourages problem-solvers to break out of the current state of their problem, and search for the Ideal Final Result (IFR). The problem-solvers then take the IFR and use it to begin thinking about the problem. The IFR has the advantage that it contains all the benefits with no problems or side effects; in addition, there are no-cost constraints. In most cases, there were no indicators or identifiers that show how the systems evolve toward the IFR because the users tend to realize the IFR naturally.
3. **Functionality:** Functionality is considered as Value Engineering, but still, there is some other functionality that TRIZ can be applied in. These functions are as follows:

- a) Each system possesses a main useful function (MUF), which suggests that any system component that does not contribute towards functionality achievement is considered to be useless or harmful.
 - b) The functional relationship between components as outlined by TRIZ emphasizes that both positive and negative relationships contained in the system should be plotted, leading to a clear problem definition.
 - c) TRIZ functionality is sharable and implied in different types of industries.
4. Use of Resources: TRIZ defines available resources as “anything in the system which is not being used to its maximum potential.” TRIZ researchers criticize systems that are not used to their maximum potentials; any available resource that is discovered should be used to improve the system. In addition, TRIZ demands that the resources in the systems should account for the negative resource potentials as well as the positive resources.

In their article, Wang, Chang, and Kao (2010) illustrated the 40 principles, the 76 standard solutions, the contradiction matrices, the evolutionary patterns and the ideal final result of TRIZ based on 40,000 patents that had been studied by Genrich Altshuller in Russia in 1965 (Altshuller, Shulyak, & Rodman, 1999). Moehrle (2005a) stated that many of the TRIZ applications are based on accumulated knowledge, while others are special techniques for directed creativity. Knott (2001) also provided evidence that TRIZ enhances innovative problem-solving. One recent example of innovative problem-solving using the TRIZ technique resulted in Michelin’s Tweel [a unique type of tire that uses flexible spokes instead of the air to absorb damages] (Filmore, 2006). However, there is

limited research concerning the long-term impact of TRIZ training on employee creativity within an organization (Puccio, Firestien, Coyle, & Masucci, 2006).

TRIZ's focus is to construct a definition to a problem in order to solve the problem; this process benefits both personal creativity and creativity in business as a whole. In their research, Domb and Dettmer (1999) described this process by specifying the eight patterns of technical evolution (technology forecast) which TRIZ provides:

1. Increased Ideality
2. Stages of Evolution
3. Non-Uniform Development of the System Elements
4. Increased Dynamism and Control
5. Increased Complexity, Then Simplicity
6. Matching and Mismatching of Parts
7. Transition to the Micro-Level and Use of Fields
8. Decreased Human Interaction (Increase in Automation).

Based on analyzing a large number of patents, Altshuller identified five levels of innovation. These analyses revealed that not every invention is equal to its inventive value. Based on Shulyak (2009), the five levels of innovation are:

1. Level One: A simple improvement to a technical system. It requires knowledge that is relevant to that system. It is not considered an innovation, but rather an improvement to an existing system; it does not solve a technical contradiction.

2. Level Two: An invention that resolves a technical contradiction. It requires knowledge from different areas within the industry that applies to that system. It is considered an innovation because it solves a technical contradiction.
3. Level Three: An invention that contains a resolution of a physical contradiction. It requires knowledge from other industries. Because it solves a physical contradiction, it is considered an innovation.
4. Level Four: A new invention that contains a breakthrough solution. It requires knowledge from several sciences. It is considered an improvement upon a technical system without solving the existing technical system. Instead, it solves the problem by replacing the current technology with a new one. Instead, it solves the problem by replacing the current technology with a new one.
5. Level Five: A discovery of a new phenomenon. It helps to push the existing product technology to a higher level.

Altshuler found that 77% of the patent database ideas belong to levels 1 and 2. He also stated that applying TRIZ helps inventors elevate their innovative solutions to levels 3 or 4 (Shulyak, 2009).

Bacon, Beckman, Mowery, and Wilson (1994) showed that it is important to understand the customer market in order to have successful product development. TRIZ process enhances creativity and improves brainstorming by using techniques which draw on the workers' knowledge and various perspectives on the customer market. Koen et al. (2002) have identified some of these techniques that TRIZ applies:

- Building an organizational culture that encourages employees to spend some time outside of work to test and evaluate their own ideas.
- Defining formal rules for coordinating ideas from generation to assessment,
- Setting a limited number of goals to track the progress of idea generation and enrichment, including: measuring the number of ideas retrieved and enhanced from the idea portfolio, the number of idea generated and enriched over a period of time, the percentage of commercial ideas, the value of the ideas in the idea portfolio (idea bank), the percentage of ideas that enter the NPD phase, the percentage of ideas that receive patents, the percentage of ideas that are accepted by the business unit to be developed.
- Defining the mechanism for handling ideas outside the scope of the business
- Including people with different cognitive styles on idea enrichment teams, as described by (Prather, 2000).

Koen et al. (2002) concluded that these techniques do not result in generating new creative ideas. Other researchers, like Von Hippel (1986) have shown that 75% of the ideas that are actually developed come from the lead user. This is because most of the tacit knowledge stays with the users. Von Hippel (1998) also found that it is difficult to transfer the tacit knowledge from the lead user to others, causing the researchers to conclude that the best methodology to use to reduce tacit knowledge is the lead user technique.

TRIZ Applications and Tools

Since its original development in 1996, various TRIZ methodology applications and systematic techniques have been applied in many industries. Mann and Dewulf (2001) contributed significantly to TRIZ by developing what is called systematic creativity which combines different techniques with TRIZ methodology. Foulds et al. (2006) have written a thoughtful literature review on TRIZ methodology and its application through the years from 1996 to 2006. They added techniques include can be Quality Function Deployment (QFD), Six Sigma, Robust Design, Theory of Constraints, Brainstorming, Mind Mapping and more.

One of the most applied systematic creativity techniques developed from TRIZ is QFD. QFD is a useful technique to investigate the problem of “What to do,” while TRIZ is useful to solve the problem of “How to do it” (Wang, Chen, Lin, & Wang, 2005). QFD identifies the problems by translating the voice of customers into engineering parameters, then TRIZ methodology generates solutions to satisfy these requirements. Many researchers believe that QFD may be the most suitable tool to combine with TRIZ (Clarke, 2000; Eversheim, Breuer, & Grawatsch, 2001; Wang et al., 2005). However, one of the limitations, which Kobayashi (2006) pointed out in his research, is that QFD-users fail to capture the ambiguous characteristics of customer voice, and so do not portray a complete picture. Moreover, researchers often add Functional Analysis (FA), which focuses on capturing the information of the existing design via correlation models to the QFD-TRIZ approach to optimize product design (Leon-Rovira & Aguayo, 1998; Schulz, Clausen, Fricke, & Negele, 2000).

Another systematic creativity technique that is used with TRIZ methodology is Brainstorming. It is considered the oldest technique in design problem-solving and creation of new ideas. Srinivasan and Kxaslawski (2006) stated that this technique is useful in the very early stages of design and is applicable for well-structured technical problems. In addition, Goel and Singh (1998) Goel and Singh (1998) describe combining of Brainstorming and TRIZ with other tools, in which case these tools are used alternatively to get raw ideas to achieve actual integration. Changqing, Kezheng, and Fei (2005) gave a more detailed comparison between TRIZ methodology and Brainstorming and indicated that Brainstorming can create good solutions of good quality, but that it requires participants from various domains (diversity) Campbell (2003) shows how Brainstorming makes TRIZ more effective by covering/filling in the gaps between general and specific solutions.

The original purpose for the TRIZ methodology was to solve technical problems, but over time it has been used in many other fields, like transportation, manufacturing, and services. In the transportation field, Cavallucci and Lutz (2000) implemented TRIZ problem-solving in the design of automobile parts. Stratton and Warburton (2003) believe that TRIZ is best suited for the manufacturing field. They described that TRIZ is important for defining conflicts based on which innovative solution can be developed. On the other hand, King (2004) King (2004) showed that it is hard to apply TRIZ methodology in service applications. Nevertheless, due to its fast development and integration of problem-solving, it can be applied to help these services satisfy customer

needs. Hua (2006)) makes the point that TRIZ has the potential to be integrated with methods and applications that have not yet been explored.

Transformational Leadership

Since first introduced by James MacGregor Burns over three decades ago, considerable attention has been given to the study of transformational leadership. Burns (1978) identified two basic types of leadership: transformational and transactional. Transactional leadership is a relationship between leader and follower based upon an exchange of resources. Transformational leadership is a relationship between leader and follower based upon mutual stimulation and elevation of the follower. Burns (1978) stated that in addition to identifying and satiating a follower's current need, the transformational leader "looks for potential motives in followers, seeks to satisfy higher needs, and engages the full person of the follower." The ethical component of transformational leadership was something novel to the study of leadership. Burns (1978) stated that transformational leadership becomes moral because it raises the level of ethical aspiration and of human conduct in both the leader and the follower. Burns' perception of transformational leadership was that of "an ethical, moral enterprise, through which the integrity of the [organization] would be maintained and enhanced" (K. W. Parry & Proctor-Thomson, 2002). Therefore, leaders like Hitler who objectify their followers may wield great power, but they are not transformational leaders.

Although his work was dedicated to Burns and furthered the notion of transformational leadership by constructing the theory of transformational leadership, Bass (1985a) differed with Burns in three ways. First, he did not agree that transactional

and transformational leadership are the extremes of a single dimension. He proposed that leaders in varying degrees are both transformational and transactional. Second, Bass acknowledged that the leadership outcome could be positive or negative and still be transformational (i.e., Hitler's leadership, although immoral, was transformational). Finally, Bass added the concept of "the expansion of the followers' portfolio of needs and wants" as a requirement of transformational leadership.

In his study of 70 senior executives, Bass (1985b) reported that respondents likened the transformational leader to a benevolent father who inspired them to work long hours to meet the leader's expectations. The transformational leader encourages self-development by allowing the follower to work autonomously, but remains accessible to provide the follower with support, advice, and recognition. The transformational leader engendered trust, admiration, loyalty, and respect.

In another study Bass (1985a) performed exploratory factor analysis on data collected from 104 military officers attending Army War College. The officers were asked to complete a 73-item questionnaire describing their supervisor. Three dimensions of transformational leadership were identified from the research: Charismatic Leadership, Individualized Consideration, and Intellectual Stimulation. Avolio, Waldman, and Yammarino (1991) later added another component, Inspiration Motivation, and changed charismatic leadership to Idealized Influence to create the 4 I's of transformational leadership. Table 1 lists the 4 I's and gives a description of each component. These four factors have been confirmed in empirical studies and dominate the general understanding of transformational leadership (Bass, Avolio, Jung, & Berson, 2003; Hay, 2006).

Collectively these factors generate what Bass (1985a) referred to as performance beyond expectation.

Table 1: The Four I's of Transformational Leadership [Adopted from (Bass et al., 2003)]

Transformational Leadership Dimension	Description
Idealized Influence	The leader puts follower needs above his/her own and is admired, respected, and trusted.
Inspirational Motivation	The leader motivates followers by establishing a vision of the future and building team spirit.
Intellectual Stimulation	The leader stimulates followers to challenge the status quo and be innovative.
Individual Consideration	The leader recognizes the individual needs of each follower and develops each follower for increased challenges.

The three dimensions of the transactional leadership construct are Contingent Reward, Active Management by Exception, and Passive Management by Exception. Contingent reward is the degree to which the leader clarifies expectations and offers recognition when those expectations are met (Bass et al., 2003). Active management by exception is the degree to which the leader proactively monitors subordinate actions and behaviors and takes corrective action before a problem occurs. Passive management by exception is the degree to which the leader corrects subordinate actions and behaviors after a problem has occurred (Judge & Piccolo, 2004).

In 1993, Chemers and Ayman (1993) proposed the augmentation effect whereby transformational leadership complements and builds upon the foundation of transactional leadership. This explanation of the relationship between the two constructs highlights the

different effect each has on the behavior of the follower. Transactional leadership encourages followers to meet expectations by achieving a negotiated level of performance to earn a predefined reward. Building on a foundation of transactional leadership, transformational leadership encourages followers to perform beyond expectations because of their commitment to the leader and to the mission of the organization (Howell & Avolio, 1993).

Transformational Leadership Applications

Transformational leaders assume followers to be trustworthy, capable of handling complex problems, and capable of making a unique contribution to the organization (Bass & Avolio, 1994). This bottom-up approach to higher organizational performance includes coaching and mentoring followers (Yukl, 1999), raising followers self-esteem (Shamir, House, & Arthur, 1993), and creating a positive mood that increases the follower's level of effort (Ilies, Judge, & Wagner, 2006). When leaders are able to encourage people to perform at higher levels, they find that organizational level performance improves (Boerner, Eisenbeiss, & Griesser, 2007).

The research has demonstrated the relationship between leadership and a wide range of organizational outcomes. Transformational leadership has been shown to have a significant positive influence on many outcomes that affect operational performance. Examples include increased employee organizational commitment (Avolio, Zhu, Koh, & Bhatia, 2004; Barling, Weber, & Kelloway, 1996; Viator, 2001; Walumbwa, Wang, Lawler, & Shi, 2004), enhanced job satisfaction and motivation (Bass, 1998; Bycio, Hackett, & Allen, 1995; Conger, Kanungo, & Menon, 2000; Kane & Tremble Jr, 2000;

Koh, Steers, & Terborg, 1995; Nemanich & Keller, 2007), reduced absenteeism (Zhu, Chew, & Spangler, 2005), and higher project quality (Elenkov, 2002; Hoyt & Blascovich, 2003; Nicholls, 1988; Piccolo & Colquitt, 2006; Quick, 1992; Sivasubramaniam, Murry, Avolio, & Jung, 2002). In a longitudinal study of 48 research and development project groups comprised of 349 professionals, Keller (1992) found that transformational leadership had a positive effect on the high overall quality of the project as well as on budget and schedule performance. Similarly, Howell and Avolio (1993) found that leaders who displayed fewer transactional leadership characteristics and more transformational leadership characteristics had a greater positive effect on business-unit goals. Sosik, Avolio, and Kahai (1997) conducted a longitudinal study of 36 undergraduate student workgroups performing a creativity task using a Group Decision Support System (GDSS). They evaluated the effects of leadership style on group effectiveness and found that transformational leadership had both a direct and indirect effect on the group performance.

One of the most researched outcomes is financial performance. In fact, K. Parry (2000) stated that decades of research has provided consistent evidence (i.e., correlations of 0.30 or higher) that transformational leadership has a significant positive impact on the financial measures of organizations. It was also shown to affect employee perception of the firm's financial standing relative to industry peers (Zhu et al., 2005). A pretest-posttest study of the effects of transformational leadership training, on 20 managers who were randomly assigned to either training or a control group found that transformational leadership had significant effects on two aspects of financial performance (Barling et al.,

1996). Awamleh and Gardner (1999) reported that organizational performance (measured as sales, profit, market share, and other financial information) had a significant, positive relationship with followers' perception of their leader's charisma and effectiveness. The charismatic aspect of transformational leadership was shown to have a substantial effect on climate and financial performance in a sample of 50 supermarket stores of a large retail chain in the Netherlands (Koene, Vogelaar, & Soeters, 2002). A survey of 293 employees from 32 business units within a large financial organization in Greece found an indirect positive relationship between transformational leadership and performance via its impact on achievement orientation. Transformational leadership engenders motivation and confidence, which in turn affects worker performance (Xenikou & Simosi, 2006). Performance has been measured as two separate objective measures of financial performance, as defined by the organization. In their study of nearly 100 Malaysian chief executive officers, Idris and Mohd Ali (2008) found that the relationship between transformational leadership and financial performance was mediated by best practices (i.e., business methods that provide competitive advantage through improved operational performance). Hui Wang, Tsui, and Xin (2011) studied the link between leadership and firm performance using data gathered from 739 matched pairs of middle managers and their supervisors within 125 Chinese firms. They found a direct relationship between transformational leadership behaviors that focus on the task and financial performance. However, the relationship between transformational leadership behaviors that focus on relationships and financial performance was mediated by employee attitude.

Change is the central goal of transformational leadership, which makes it the ideal leadership style for promoting innovation (Bass & Riggio, 2006; Jaskyte, 2004; Pieterse, Van Knippenberg, Schippers, & Stam, 2010). Organizations adjust to change through their innovativeness and the creativity of their employees. There is a growing interest in the relationship between transformational leadership, the creativity of the followers and the innovativeness of the organization (Gumusluoglu & Ilsev, 2009). Jung, Chow, and Wu (2003) found that only a handful of studies have looked at the relationship between them. Their study of 32 Taiwanese firms found a significant positive relationship between transformational leadership and organizational innovativeness. Eisenbeiss, van Knippenberg, and Boerner (2008) found that the relationship between transformational leadership and team innovation was mediated by the support for innovation, which was moderated by a climate of excellence. Similarly, a study of 163 research and development personnel and managers at 43 Turkish software development companies found that transformational leadership positively influenced both organizational innovativeness and employees' creativity (Gumusluoglu & Ilsev, 2009).

Keller (2006) conducted longitudinal research towards transformational leadership and its relationship towards the R&D team performance. He identified a group of project teams that were formed within similar project objectives, but with different kinds of industries that were run by a project leader. He measured their leadership based on Bass's multifactorial leadership questionnaire and dedicated a full year to measuring the project team performance and ensuring that the R&D team transformed their scientific and technological information into innovation (also based on Harrison et al.,

(2002)). Sheremata (2000) furthered the research with another 5 years in order to consider the time, effort and resources needed for new technology to be introduced as a new product in the market. As a result, Keller and Sheremata concluded that there is strong evidence that the transformational leadership, initiation of structure and the type of leadership structure (ability and intrinsic satisfaction) influence the R&D project team over time. Some limitations for the study included the fact that there was no data collected on the independent, moderator or control variables in the 5 years of the study when the performance measurements were collected. Moreover, there is not enough information or explanation concerning the relationship between the transformational leadership and their project performance. In order for this to be more applicable, laboratory tests or field case studies should be conducted in order to clear the ambiguity.

CHAPTER THREE

THEORETICAL JUSTIFICATION

In this chapter, the relationships and the potential gaps that were illustrated in the literature review will be summarized. Figure 7 outlines the potential gaps in what is known about how innovation occurs within organizations. The research questions which lead to the hypotheses for this study arose from the literature review. Each instrument of measurement shown in Figure 7 will be described along with the theoretical justification found in the literature. At the end of the chapter, the proposed model will be defined.

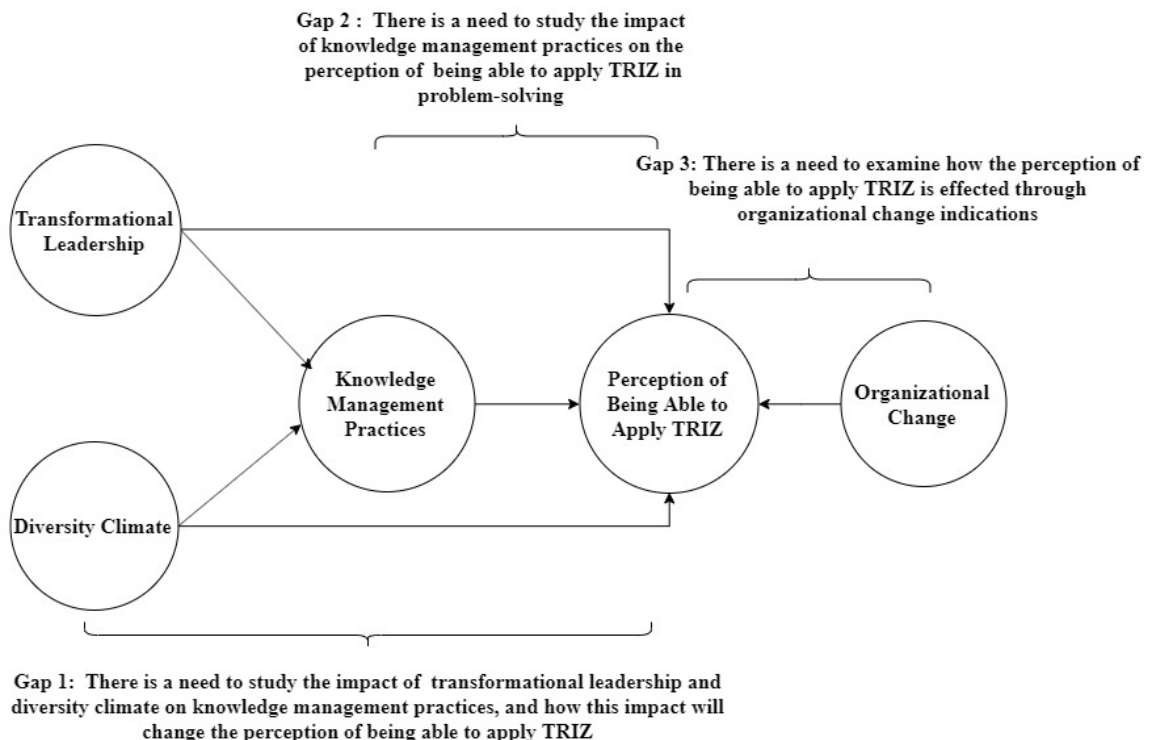


Figure 7: Gaps and Potential Relationships in the Innovation Process Within Organizations

Gaps Justification and Proposed Measurements

The first gap is the need to examine the impact of transformational leadership and diversity climate on knowledge management practices and the perception of being able to apply TRIZ. Creativity is said to be the production of novel and useful ideas (Amabile, 1996). Innovation through creativity plays an important role in the success and competitive advantage of organizations (Woodman et al., 1993). Transformational leaders are shown to raise the expectation of their followers (Bass, 1995). In addition, they “seek to transform followers” to higher needs and aspirations (Jung et al., 2003, p. 187). Transformational leadership supports the development of innovation and creativity at the workplace, through influencing the followers’ vision, supporting innovation, allowing autonomy, providing encouragement, and recognizing followers' challenges (Elkins & Keller, 2003). The 4 I’s of leadership should act as a creativity-enhancing force: Individual Consideration acts as a reward to followers by providing recognition and encouragement; Intellectual Stimulation engenders exploratory thinking by providing support for innovation, autonomy, and challenge; Inspiration Motivation provides encouragement in the idea generation process by energizing followers to work towards the innovation’s vision (Bass, 1995; Sosik et al., 1997). Thus, the followers will feel self-success which will lead to higher innovation performance (Mumford & Gustafson, 1988; Redmond, Mumford, & Teach, 1993). Gumusluoglu & Ilsev (2009) stated that there is a need to apply Transformational Leadership to creativity as a moderator. Sheremata (2000) emphasized the need to further demonstrate the effect of leadership on team performance in a practical case study.

The sources of knowledge for any given workgroup can range from customers to organization experts to group members themselves (Von Hippel, 1988). Moreover, because task-related knowledge from a customer versus that from an organization, experts are likely to be non-overlapping, group members can elicit new ideas and insights from different sources of knowledge (Hansen, 1999). Research theories support the claim that unique knowledge sources can be more valuable than knowledge sources shared by everyone (Burt, 1992). Hajro et.al (2017) developed a novel theory of knowledge exchange processes in multi-culture teams that reveals how diversity climate affects team effectiveness. In addition, they described other contextual factors, like the leader's skills and the power dynamics inside the group, that also influence knowledge exchange. Research has yet to address other types of diversity that influence the value of knowledge sharing in workgroups.

Ilevbare et al. (2013) found that TRIZ is mostly applied in technical problem solving, and somewhat in product and technology development. They developed a survey to investigate the challenges that people face applying TRIZ, for instance, that the method is too hard to adopt or to apply in a variety of situations, that the time required is too long, that there is a lack of a standardized best practice guide, and that the degree of acceptance by the workers is low. Researchers must investigate the responses of TRIZ users and then develop a systematic simplified approach to make it easier to understand and to apply in the organizations.

The second gap is the need to study the impact of knowledge management on a team's perception of being able to apply TRIZ. Theory of Inventive Problem Solving

(TRIZ) is a creativity technique for generating innovative ideas which has become increasingly popular in helping employees think through and solve problems (Wang et al., 2010). Koen et al. (2002) illustrated that TRIZ is one of the most effective methods to enrich the idea stream in the Fuzzy Front-End of idea generation. Some of the tools and techniques are as follows: First, the organizational culture encourages employees to spend unscheduled time generating, testing and validating their own ideas. Second, a variety of incentives (awards, recognition) to stimulate and support the generation and enrichment of ideas are introduced. Third, a formal process for workers to assess ideas that have been generated. Still, these tools and techniques do not lead to break-through ideas as the first user reaches only 75% of the potential solutions by using common ideation tools. This is due to the fact that the tacit knowledge stays with the user in the idea generation session and thus, creates difficulty transferring ideas from one lead user to others (Von Hippel, 1986).

Although preliminary evidence exists for TRIZ's potential as an effective ideation tool, its ability to be adapted to various organizational settings has not been conclusively demonstrated in practice. Hua (2006) showed that although many applications have been integrated with TRIZ, there are other applications that still need to be integrated. Integrations such as leadership and diversity need to be validated quantitatively and/or qualitatively. Hua also stated that there are some creativity tools that potentially benefit from integration with TRIZ that have not yet been considered, like Morphological Matrix, which combine design options at the sub-function level to help come up with new

solutions and Jito Kawakita's KJ method, which helps categorize and organize a large number of fragmented uncertain information and solutions into logical cohesive groups.

Knowledge management occurs when an individual reveals his or her acquired knowledge to other members within the organization (Ryu, Ho, & Han, 2003). Some factors that influence an individual's willingness to share knowledge include the incentive system, cost and benefit, extrinsic and intrinsic motivation and organizational climate and management champions (Bock & Kim, 2001; Bock, Zmud, Kim, & Lee, 2005; Kankanhalli, Tan, & Wei, 2005; Purvis, Sambamurthy, & Zmud, 2001; Wasko & Faraj, 2005). Researchers have shown that the longer the team members are together, the more they will share knowledge (Sawng, Kim, & Han, 2006; Smith et al., 2006). Cooper (1978) emphasizes the role of pre-development activities for new product development (NPD). Workers' creativity is considered an added value to an organization's innovation (Madjar et al., 2002; Shalley et al., 2004). Srivastava, Bartol, and Locke (2006) illustrated that leadership which empowers workers also fosters knowledge sharing among team members. Birasnav, (2014) confirmed that transformational leaders greatly influence employees to engage in the knowledge sharing process which results in improved organization performance.

The third gap examines how the perception of being able to apply TRIZ is affected by organization change. Creativity techniques like brainstorming have been shown to lead to a loss of group creativity, due to issues like blocking which occurs when idea generation is reduced as a result of periods when not all group members can express their ideas because other members are expressing their ideas (Diehl & Stroebe, 1987).

Nemeth and Ormiston (2007) stated that the introduction of a new perspective on problems is more important for group creativity than being comfortable or belonging to a group. Brainstorming is useful for increasing the effectiveness of TRIZ and for bridging the gap between general and specific solutions (Campbell, 2003). Creativity can be generated at the individual or social level. Creativity at the individual level involves solving personal problems at work or in daily life, but creativity at the social level can lead to significant new findings, movements in arts, inventions, and programs that affect society (Sternberg & Lubart, 1999). Team creativity can lead to new and useful ideas, processes and procedures in an interactional work environment (Amabile, 1996; Woodman et al., 1993). However, there are factors which can reduce creativity within teams. One of these factors, discourse on the design task by group members, will potentially promote new/ additional ideas. Puccio et al. (2006) illustrated that there are few research studies that evaluate the impact of TRIZ training on employee's creativity over a long period.

In today's chaotic business environment, for organizations to gain competitive advantage and respond to the rapid changes, the development of creativity and innovation is crucial (Lapierre & Giroux, 2003). Many companies are still looking for powerful solutions that can transform their efficient product development process into a source of competitive advantage and innovation capabilities (Hua, 2006). An important challenge in organizations is to measure the complex processes that influence the organization's innovation capabilities, which leads organizations to develop innovations continuously to respond the changing market environment to be more managed (Cordero, 1990).

Koen et al. (2002) stated that innovation performance can be improved by reducing the fuzziness of Fuzzy Front-End (FFE) stages. Cooper (1988) showed the importance of idea generation on innovation by stating that ideas are raw materials that are inexpensive to generate and screen but have a significant impact on the success or failure of innovation. McAdam and McClelland (2002) reviewed the role of individuals and groups in idea generation and concluded that there is limited research on FFE idea generation and a need for more studies that focus on individual and team perspectives. Moreover, they stated that there is a need to have more systematic approaches to idea generation to develop strategies which will spark idea generation in organizations. Other researchers have focused on measuring the process of innovation inside industries, Adams et al. (2006) reviewed the literature focused on measuring innovation levels inside the firms and outlined seven areas: Input, Knowledge Management (idea generation), Strategy, Organization and Culture, Portfolio Management, Project Management, and Commercialization. They concluded that there should be a framework to help managers evaluate the innovation in their organization. Moreover, they stated that there is no metric devising stage that was valid in their research.

Traditional creativity methods, such as brainstorming, analogical thinking, mind mapping, attribute listing, and idea checklists, call upon the needs of the users to find new sources of inspiration. TRIZ, on the other hand, provides the users with a ready pool of knowledge for inspiration (Davis, 2004; Oslapas, 1993). TRIZ users need to be guided through systematically directed methods to carry out intelligent idea generation in areas

where other people have solved a similar general design problem (Kazi et al., 2014).

Figure 8 shows a summarized gap for each of the targeted variables.

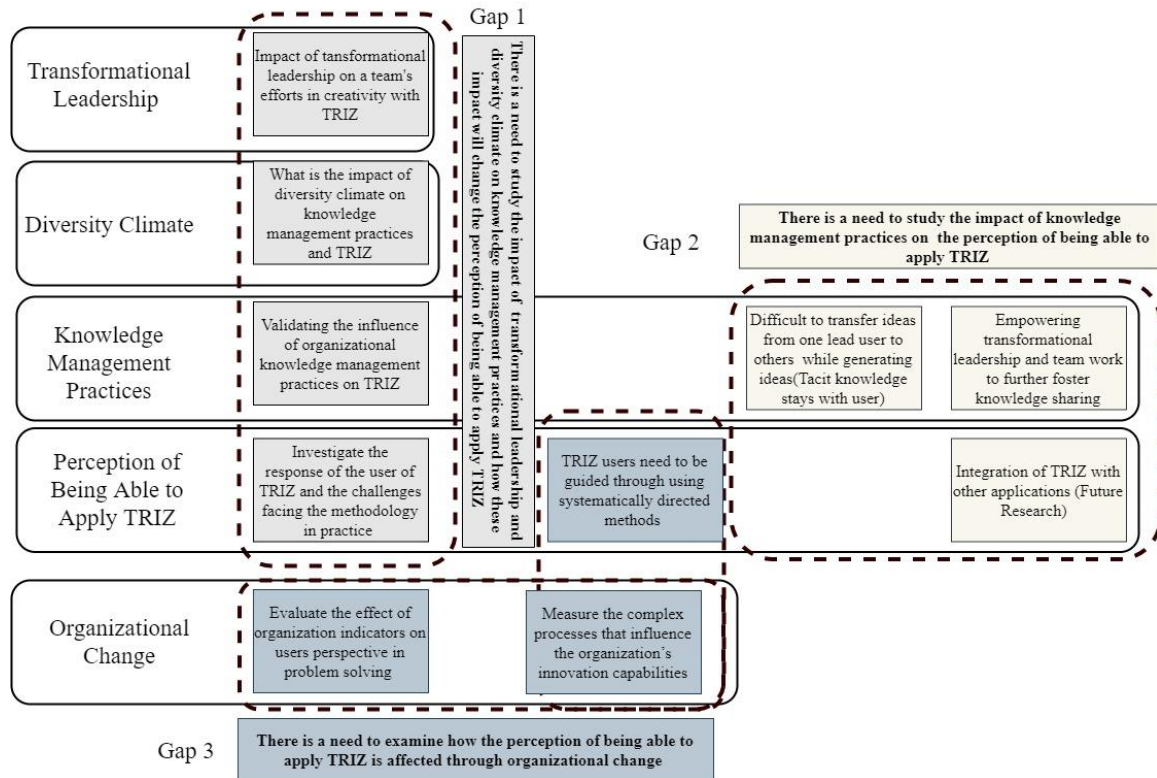


Figure 8: Summarized Gaps

Measuring Transformational Leadership

Several measurement instruments have been created for measuring transformational leadership behaviors within organizations, including the Key Performance Index, the Leadership Practice Inventory (LPI), the Global Transformational Leadership Survey (GTL) and the Multifactor Leadership Questionnaire (MLQ) Form 5X. The Multifactor Leadership Questionnaire (MLQ) Form 5X is the most widely used of these measurements (Antonakis & House, 2013; Avolio & Bass, 2004; Judge &

Piccolo, 2004; Schriesheim, Wu, & Scandura, 2009). The MLQ 5X measures Idealized Influence, Inspirational Motivation, Intellectual Stimulation, Individual Consideration, Contingent Reward, Management by Exception Passive, Management by Exception Active and Laissez-Faire Leadership, which researchers have shown define the full range of leadership characteristics (Avolio & Bass, 2004; Bass et al., 2003). A meta-analysis conducted by Lowe, Kroeck, and Sivasubramaniam (1996) supported the Multifactor Leadership Theory from which the MLQ 5X is derived, and several studies have demonstrated the reliability of MLQ 5X.

An alternate measurement instrument, the Leadership Practice Inventory (LPI) was developed and validated by Posner and Kouzes (1988). The LPI measures five practices that show the fundamental pattern of leadership behavior, namely: Challenging the Process, Inspiring a Shared Vision, Enabling Others to Act, Modeling the Way, and Encouraging the Heart. The LPI questionnaire was generated through 28 case study interviews with managers in middle- to senior-level positions. It consists of 30 statements, six for measuring each of the five leadership styles.

Another reliable instrument is the Global Transformational Leadership Survey (GTL), developed and validated by Carless, Wearing, & Mann (2000). The GTL is a short instrument that captures seven alternative behaviors of transformational leadership: communicating a vision, developing staff, providing support, empowering staff, being innovative, leading by example, and being charismatic. This measurement was developed through a survey of 695 branch managers of a retail bank in Australia, 66 district managers, and 1440 subrogated branch managers.

Both LPI and GTL have a strong correlation with MLQ 5X (Carless et al., 2000). However, LPI and GTL are shorter measures of MLQ 5X factors and do not give a full leadership behavior rating (Bass et al., 2003; Carless et al., 2000; Posner & Kouzes, 1988). Another point in favor of the MLQ 5X is that it is the only measurement instrument that fully captures the 4 I's of transformational leadership (Idealized Influence, Inspirational Motivation, Intellectual Stimulation, and Individual Consideration) which have been shown to act as a creativity-enhancing force (Bycio et al., 1995; Sosik et al., 1997). Figure 9 shows the instrument variables of MLQ 5X. Five item samples of the MLQ survey are shown in Appendix B.

<i>Instrument</i>	Multi-Factor Leadership Questionnaire MLQ 5X		
<i>Variable 1</i>	<u>Transformational Leadership</u>		
<i>Construct 1-A</i>	Idealized Influence Attribute	Q10	Q18
		Q21	Q25
<i>Construct 1-B</i>	Idealized Influence Behavior	Q6	Q14
		Q23	Q24
<i>Construct 2</i>	Inspirational Motivation	Q9	Q13
		Q26	Q36
<i>Construct 3</i>	Intellectual Stimulation	Q2	Q8
		Q30	Q32
<i>Construct 4</i>	Individual Consideration	Q15	Q19
		Q29	Q31
<i>Variable 2</i>	<u>Transactional Leadership</u>		
<i>Construct 1</i>	Contingent Reward	Q1	Q11
		Q16	Q35
<i>Construct 2-A</i>	Management by Exception Passive	Q3	Q12
		Q7	Q28
<i>Construct 2-B</i>	Management by Exception Active	Q4	Q22
		Q24	Q27
<i>Variable 3</i>	<u>Laissez-Faire Leadership</u>	Q3	Q5
		Q28	Q33

Figure 9: MLQ5X Instrument Variables [Adopted from (Bass et al., 2003)]

The reliability of MLQ was demonstrated by Tejeda, Scandura, and Pillai (2001). They surveyed data for four samples of employees and managers (Samples 1 & 2 of 782 employees, Sample 3 of 486 employees, Sample 4 of 199 middle managers); the reliability of their analyses, which is above the acceptable minimum of 0.7 as suggested by Cortina (1993), is shown in Table 2.

Table 2: Internal Consistency Estimates for MLQ 5X [Adopted from (Tejeda et al., 2001)]

	Sample 1	Sample 2	Sample 3	Sample 4
<i>Transformational subscales</i>				
AC	.88	.85	.90	.87
II	.86	.89	.91	.91
INSP	.90	.89	.94	.92
IS	.86	.89	.91	.90
IC	.91	.86	.93	.92
<i>Transactional subscales</i>				
CR	.87	.84	.87	.88
MBEA	.71	.69	.70	.79
MBEP	.82	.85	.90	.85
<i>Nonleadership Subscale</i>				
LF	.82	.85	.88	.78

The MLQ also demonstrated high reliability based on a meta-analysis of published and non-published studies conducted by Lowe et al. (1996), which considered the relationship of the MLQ scales to leader effectiveness. The results found that four out of five scales of MLQ are above the 0.7 minimum suggested by Cortina (1993), with only Management by Exception under the minimum value ($\alpha = 0.65$). The scores are shown in Table 3.

Table 3: Internal Consistency Estimates for MLQ 5X [Adopted from (Lowe et al., 1996)]

	Total Sample Size	Mean Cronbach α for Scale	Mean Scale Score	Mean Scale SD	N of Correlation Coefficients	Range of Correlation Coefficients	Mean Raw Correlation	Mean Corrected Correlation	95 % Confidence Interval	95 % Credibility Interval
Charisma	6,485	.92	2.52	1.04	47	.10 to .91	.623	.713	.69 to .74	.23 to 1.00
Individualized Consideration	6,232	.88	2.50	0.99	41	-.01 to .84	.528	.615	.59 to .64	.16 to 1.00
Intellectual Stimulation	6,360	.86	2.48	0.85	45	.08 to .89	.512	.602	.58 to .63	.12 to 1.00
Contingent Reward	7,163	.82	1.83	0.90	43	-.25 to .72	.338	.408	.38 to .43	-.12 to .94
Management-by-Exception	6,948	.65	2.32	0.74	41	-.54 to .47	.040	.054	.04 to .07	-.32 to .43

The Mind Garden Manual for MLQ (Avolio & Bass, 2004) provides a full descriptive reliability analysis. Table 4 shows the reliability results of MLQ 5X from their research.

Table 4: Descriptive Statistics and Internal Consistency Estimates for MLQ 5X [Adopted from (Avolio & Bass, 2004)]

Variable	M	SD	1	2	3	4	5	6
1. CH	2.58, 2.69	.87, .91	.92, .92					
2. IS	2.51, 2.54	.95, .93	.82, .81	.83, .78				
3. IC	2.66, 2.64	.99, .99	.81, .82	.74, .77	.79, .78			
4. CR	2.51, 2.40	.98, .99	.77, .71	.73, .67	.75, .68	.80, .74		
5. MBEA	1.69, 1.60	.85, .90	-.17, -.16	-.09, -.08	-.23, -.21	-.11, .02	.63, .64	
6. PA	1.02, 1.09	.79, .89	-.51, -.54	-.46, -.44	-.45, -.52	-.38, -.28	.24, .45	.84, .86

Note: Each of 36 items was rated on the 5-point scale from 0 (not at all) to 4 (frequently, if not always). Cronbach's coefficient alphas are reported values in boldface along the diagonal. First values in each column show correlations from the original set of samples (N=1,394 after listwise deletion) and the second value in each column show correlations from the replication set of samples (N=1,498 after listwise deletion).

The internal consistency analysis shown in Mind Garden Manual shows that most alpha values are above 0.7 minimum suggested by Cortina (1993) with only management by the exception under the minimum value (alpha = 0.63 and alpha = 0.64).

Measuring Diversity Climate

Diversity climate is the extent to which the firm promotes equal employment opportunities and inclusion. One of the measurement tools that has been created to measure diversity climate is the Diversity Climate Scale (DCS), developed by Kossek & Zonia, (1993), which contains twenty items covering four factors. It measures efforts to promote diversity, attitudes towards the qualifications of racial-ethnic minorities, attitude

towards women's qualifications, and departmental support for racial-ethnic minorities. Another measurement tool is the Organizational and Diversity Inventory (ODI), developed by Hegarty and Dalton (1995), which contains twenty items for five factors. The five factors are the existence of discrimination, discrimination against specific groups, managing diversity, actions regarding minorities, and attitude towards religions. Another diversity climate measurement developed by Montei, Adams, and Eggers (1996) and called the Attitude Towards Diversity Scale (ATDS) is composed of thirty items. It focuses on co-workers, supervisors, hiring and promotion decisions. One of the most commonly used instruments is the Diversity Perceptions Scale (DPS), developed by Barak et al. (1998). It consists of sixteen items measuring four factors. It focuses on personal and organizational perceptions and resulting behaviors in a diversity climate. The Diversity Climate Survey (DCS) was developed by Bean, Sammartino, O'Flynn, Lau, and Nicholas (2001). It includes fifteen profile questions and fifteen statements with a five-point Likert scale and covers three dimensions (individual, group and organizational) with five items each: how differences are perceived (Respect, Equality), how differences affect the work of the individual and the team (Conflict, Discrimination) and how effectively information is managed and gathered (Feeling About Diversity). They portrayed the factors of diversity climate as individual, workgroup and organizational factors.

Reichers & Schneider (1990) developed an interactional model of culture diversity (IMCD) to describe diversity climate's effects on organizational processes. IMCD - firm performance on employee attitude (organization recognition and job

satisfaction) or on achievement outcome (job performance). Employee perception of the company's diversity climate was assessed using Mc Kay's five-point Likert scale. These scales examine perceptions of how well employees utilize fair practices and integrate underrepresented employees into the work environment, thereby accounting for the mean racial-ethnic difference in employee performance (McKay et al., 2008).

Sparrow and Gaston (1996) did a very large scale study and gathered data from 3030 individuals and 93 organizations using and determined that this tool reflects individual perception. They also concluded that this is a strong measurement of managers' and workers' cognitive framework and judgments and is representative of organizational behavior and action. McKay et al. (2009) had assessed the main individual and interactive effects of the diversity climate on manager performance and subordinate performance with respect to sales growth. Those with the highest sales growth had managers and subordinates with a highly pro-diversity climate (positive consistency), while the lowest sales growth was with managers and subordinates with a low pro-diversity climate (negative consistency). Figure 10 shows the DCS instrument variables. The DCS survey is fully shown in Appendix B.

<i>Instrument</i>	Diversity Climate Survey	
<i>Variable 1</i>	<u>Individual Level Diversity Climate</u>	
<i>Construct 1</i>	Respect	Q1
<i>Construct 2</i>	Equality	Q2
<i>Construct 3</i>	Conflict	Q3
<i>Construct 4</i>	Discrimination	Q4
<i>Construct 5</i>	Feeling About Diversity	Q5
<i>Variable 2</i>	<u>Group Level Diversity Climate</u>	
<i>Construct 1</i>	Respect	Q6
<i>Construct 2</i>	Equality	Q7
<i>Construct 3</i>	Conflict	Q8
<i>Construct 4</i>	Discrimination	Q9
<i>Construct 5</i>	Feeling About Diversity	Q10
<i>Variable 3</i>	<u>Organizational Level Diversity Climate</u>	
<i>Construct 1</i>	Respect	Q11
<i>Construct 2</i>	Equality	Q12
<i>Construct 3</i>	Conflict	Q13
<i>Construct 4</i>	Discrimination	Q14
<i>Construct 5</i>	Feeling About Diversity	Q15

Figure 10: DCS Instrument Variables [Adopted from (Bean et al., 2001)]

The reliability of DCS was demonstrated through research done on several university campuses. The University of Maryland used DCS to collect information from a sample of 112 respondents. DCS was also used by Yeo (2006), to measure the response of 584 middle and upper school students. A comprehensive campus climate study was conducted at Western Michigan University. A variety of participants were included in this email survey, ranging from students (undergraduate, graduate), to faculty (tenured,

term, part-time), to staff (bargaining, non-bargaining, bargaining leaders, non-bargaining leaders, temporary) and administration (senior leaders, non-academic leaders, academic leaders). A total of 5615 responses were collected (4072 students, 493 faculty, 924 staff, and 126 administrations) (Worthington, 2008). The reliability analysis for diversity climate at the team level is shown in Table 5 [responses are above the acceptable minimum of 0.7 as suggested by Cortina (1993)].

Table 5: Internal Consistency Estimates for DCS [Adopted from (Worthington, 2008)]

Reliability Statistics	
Cronbach's Alpha	N of Items
.855	5

Measuring the Perception of Being Able to Apply TRIZ

Many case studies have been developed using the Theory of Inventive Problem Solving (TRIZ) to improve innovation and new product development. Gironimo et al. (2015) developed a forest harvesting system by integrating TRIZ with Quality Function Deployment (QFD). In another study by Mann (1998), TRIZ was used in the design process of a complex helicopter engine. Mann determined that although TRIZ provided a framework for the innovation process, the designers were not able to produce sufficient material to generate a good solution. In 1999, Mann conducted another case study in which he used TRIZ in a car-racing session to solve the problem of wheel removal and safe replacement. He generated a number of ideas for a self-locking nut and relied on Atshuller's Trend of Technology (Domb & Dettmer, 1999) to attain the Ideal Final Result (IFR). He again concluded that TRIZ was insufficient when used alone and required the

assistance of other innovation instruments. In this instance, he emphasized the importance of relying on an effective problem definition to achieve the best solution.

Although much research has applied TRIZ in case studies, there is very limited work that has surveyed the feedback regarding the use of TRIZ inside organizations or teams. Belski (2011) developed a 13-week semester course in TRIZ and measured student feedback. By using a simple course survey that consists of 6 questions, he found that learning the principles of TRIZ had changed many students' opinion of their ability to come up with unique ideas; they had not expected what they could achieve on their final projects. He also showed that the TRIZ course had impacted students' problem-solving ability much more than any normal course. Nakagawa (2011) developed a condensed two-day TRIZ/USIT Training which he presented 33 times in eight years in Japan. In the two-day training, participants generated 30-50 ideas from which 5-10 ideas were selected as concepts to be developed. Birdi, Leach, and Magadley (2012) developed a five-point scale survey that measures the impact of TRIZ training courses and application after 33 months. This survey was based on four types of outcomes developed by Birdi (2005) knowledge of creativity techniques, workers' motivation towards innovation, workplace idea generation, and workplace idea implementation. There are limited instruments that survey feedback from workers who have applied TRIZ inside their organizations. Ilevbare et al. (2013) stated that there are many challenges that need to be examined to improve the practical application of TRIZ. These include.

- Is the method too hard to adopt and apply?
- Does this method consume a lot of time?

- Is there is a standardized guide for best practices in using TRIZ?
- Is TRIZ accepted by the organization workers?

Thus, the instrument of measurement for TRIZ in this study will combine two different instruments to understand workers' perception of TRIZ. The first examines problem-solving, based on Belski (2011). The second measures degree of adoption, time consumption, systematic guidance and degree of acceptance, based on Ilevbare et al. (2013). Figure 11 shows the variables being used to be measured by the instrument used in this study: the perception of being able to apply TRIZ (TRIZ Feedback Survey). The full survey is shown in Appendix B

<i>Instrument</i>	TRIZ Feedback Survey			
<i>Variable</i>	<u>Perception of Being Able to Apply TRIZ</u>			
<i>Construct 1</i>	Problem Solving	Q1	Q2	Q3
		Q4	Q5	Q6
<i>Construct 2</i>	Degree of Adoption	Q7	Q8	Q9
<i>Construct 3</i>	Time Consumption	Q10	Q11	Q12
<i>Construct 4</i>	Systematic Guidance	Q13	Q14	Q15
<i>Construct 5</i>	Degree of Acceptance	Q16	17	Q18
		Q19	Q20	

Figure 11: TRIZ Feedback Instrument Variables [Adopted from (Belski, 2011; Ilevbare et al., 2013)]

Measuring Knowledge Management and Organization Change

As discussed in the literature review, innovation is difficult to define and much harder to measure, especially without a longitudinal study. It is difficult because the very

nature of innovation is that is characterized by a high level of change. Evangelista, Perani, Rapiti, and Archibugi (1997) stated that measuring innovation can vary due to:

- the technological knowledge that may be formal or tacit,
- the source of innovation activity that may be internal or external to firms,
- the innovation activities that cannot be identified in economic terms, and
- the tangible activities that include the generation of new ideas, innovative and invention,

Different innovation surveys have been tested and developed in the literature. Deshpandé, Farley, and Webster Jr (1993) studied 50 Japanese firms; in the study, two executives and two randomly selected customers from each firm were interviewed by a market research firm. They used the results to create an innovation scale to capture creativity and adoption of new products and processes. Han, Kim, and Srivastava (1998) measured the innovation inside 134 banks using a market orientation framework and determined whether the innovation was technical or administrative. The innovation performance was measured using self-reported data on the bank's growth and profitability. Hurley, Hult, and Knight (2005) examined firms with sales above \$100 million per year by collecting 181 questionnaires from marketing executives. Their measurement of innovation captured the capacity to introduce new products, processes, and ideas within an organization. The performance was measured as profitability, growth in sales, market share and work performance.

The problem with these measurements is that they are all financial. As discussed in the literature review, there is a need to balance financial and non-financial measurements of innovation (Zizlavsky, 2014). One of the most comprehensive surveys which measures organizational innovation with both financial and non-financial measurements is the Community Innovation Survey (CIS). CIS is a European survey that is updated every four years by each European Union (EU) state. It is designed to gather extensive information on innovation in European firms across more than 41,000 European industries and business enterprises. The CIS was developed by the Organization for Economic Co-operation and Development (OECD) which proposed guidelines for collecting and interpreting technological innovation data; these guidelines are known as the Oslo Manual.

In the United Kingdom (UK), this survey was conducted by the Office of National Statistics on behalf of the Department of Trade and Industry (DTI). In the three-year period from 2002-2004 and in 2005, an updated version, the fourth CSI, was created (Battisti & Stoneman, 2010; Evangelista et al., 1997; Evangelista, Sandven, Sirilli, & Smith, 1998). From a sampling of 28000 enterprise and 16383 responses, the data set of the fourth CIS contain a variety of innovation activities: new product innovation, new process innovation, technological innovation (new machinery, equipment and computer hardware or software), and implementation of advanced techniques or changes to the organization structure, marketing concept or marketing strategies (Battisti & Stoneman, 2010). Table 6 describes each variable in the fourth CIS and the percentage of adoption by EU firms:

Table 6: 4th CIS Variables Implemented by EU Firms [Adopted from (Battisti & Stoneman, 2010)]

Innovation variable label	Definition	Adopting firms
PROCINOV	Whether a product innovation (new to the enterprise or to the market or a significantly improved good or service) has been introduced on the market between 2002 and 2004 (see Q7–Q8)	20%
PRODINOV	Whether a process innovation (new to the enterprise or to the market that significantly improved methods for the production or supply of goods and services) has been introduced between 2002 and 2004 (see Q11)	29%
MACHINE	Whether advanced machinery, equipment and computer hardware or software to produce new or significantly improved goods, services, production processes or delivery methods has been acquired between 2002 and 2004 (see Q13)	47%
STRATEGY	Whether a new or significantly changed corporate strategy has been implemented between 2002 and 2004 (see Q23.10)	19.9%
MANAGEMENT	Whether advanced management techniques, e.g. knowledge management systems, Investors in People etc., have been implemented between 2002 and 2004 (see Q23.20)	17.6%
ORGANIZATION	Whether major changes to the organizational structure, e.g. introduction of cross-functional teams, outsourcing of major business functions, have been implemented between 2002 and 2004 (see Q23.30)	22.6%
MARKETING	Whether changes in marketing concepts or strategies, e.g. packaging or presentational changes to a product to target new markets, new support services to open up new markets etc., have been implemented between 2002 and 2004 (see Q23.40)	23%

The innovation variables which will be measured in this study include organizational change and knowledge management practices variables (Referred in CIS Variables as Organization and Management respectively). As stated by Desouza and Paquette (2011), the Knowledge Management Practices variables are Knowledge, People, Processes, and Technology (KP2T), while the Organizational Change variables are Knowledge Sharing System, Decision Making, Management Structure, and Public Relations. The Fourth CIS instrument measures each of these elements. The proposed instrument of measurement for knowledge sharing and organization change is shown in Figure 12. The full fourth CIS survey is shown in Appendix B..

<i>Instrument</i>	Fourth Community Innovation Survey (4th CIS)	
<i>Variable 1</i>	<u>Knowledge Management Practices</u>	
<i>Construct 1</i>	Knowledge	Q1
<i>Construct 2</i>	People	Q2
		Q3
<i>Construct 3</i>	Process	Q4
<i>Construct 4</i>	Technology	Q5
<i>Variable 2</i>	<u>Organizational Change</u>	
<i>Construct 1</i>	Knowledge Sharing System	Q1
		Q2
<i>Construct 2</i>	Decision Making	Q3
<i>Construct 3</i>	Management Structure	Q4
<i>Construct 4</i>	Public Relations	Q5

Figure 12: Knowledge Management and Organization Change Instrument Variables
[Adopted from CIS and (Desouza & Paquette, 2011)]

The fourth CIS (CIS 4) became the base of newer versions of CIS created by the OCED in 2006, 2008, 2010 and 2012. An intercorrelation analysis between CIS variables was conducted by (Battisti & Stoneman, 2010), which showed that knowledge management practices and organizational change are positively correlated. The results are shown in Table 7.

Table 7: Inter Correlation Analysis [Adopted from (Battisti & Stoneman, 2010)]

	PRODINOV	PROCINOV	MACHINE	STRATEGY	MANAGEMENT	ORGANIZATION	MARKETING
PRODINOV	1.000						
PROCINOV	0.429	1.000					
MACHINE	0.319	0.360	1.000				
STRATEGY	0.275	0.253	0.198	1.000			
MANAGEMENT	0.214	0.238	0.220	0.407	1.000		
ORGANIZATION	0.275	0.255	0.204	0.543	0.412	1.000	
MARKETING	0.338	0.293	0.252	0.448	0.381	0.445	1.000

Research Objectives

There is a need to establish a model that investigates the gaps in the innovation process within organizations shown in the literature review. The purpose of this dissertation is to examine the key element identified in the literature review on TRIZ utilization in UAE Semi-Government companies. These elements include the relationship between the leadership effects (transformational leadership, transactional leadership and laissez-faire leadership) in a formed group member and how will it change the user's perception of being able to apply TRIZ. This study will also include examining diversity climate and how it impacts the perception of being able to apply TRIZ among team members. Examining the impact of both leadership and diversity climate influences on knowledge management practices and how they can be used together to improve perception on being able to apply TRIZ inside UAE semi-government companies. Organizational Change will be examined inside the targeted UAE semi-government companies to further investigate the effects on the user's perception of being able to apply TRIZ in problem solving.

One of the prime objectives of this study is to establish a training session inside the targeted UAE companies. Using real life case studies that represent a problem being experienced by each targeted UAE company, participants will work to develop solutions to the problem before and after practicing TRIZ. These cases will further support the users' perception and application of TRIZ as a problem solving by:

- Providing a problem-solving exercise for the group to show the effects of leadership (transformational, transactional and laissez-faire) types and individual & group diversity climate.
- Discussing and sharing previous practices among participants in the case study will show the effect of knowledge management practices.
- Measuring the users' feedback after practicing the methodology which will show the effect of the perception of being able to apply TRIZ in problem solving.

Furthermore, this study will develop a structural model to investigate the gaps between variables in the literature. The Hypothesis analysis of the model produced should explain the relationship between the variables. By showing the significance of each relationship, the hypothesis analysis will show the variables that improve the perception of being able to apply TRIZ inside the organization. This study seeks to answer the following research questions:

1. What effect does leadership (transformational, transactional and laissez-faire) types have on user's perception of being able to apply TRIZ?
2. What effect does diversity climate at the individual, group and organizational levels have on the user's perception of being able to apply TRIZ?

3. Could the effects of leadership and diversity climate further support the relationship between knowledge management practices and perception of being able to apply TRIZ?
4. What is the perceived effect of TRIZ application in semi-government organizations in the United Arab Emirates (UAE)?
5. Does Knowledge Management in the organization and the knowledge shared between group members help in changing the perception of being able to apply TRIZ?

Expected Contribution

The work presented in this dissertation offers several potential contributions. From the research perspective, this study will provide an understanding of the relationship between Transformational Leadership and the successful application of a new methodology, in this case TRIZ, within organizations. Hopefully, this research will encourage further investigation between Transformational Leadership and TRIZ and emphasize the importance of Transformational Leadership effects within teams which hope to successfully apply TRIZ. This project will also show the effects a diversity climate can have on the application of a new methodology like TRIZ. Finally, this study will show the impact which the application of TRIZ had on semi-government companies in the UAE.

The contribution this study provides to the research literature will be establishing a model that investigate the gaps between variables in the literature review. Investigating the gaps between variables will help improve changing users' perception of being able to

apply TRIZ. Furthermore, the established model should help researchers to solve the challenges facing TRIZ in practice, introduces variables and integrations that could be beneficial to improve the application of TRIZ. Using training approach, Researchers could benefit from TRIZ principles to further access other product or process organizations for further research opportunities.

For practitioners, this study will establish a foundation to further apply TRIZ in other organizations in the UAE. Workers could apply the principles of TRIZ that were trained for upcoming projects. Practitioners could simplify the TRIZ principles for certain areas needed inside the organization, through establishing and recording ideas that were generated for needed projects. This study could help practitioners in showing of the necessity variables to change the workers' perception of being able to apply TRIZ and included these influencers in day to day work.

Hypothesis Development

The purpose of this dissertation is to examine the relationship and effects between leadership (transformational, transactional and laissez-faire), diversity climate (group and organizational), knowledge management practices, organizational change, and the perception of being able to apply TRIZ in problem-solving. The stated hypotheses will fill the gaps shown in the research literature between TRIZ and transformational leadership, diversity climate, knowledge management practices, and organizational change. The remaining hypothesis will further support and provide consistency with the literature

Transformational Leadership and Knowledge Management Practices

The following hypotheses are investigated:

Hypothesis 1a –

H₀: Transformational Leadership will not affect Knowledge Management Practices

H_a: Transformational Leadership will positively affect Knowledge Management Practices

Hypothesis 1b–

H₀: Transactional Leadership will not affect Knowledge Management Practices

H_a: Transactional Leadership will positively affect Knowledge Management Practices

Hypothesis 1c–

H₀: Laissez-Faire Leadership will not affect Knowledge Management Practices

H_a: Laissez-Faire Leadership will positively affect Knowledge Management Practices

Diversity Climate at the Individual Group & Organization Level and Knowledge Management Practices

The following hypotheses are investigated:

Hypothesis 2a –

H₀: Individual Diversity Climate will not affect Knowledge Management Practices

H_a: Individual Diversity Climate will positively affect Knowledge Management Practices

Hypothesis 2b–

H₀: Group Diversity Climate will not affect Knowledge Management Practices

H_a: Group Diversity Climate will positively affect Knowledge Management Practices

Hypothesis 2c–

H₀: Organizational Diversity Climate will not affect Knowledge Management Practices

H_a: Organizational Diversity Climate will positively affect Knowledge Management Practices

Types of Leadership and the Perception of Being Able to Apply TRIZ

This dissertation will test the following hypotheses:

Hypothesis 3a –

H₀: Transformational Leadership will not affect the Perception of Being Able to Apply TRIZ

H_a:Transformational Leadership will positively affect the Perception of Being Able to Apply TRIZ

Hypothesis 3b –

H₀: Transactional Leadership will not affect the Perception of Being Able to Apply

TRIZH_a:Transactional Leadership will positively affect the Perception of Being Able to Apply TRIZ

Hypothesis 3c –

H₀: Laissez-Faire Leadership will not affect the Perception of Being Able to Apply TRIZ

H_a: Laissez-Faire Leadership will positively affect the Perception of Being Able to Apply TRIZ

Diversity Climate at the Individual, Group & Organization Level and the Perception of Being Able to Apply TRIZ

The following hypotheses were tested:

Hypothesis 4a –

H₀: Individual Diversity Climate will not affect the Perception of Being Able to Apply TRIZ

H_a: Individual Diversity Climate will positively affect the Perception of Being Able to Apply TRIZ

Hypothesis 4b –

H₀: Group Diversity Climate will not affect the Perception of Being Able to Apply TRIZ

H_a: Group Diversity Climate will positively affect the Perception of Being Able to Apply TRIZ

Hypothesis 4c –

H₀: Organizational Diversity Climate will not affect the Perception of Being Able to Apply TRIZ

H_a: Organizational Diversity Climate will positively affect the Perception of Being Able to Apply TRIZ

Knowledge Management Practices & Organizational Change and the Perception of Being Able to Apply TRIZ

This dissertation will test the following hypotheses in this area:

Hypothesis 5 –

H₀: Knowledge Management Practices will not affect the Perception of Being Able to Apply TRIZ

H_a : Knowledge Management Practices will positively affect the Perception of Being Able to Apply TRIZ

Hypothesis 6 –

H_0 : Organizational Change will not affect the Perception of Being Able to Apply TRIZ

H_a : Organizational Change will positively affect the Perception of Being Able to Apply TRIZ

Overall Hypothesis Model

Figure 13 portrays the theoretical model and the associated hypotheses. All hypothesized relationships between the constructs positively influence the outcome measures. This study considers any significant relationship in the opposite direction if founded (negative relationship).

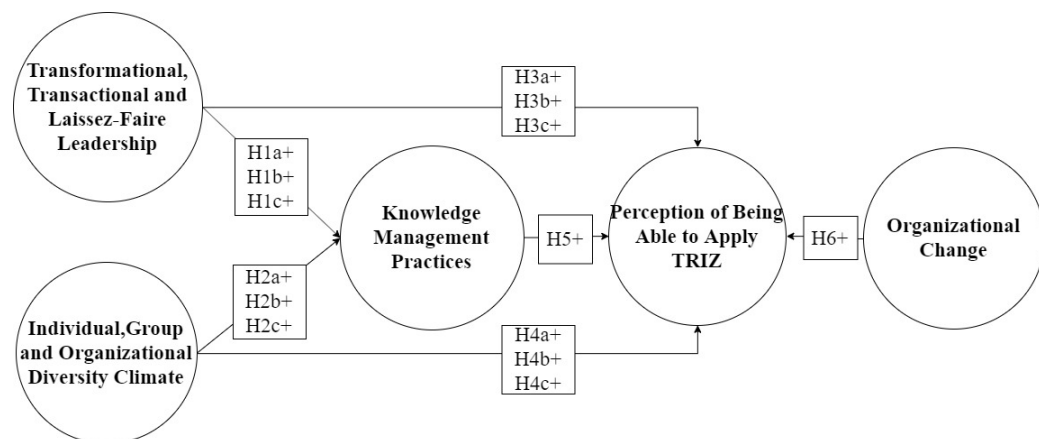


Figure 13: Hypothesis Model

Research Design

To discover how transformational leadership, diversity climate (individual, group and organizational), organizational change, and knowledge management practices

influence the perception of being able to apply TRIZ, this empirical study performed a cross-sectional study using data collected from semi-government organizations in the United Arab Emirates (UAE) through surveys. A survey is one of the most common data collection tools for studying an unobserved behavior and forming a hypothesis of a population of interest based on a sample (Dooley, 1996). In addition, several case studies of problem-solving were analyzed in the literature review which demonstrated the effectiveness of TRIZ in generating innovative ideas as well as the effects of leadership and diversity climate variables on innovation. Surveys and case studies are considered to be categorical methods, which means the use of a specialist set of statistical tools as they are not normally amenable to the standard tools available for continuous data and are therefore classified as acceptable academic field methods (Keathley et al., 2013). These two methods were combined in one training-session presentation performed at several UAE semi-government companies. Data were collected through a case study of the participants in the session: the participants were trained in TRIZ principles which they applied to a real-life problem in their company to generate a number of solution ideas, and, at the end, they gave feedback on the methods. Perceptions of being able to apply TRIZ is considered as an outcome for the measurement model. In combination with the case study, surveys were distributed to measure transformational leadership, diversity climate, knowledge management and organization change within the company.

The Instrument of Measurement Model

The instruments used in this study were a combination of surveys consisting of total of 90 questions (45 questions to measure leadership behavior, 15 questions to

measure diversity climate, 20 questions to measure perceptions of being able to apply TRIZ and 10 questions to measure organization change and knowledge management). Transformational leadership was measured as a component of the full range of leadership model using the 45 item Multi-Factorial Leadership Questionnaire (MLQ 5X), and diversity climate levels were measured using the 15 item Diversity Climate Survey (DCS). In order to measure the perceptions of being able to apply TRIZ, a new 20-item survey instrument was developed. This instrument had already been piloted, the results of which are discussed in the pre-test section. The 10-item Community Innovation Survey (4th CIS) from the European Union (EU) was used to measure organization change and knowledge management practices inside the organization. A full description of the relationship between each of these measurements is illustrated in Figure 14:

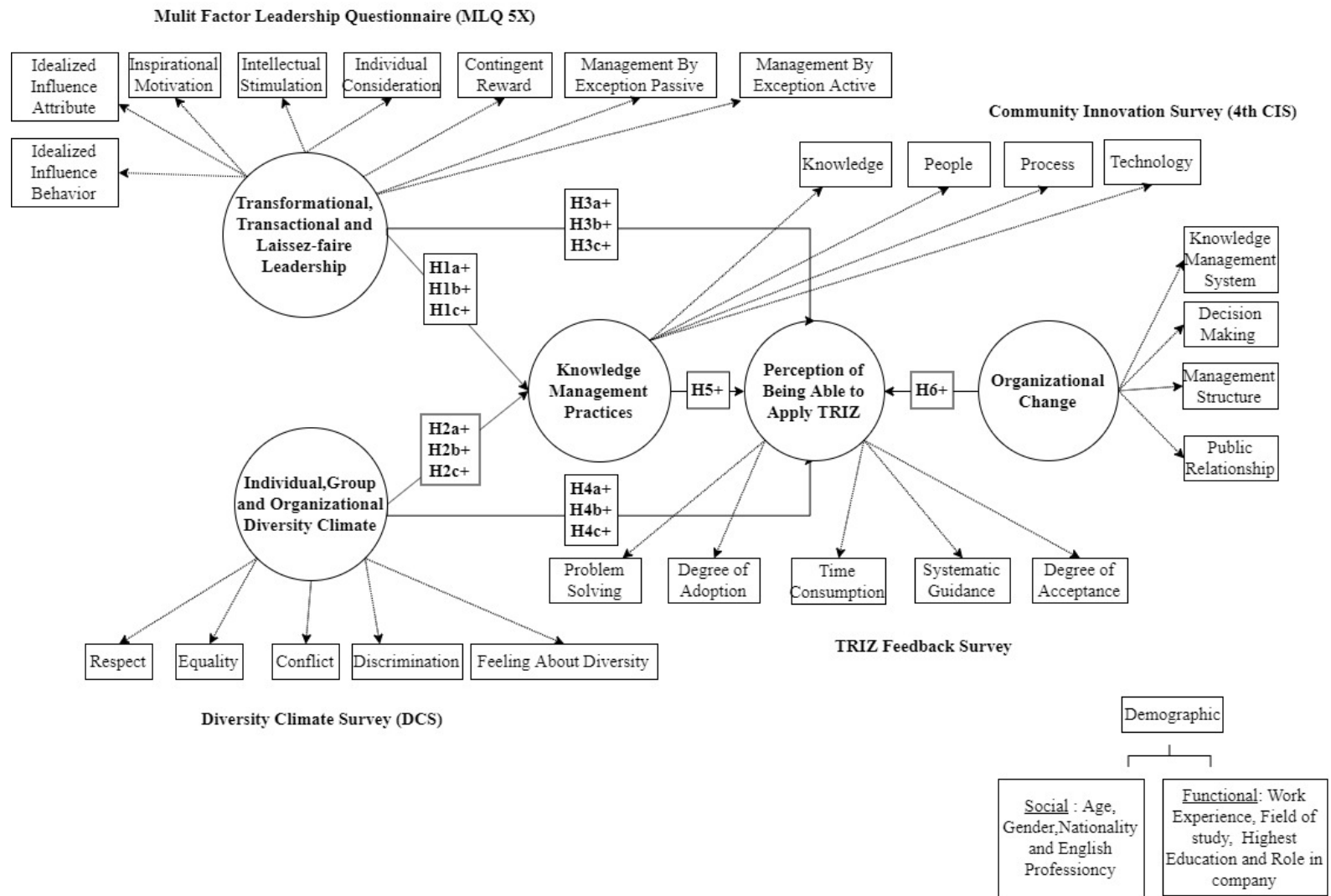


Figure 14: Instrument of Measurement Model

CHAPTER FOUR

METHODOLOGY OF DATA COLLECTION

Population, Samples and Training Course

The population of interest consists of 30 UAE semi-government companies, which do business in modern cities of Abu Dhabi, Dubai, and Al Ain. UAE semi-government companies are mostly under the supervision of Mubadala Investment Company, which also has many partnerships around the world (Al Hallami et al., 2013). Mubadala targets different types of industries, like aerospace, oil & gas, metal & mining, defense services, semiconductors, renewable, information & communication technology, healthcare, real estate & infrastructure, capital investment, and utilities, to improve their productivity and reliability in the world market (Mubadala, 2002).

Eight companies were targeted in this study and each company was communicated to through the United Arab Emirates Embassy (UAE Embassy) using a formal letter to initiate the research. After each company had given approval, workers from different departments within the companies were selected to participate in the study, based on the recommendations of their superiors. Groups (ranging from three to six members) were formed with their respective leader, either someone who is known by participants to have leadership skills or currently a leader of a particular team. Most of the group participants were selected based on their specialization within the organization. Due to the nature of the work field, participants were either in management or in

technical positions. Group formation was based on the approach Paulus and Yang (2000) suggested for forming idea-generation groups.

This study considered eight companies with each company having a minimum of five groups with most groups having four participants. In some cases, participants decided to form a group consisting of only three members; either these members were highly experienced in their work field or they believed it was easier to understand the TRIZ lecture with fewer members. The study included a sample of 205 workers from the eight UAE semi-government companies. A minimum of 30 ideas were generated by the groups in each company for a total of 240 ideas.

Study Procedure

Training presentations and work sessions were developed for participants of this study. The training consisted of a two-day session derived from Nakagawa's (2011) TRIZ/USIT agenda. This training provided a basic introduction to the principles of TRIZ problem-solving as well as the methodology for its application. On the first day of the session, a survey was distributed to participants to measure the influence of leadership and diversity inside the group. Then, the participants were trained in the basic principles of TRIZ. This included understanding the background of the method, principles for identifying a problem, how to convert their specific problem to a general problem using the contradiction matrix, how to convert the general problem to a general solution using the 40 principles, and how to use the general solution to solve their specific problem. On the first and second days, the group participants were asked to solve a real-life problem in their organization. These problems (refer to Chapter Five for further details) were based

on issues identified by each organization' senior management. As part of the training, the participants applied TRIZ methods to the problem and generated a number of solutions. Those ideas were recorded and collected. At the end of the training, another survey was distributed to participants. This survey measured the perception of being able to apply TRIZ, organizational change, and knowledge management practices. To incentivize participation, each worker who attended this training session earned a certificate of having completed TRIZ basic training from the American Institute of Professional Studies (A.I.P.S). The presenter of this course had taken a course in TRIZ basic training from the Technical Innovation Center in Boston and achieved an associate degree in November 2016. The presenter (the author) was trained to teach/present training sessions with a certified Training Of Trainers Program (TOT). Table 8 shows the proposed two-day TRIZ training and idea generation workshop schedule.

Table 8: TRIZ Time Schedule

	Day (1)		Day (2)
Time	Agenda	Time	Agenda
08:30 AM	Survey Collection for Transformational Leadership and Diversity Climate	08:30 AM	Review of TRIZ Basics
08:50 AM		08:45 AM	
09:00 AM	Introducing a Problem-Solving Case	09:00 AM	TRIZ Session
09:30 PM		10:00 AM	
09:45 AM	Brainstorming Session	10:00 AM	Further TRIZ Session (If needed)
10:45 AM		10:15 AM	
11:00 PM	Lecture in TRIZ Basics	10:30 AM	Assign Functions Weight, Scores, and Constraints, then Measuring the Idea Effectiveness
12:30 PM		11:15 AM	
1:00 PM		11:30 AM	

	Day (1)		Day (2)
Time	Agenda	Time	Agenda
2:00 PM	Continue Lecture in TRIZ Basics	12:00 PM	Survey Collection of Perception of Being Able to Apply TRIZ, Organizational Change and Knowledge Management Practices

Method of Data Collection

Figure 15 shows the data collection methodology used in this study on eight semi-government companies in the UAE for which each company formed a minimum of five groups with three to four members each. The data was collected during a two-day TRIZ training session.

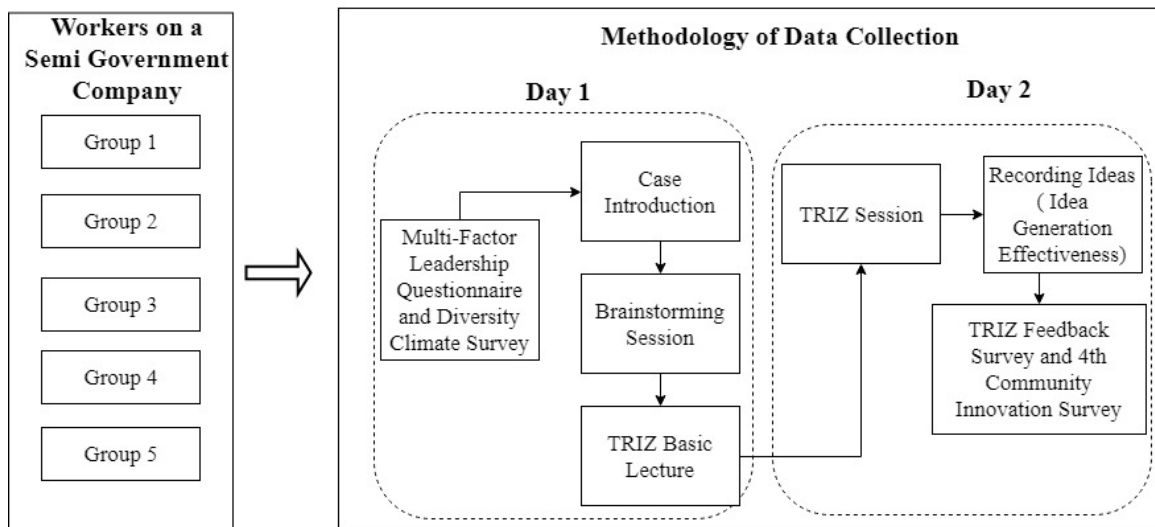


Figure 15: Method of Data Collection

The participants of each group had previously worked together on another project, where they had established a relationship among themselves and knew the leader well. In cases for which the group did not have a leader, the participants voted to choose a leader of the group: such groups created a different category for the study. The total number of

groups with existed leaders' category in each session are between three to four groups, while groups with a newly voted leaders' category are between one to two groups. Groups with a newly voted leader were given more time to discuss the problem and also were briefly lectured (five minutes to 10 minute) about the responsibilities for both leaders and members in group problem-solving. The determination of group size was based on recommendations from upper management considering previous projects, working relations, and department positions. These conditions influenced group formation, resulting in a range of three to six members in each group. The first day of the training session focused on collecting data using the MLQ 5X and diversity climate survey. At the end of the training, a feedback survey on TRIZ and a community innovation survey were conducted to measure the perception of being able to apply TRIZ, organizational change and knowledge management practices.

In the idea-generation session, the participants went through different stages. First, a case problem study was identified for the team participants to solve using both brainstorming and TRIZ tools. Second, a 45-minute general brainstorming session was held to help team participants generate different potential ideas and solutions to the problem. Third, another 45-minute session was held on the next day of TRIZ training to expand upon the potential ideas in which participants applied the concepts of TRIZ in problem-solving. Each idea had potential contraction parameters that could be/were resolved through TRIZ principles. This process helped to show the differences between the ideas that were generated through brainstorming and those generated through TRIZ.

In addition, the training interim helped make it easier to use in problem-solving (Campbell, 2003). Figure 16 provides further details on the idea-generation session.

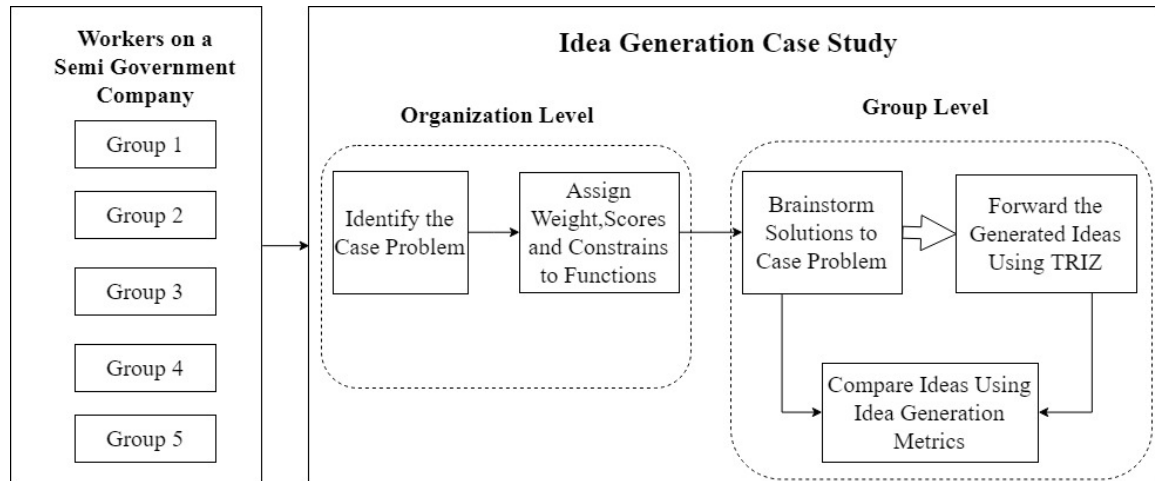


Figure 16: Idea-Generation Session

As the case was introduced in the training session, leaders identified the problem and made sure that all group members understood the problem statement and all the criterias and constrains needed to solve the case (refer to Appendix D for further information). In addition, the idea-generation process was clarified for the whole group in case a concern was raised by one of the group members. First, a lecture was given on the brainstorming methodology (five to ten minutes) in case some of group members had never used brainstorming, then a general brainstorming session was held. As the brainstorming session concluded, each team had generated ideas which could be furthered by the tools of the TRIZ on the following training day. Second, a TRIZ training was held still on the first day. The training was done in the groups so members of the groups would be able to share knowledge with each other. Throughout the lecture on the principles of applying TRIZ, group members were allowed to participate by sharing their

opinions or previous experiences with the whole group. Finally, on the second day of training, another TRIZ session was held with each group in which they were encouraged to expand their ideas for solving the problem that had been introduced in the first day of the training, this time by using the TRIZ tools they had just learned in the training. Each group formed its own solutions or generated its own ideas using TRIZ (40 principles of invention). Figure 17 gives an overview of the training session procedure.

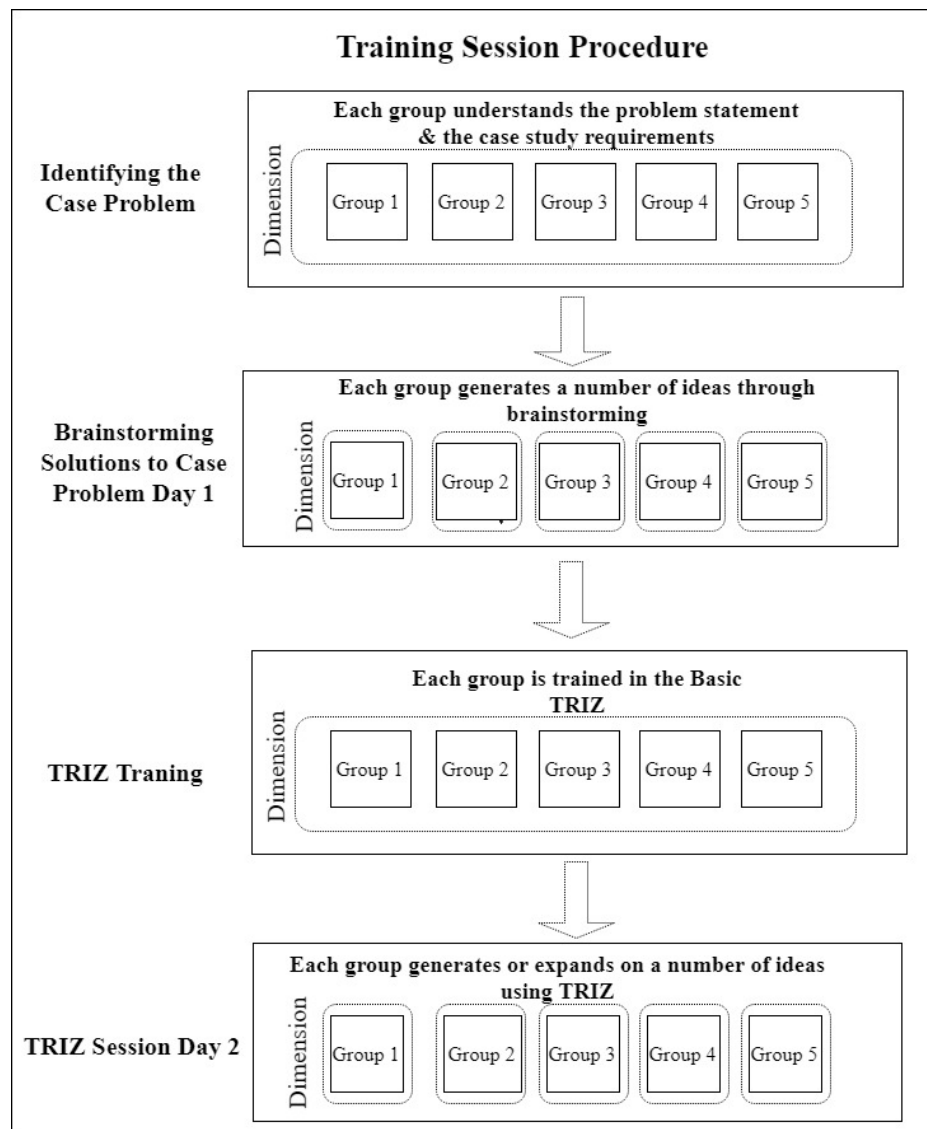


Figure 17: Training Session Procedure

In each company, upper management chose a real-life problem that the organization was currently dealing with or might face in the future which required problem-solving; this became the case study for that company. The groups were required to generate feasible solutions to the problem for upper management to select from, even if, in the end, none of the solutions were adopted within the organization. Upper management was also involved in group assignment; once assigned, the groups were gathered inside a conference room and the procedure outlined above was conducted.

After developing two training courses for the first two companies, pilot testing was performed to analyze the correlation between the measurement instruments, to determine if any changes were needed to the methodology. Figure 18 summarizes the process for conducting the research and applying TRIZ in the targeted companies. Official papers were issued from the Institutional Review Board (IRB) of Montana State University and submitted to the Embassy of the United Arab Emirates which in turn issued an official statement permitting research to be conducted in the targeted companies.

The targeted companies were accessed by submitting the documentation required to hold a training session. These documents included the Montana State University IRB form, a copy of the proposal paper, a copy of the official statement from the UAE embassy, as well as other required documents, such as a resume of the presenter and copies of the PowerPoint slides. A meeting was formed with the upper management of each of the targeted companies to discuss the problem to be solved through the case study, the participants selected for the training, and the recommended group formation.

Additional time was provided in each company to establish teams and to form a problem-solving statement before the actual training day.

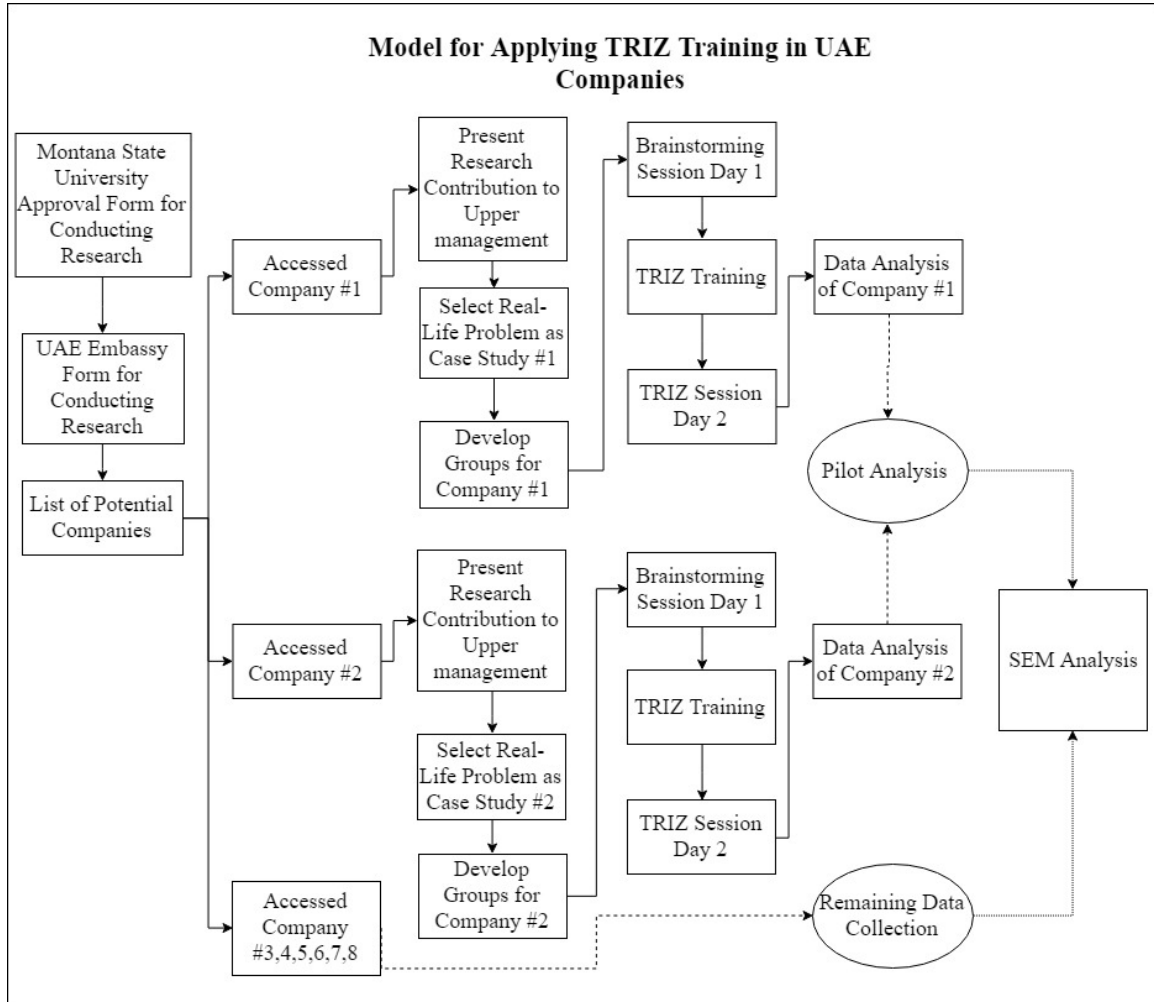


Figure 18: Model for Applying TRIZ for in the Targeted UAE Companies

Assumption and Limitations

To achieve the objectives of this study, the following assumptions were made:

- Hearing (Participating in) a lecture can lead to gaining knowledge on how to apply TRIZ principles to problem-solving; the participants will become familiar with TRIZ and be able to apply it after the training sessions.

- Each team will agree on the weight to assign each of the factors in the case study.
- Each team will fully use the 45-minute general brainstorming session and another 45-minute session to further/expand on these ideas using TRIZ principles.
- TRIZ training will be given in English and all the participants have the needed English-language proficiency.

This study may have the following limitations:

- The proposed method is only applied in the idea generation and expansion stage, whereas the research shows that the best idea generation has gone through the FFE stage of idea selection, as well.
- The research was only conducted within the UAE, and researchers may find difficulty in duplicating the research in their own industrial region.
- Changes to the study requested by the semi-government companies, like shortening the presentation time and eliminating certain sections from the TRIZ presentation, may have biased the results.

Dimensions of the Various Measurement Instruments

The data collected in this study can be delineated into three dimensions. The first is the case study group dimension, in which the responses on the instruments show the influence of the factors on the respective teams. In this dimension is the Multifactor Leadership Questionnaire, Diversity Climate Survey at the individual level and the questionnaire developed to measure Leadership effects and Individual Diversity Climate. The second is the Training Participants dimension, in which the response on the instruments shows the influence of the factor in the training. These effects were measured

individually and compared between team members to show the influence of diversity climate at the group level, and perception of being able to apply TRIZ (TRIZ Feedback Survey) and the questionnaire developed to measure Group Diversity Climate and perception of being able to apply TRIZ variables. The third dimension is the organizational dimension. This dimension focuses on participant perspectives of their work environment in the organization. The instruments that measure this dimension are the Diversity Climate Survey at the organizational level and the Community Innovation Survey. Participants' responses target organizational diversity climate, knowledge management practices, and organizational change variables. Further information on the instruments' level of measurement is shown in Table 9. Figure 19 and Figure 20 illustrate the dimensions of these instruments and Figure 21 outlines the dimension of the instruments in the theoretical model.

Table 9: Instrument Study Dimensions

Dimension Level	Targeted Variables	Instrument Measurement
Case Study Group	Transformational, Transactional and Laissez-Faire Leadership	Multi Factor Leadership Questionnaire MLQ 5X
	Individual Level Diversity Climate	Individual Diversity Climate Survey
Training Participants	Perception of Being Able to Apply TRIZ	TRIZ Feedback Survey
	Group Level Diversity Climate	Group Diversity Climate Survey
Organization	Organization Level Diversity Climate	Organizational Diversity Climate Survey
	Knowledge Management Practices	4 th Community Innovation Survey Knowledge Management Practices
	Organizational Change	4 th Community Innovation Survey Organizational Change

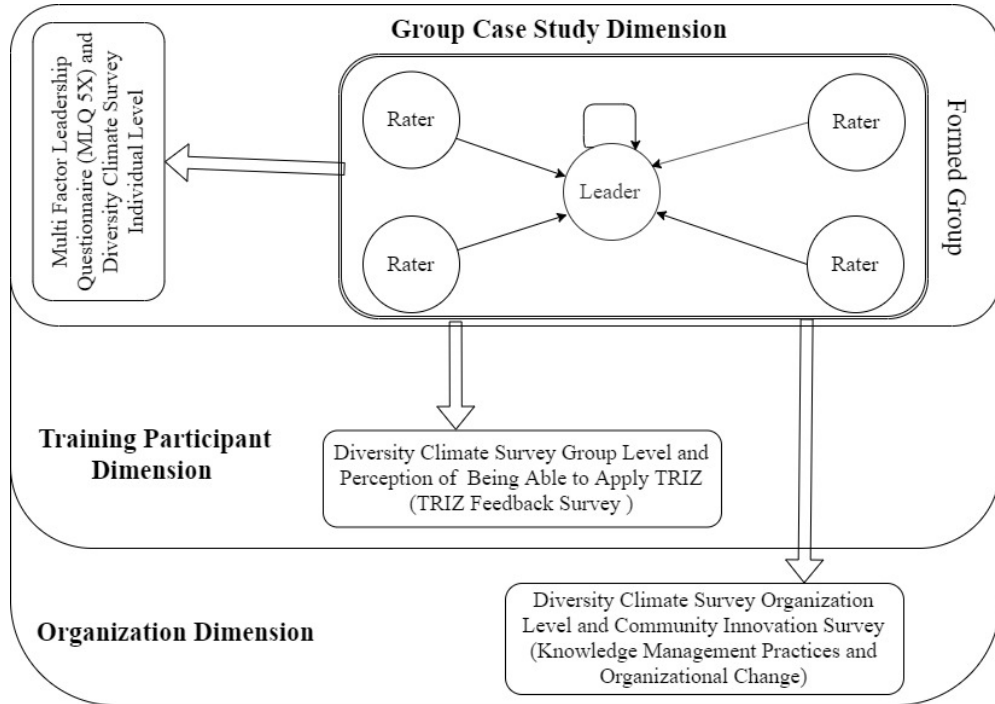


Figure 19: Dimension Levels in a Formed Group

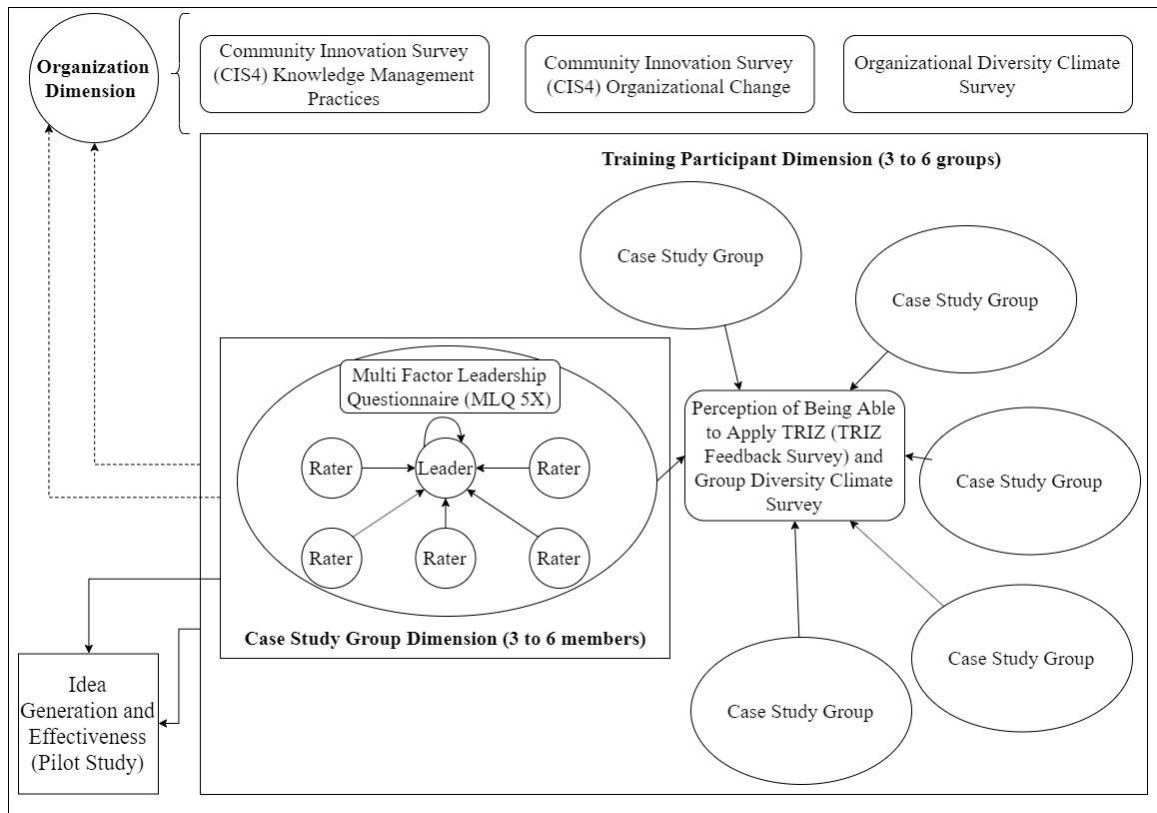


Figure 20: Detailed Dimension Levels

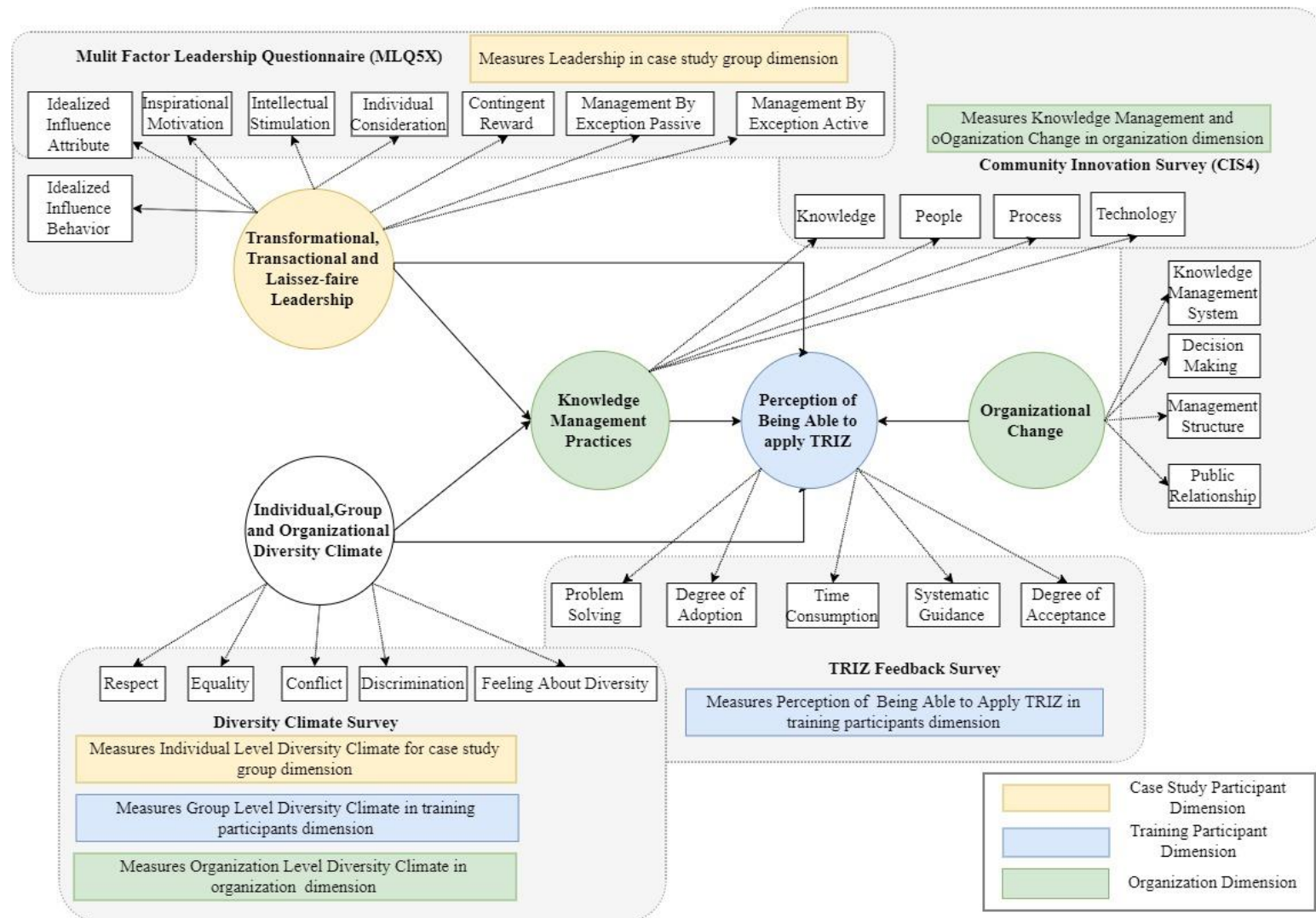


Figure 21: Theoretical Model For Instrument Dimensions

UAE Targeted Companies

The targeted companies in the UAE are from different industries. Based on recommendations from the UAE government, the targeted companies were selected as companies which could benefit from TRIZ training. Table 10 shows the targeted companies and their industrial specialization in UAE and Figure 22 shows the sectors leading to innovation that the UAE government is interested in, the bolded sectors were targeted in this study.

Table 10: Companies Targeted in the UAE

UAE SECTORS	UAE COMPANIES
AEROSPACE	Abu Dhabi Airport Companies
SERVICE	Urban Planning (Alain Municipality)
	Abu Dhabi Chamber
	General Authority of Islamic Affairs & Endowments
	General Directorate of Residency and Foreigners Affairs
HEALTHCARE	Abu Dhabi Health Service Company (SEHA) – Angel Wings
	Medical Center
TECHNOLOGY	Ajman Companies (Etisalat)
	Monitor and Control Abu Dhabi

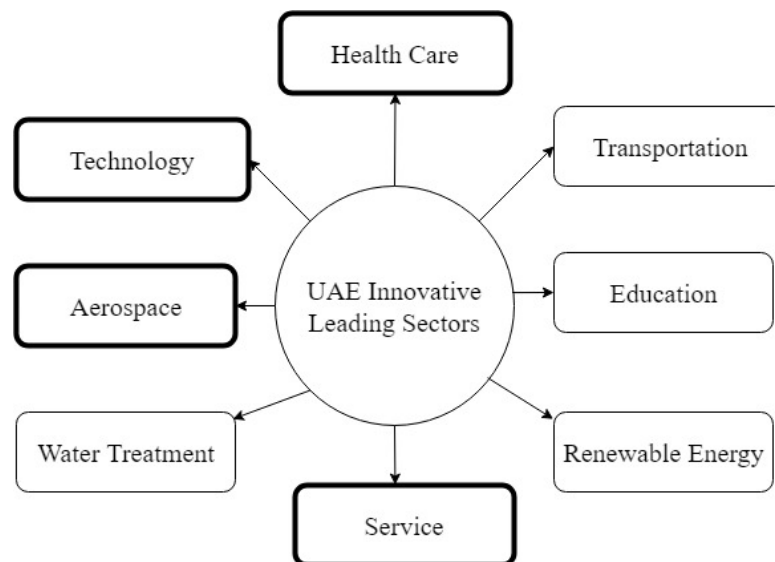


Figure 22: Sectors leading in Innovation in the UAE

Analyzing the Results

After gathering the data required, an analysis of the survey respondents was conducted using Statistical Package for the Social Sciences (IBM SPSS V.22). An inter-correlation matrix test was developed for this study to show the relationship between the response variables and to enable testing of the hypotheses. In addition, a reliability analysis was run for each proposed instrument: the Perception of Being Able to Apply TRIZ (TRIZ Feedback Survey), the Transformational Leadership Questionnaire (MLQ), the Diversity Climate Survey (DCS), and the Community Innovation Survey for Knowledge Management Practices and Organizational Change (CIS 4). A Confirmatory Factor Analysis (CFA) on each instrument was performed to show that the underlying factors were as expected. A Structural Equation Model was developed to test the simultaneous behavior of the factors against the hypothesis of interest if all instruments show effectiveness in CFA analysis and the sample size is high. A detailed diagram of the methodology for data analysis is shown in Figure 23.

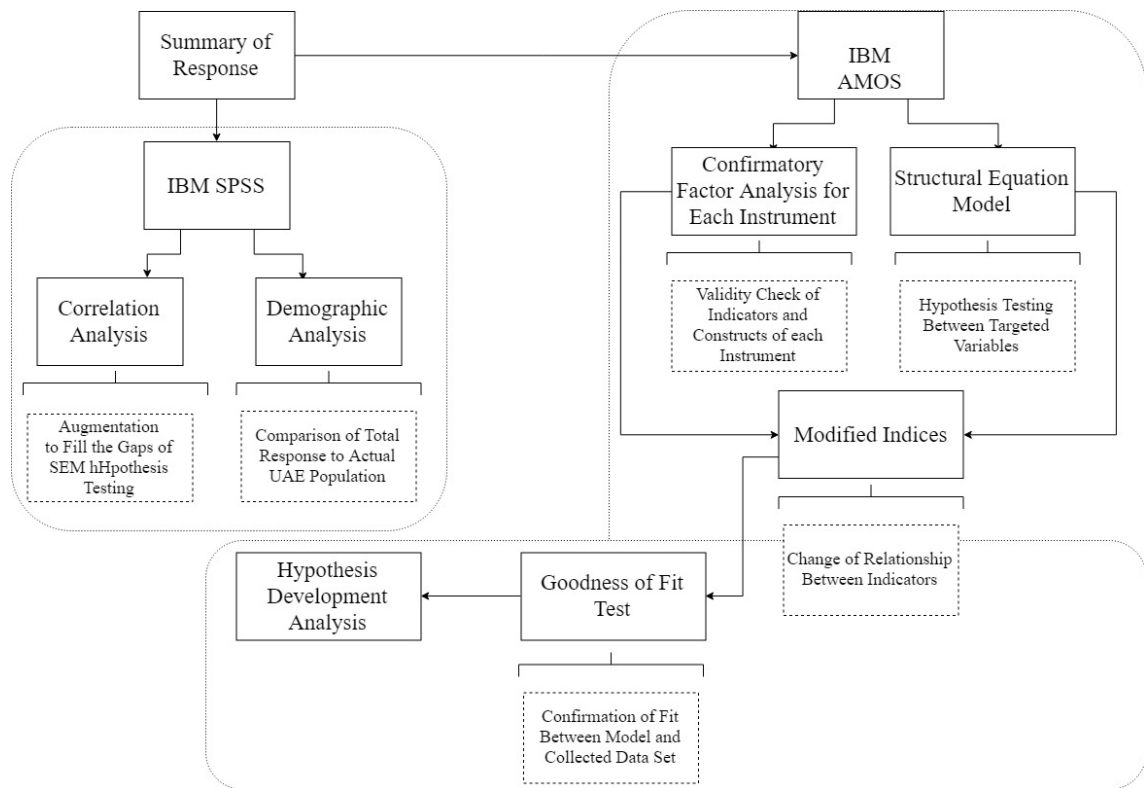


Figure 23: Methodology for Analyzing the Data Collected

Pre-Test and Results

One round of pre-testing for the instruments was conducted as part of the EIND 525 Multi-Attribute Analysis of Advanced Manufacturing and Service Systems course at Montana State University. This course focuses on multi-attribute decision-making and one of the topics discussed is TRIZ. 12 graduate students (8 males, 4 females) listened to two basic lectures on TRIZ, where they were given:

- a brief history of TRIZ.
- an introduction to technical and physical contradiction.
- a general description of the 40 principles of TRIZ.

After being assigned into 6 groups with each group consisting of two members, the students were asked to solve a problem regarding the design of a road sign. Each group had a general brainstorming session to generate ideas on how to solve the road sign problem, then each group applied TRIZ principles to come up with as many solutions as possible for the road sign. Each group created a paper assignment that was required to grade the different solutions, and a presentation was held in class to show the different solutions from each team. Near the end of the course, surveys were distributed to the participants to determine the relationship between the individual and group responses to the diversity climate, perception of being able to apply TRIZ, organizational change and knowledge management practices. These surveys were analyzed using IBM SPSS Statistics (V.22) to show the potential relationship between the variables using Bivariate correlation with the Pearson coefficient. All the ideas that were generated were gathered into a total of seven ideas from the general brainstorming session and 31 expanded variations from the TRIZ session. All these ideas were analyzed using the novelty, variety, quality and quantity metrics developed by Shah, Smith, and Vargas-Hernandez (2003). The summary of the questionnaire responses to a total of 25 questions and their potential correlation are shown in Table 11 and Table 12.

Table 11: Summary of the Questionnaire Responses

	Survey Questions
Individual Diversity Climate	Q1,Q2,Q3,Q4,Q5
Group Diversity Climate	Q6, Q7, Q8, Q9, Q10
Perception of Being Able to Apply TRIZ	Q11,Q12,Q13,Q14,Q15
Organizational Change	Q16,Q17,Q18,Q19,Q20
Knowledge Management Practices	Q21,Q22,Q23,Q24,Q25

Table 12: Correlation Between Variables, *P<0.05 (level of significance with two tails)

Response	Coefficient	Correlation Matrix								
		Q16	Q17	Q18	Q19	Q20	Q21	Q22	Q23	Q24
Q1	Correlation							0.696		
	P-Value							0.012*		
Q3	Correlation			-0.59						0.665
	P-Value			0.043*						0.018*
Q5	Correlation	0.731			0.588		0.725			
	P-Value	0.007*			0.044*		0.008*			
Q7	Correlation								0.821	
	P-Value								0.001*	
Q9	Correlation							0.599		
	P-Value							0.04*		
Q12	Correlation		0.626			0.683				
	P-Value		0.03*			0.014*				
Q14	Correlation					0.683				
	P-Value					0.014*				
Q15	Correlation			0.576						
	P-Value			0.05*						
Q16	Correlation						0.599			
	P-Value						0.04*			
Q20	Correlation									0.6
	P-Value									0.039*

The pre-test correlation matrix shows that the hypothesized relationship between variables is valid in several cases but not all. One of the cases that shows validation is a positive correlation between perception of being able to apply TRIZ and organizational change (Q12 and Q17, Q20). In addition, the correlation of diversity climate with both knowledge management practices and organizational change shows that the relationship between these variables (Hypothesis 2 and 4) is also valid. On the other hand, the analysis did not show a correlation between perception of being able to apply TRIZ and knowledge management practices or diversity climate. This may be due to the small number of participants and will be investigated in the full study. The correlations that have been shown demonstrate the potential for a correlation between TRIZ and diversity climate or knowledge management practices with larger sample size. Based on the

responses from the 12 graduate-student participants, the reliability of the TRIZ training is shown in Table 13:

Table 13: Measurement of the Reliability of the TRIZ Training

Pilot Study Test For TRIZ Training	
# of Participants	12 (8 Male, 8 Female)
# of Survey Questions	25 Questions (5 Individual Diversity Climate, 5 Group Diversity Climate, 5 Perception of Being Able to Apply TRIZ, 5 Organizational Change, 5 Knowledge Management Practices)
Cronbach's Alpha	0.795 > 0.7

To be considered reliable, the results of Cronbach's alpha value must be greater than 0.7, showing that the TRIZ training can be considered reliable at its result of 0.795. Overall, there seemed to be no problems with the questions in the survey as there were no missing data points and all participants who started the survey finished it. This pre-test did not consider the assigned variables for TRIZ, as proposed. This is because the participants were only academically lectured on TRIZ (not fully trained). In addition, there was a limited number of members in each team, which limited the discussion of any further ideas and the understanding of how to best apply TRIZ.

CHAPTER FIVE

PRESENTATION AND ANALYSES OF DATA

This chapter presents the data collected and the analysis of that data. The chapter begins by presenting the cases that utilized in TRIZ training for each targeted UAE company. Next, a detailed summary of the TRIZ training agenda and outcomes are discussed. Participants are then described through demographic statistics and compared to the general demographic. Finally, the analyses of the data include verifying the relationship between the variables using correlation analysis, verifying each instrument of measurement using the Confirmatory Factor Analysis (CFA), and apply Structural Equation Modeling to test the proposed hypotheses. Evidence of reliability and validity are presented for each instrument.

TRIZ Training Case Studies

Each company that participated in this study selected a real-life case study to be discussed and solved during the TRIZ training course. A summary of each company's background and case study is presented in this section. A total of eight companies participated in this study; of those companies, two of them participated in the study more than once. The first of these two conducted four training sessions, while the second conducted two sessions. Outlined observations and outcomes of the TRIZ training course are discussed for each targeted company. Table 14 summarizes all the cases that were developed in this research and gives a description of what was delivered in the TRIZ training. All remaining cases are provided in Appendix D.

Table 14: Summarized Case for Each Targeted Company

Case	Company	Title	Description
Case #1	ADAC	Improving the Baggage Claim Process	Abu Dhabi Airport Companies (ADAC) focuses on providing the easiest and most comfortable process for travelers to reclaim their baggage. After hours spent in traveling, security checks, and the immigration process, travelers become tired, exhausted and frustrated in the baggage claim area.
Case #2	AWMC	Reducing Ego and Improving the Work Environment	Angel Wings is a medical center that has highly experienced workers who act as a mediator between the patient and the medical staff by facilitating the exchange of necessary documents. There was a situation where a worker was fired due to the toxic environment created by his egocentric behavior.
Case#3	UPC 1-2	Improving the Contract Documenting Process	Urban Planning and Municipalities (UPC) uses the most suitable technologies for providing comfort to customers while they are waiting for their contracts to be documented and approved. However, customers are (often) delayed in this process for many uncontrollable reasons, like paperwork being rejected due to differences between UPC and the Electricity Distribution Company. This forces the customer to have to go through the whole process again.
Case#4	UPC 3-4	Improving the Food Distribution Center	The Food Distribution Center is designed to provide wholesale prices to UAE citizens who own unique cards. The Food Distribution Center has existed for a long time and there is no system to ensure that it helps UAE citizens save money, especially those with big families.

Case	Company	Title	Description
Case#5	GDRFA	Detecting Fraudulent Promises	The General Directory of Residency and Foreigners Affairs do their best to eliminate fraud through legal means. Some companies promise foreign workers better treatment and higher wages but force them to come to the country on visitor visas, so that they are not obligated to provide these benefits. After the visa duration is over, the foreign workers are forced to return home and the companies no longer concern themselves with their complaints.
Case#6	Ajman Companies	Improving the Number Exchanging Process	Etisalat, one of the telecommunication companies in UAE focuses on increasing security where there is an exchange of services between users. They use a highly technical tool to scan the national ID through fingerprints. There was a situation in which one user wanted to exchange phone numbers with another user; they waited in line for 40 minutes due to a busy time of day. After waiting, one of the users could not pass the national ID fingerprint test because there was a problem with his card that was initially caused by the Federal Authority for Identity and Citizenship.
Case #7	AD Chamber	Authorizing Licenses	Previous cases have shown that some UAE citizens authorize a business license under their names on behalf of foreign citizens. In this way, they get official authorization that allows them to manage the business account of and also request loans on behalf of the retail store or company. If the foreign citizen is not able to repay the loan, or if they smuggle the money outside the country, the legal owner of the business (the UAE citizen) is held legally accountable and all his assets are held by the bank until payment of debt.

Case	Company	Title	Description
Case#8	Monitor and Control Centre	Developing a Calling System	The Monitoring and Control Center cooperates with the Command and Control Centre of the Abu Dhabi Police in receiving emergency calls (999) from all around the emirates of Abu Dhabi, Al Ain, and Al Dhafra. The calls vary between traffic or criminal reports and inquiries from the public regarding travel directions; sometimes they also receive calls from people asking for help after their vehicles have broken down. The center works around-the-clock using a high-tech electronic system and an advanced database to receive urgent calls and deal with them according to the established work mechanisms. Some of the non-urgent calls result in a waste of time and effort which could be better dedicated to those who need urgent help.
Case #9	GAIAE - AD	Improving the Cleanliness of the Carpets in Crowded Mosques	Many people rush to the mosque to pray and forget to clean up or take off their socks before entering the mosque. Over time, this causes the carpets inside the mosque to be unclean, messy and worn out, which, in turn, requires the purchase of new ones. This situation also creates an unsatisfactory and untraditional prayer experience in the mosque. There is a need for the Authority of Islamic Affairs to address this problem

Case	Company	Title	Description
Case#10	GAIAE - AA	System for Mosque Maintenance	General Authority of Islamic Affairs & Endowments (GAIAE) provides periodic maintenance to the mosques. The mosques are mostly located within a 5-7 block area of residential houses inside Abu Dhabi and Alain. There is no system, however, to indicate that the mosque is under maintenance. If the mosque is under maintenance, there is no substitute mosque in the residential area and the residents will have to go far to pray. Furthermore, those wanting to pray have no way of knowing if the mosque will be under maintenance or construction until they arrive at the mosque. There is a need to improve/ provide solutions either in communication, providing awareness, or by providing an alternative place of prayer in the area.

Detail of the TRIZ training

The training departments of each company were contacted with all the documents of the proposal to inquire if there was any interest in participating in the research. In addition, a formal paper that included a full description of the training course goals and the goals outcomes of the research were submitted to the training departments for further evaluation. After approval, a formal meeting was arranged with the heads of the training department (in some cases they were senior managers) for them to select the group participants and suggest a problem that was currently being faced inside the organization. Most of the managers requested that they select the group participants because they knew their workers and how many projects they had done together as a team. Five days were provided for the researchers to summarize the problem on a spreadsheet to be submitted

to the group participants at the beginning of the training. An attendance sheet was sent via email by the head of service quality showing the participants' names and their assigned groups. The training departments also scheduled a meeting room in their companies in which the proposed two-day training session could be held.

At the beginning of the training session, the participants were asked to get into groups as suggested by the training department or senior manager. After taking attendance of all the participants, a spreadsheet detailing the case problem was distributed to each participant; at the same time, a slide presentation was shown which summarized the case study and gave a detailed sketch of the problem area. Before distributing the surveys, participants were lectured on the protocols of the study and then asked if they were willing to participate in a survey questionnaire for the study; all participants agreed and the consent forms were collected. The MLQ and Diversity Climate Survey were submitted to the participants. Participants also filled out the demographic information questionnaire as well as a review of the leader of their group. They filled out an initial survey on their perspectives of being able to apply TRIZ and were told they would complete this after the training session.

Before beginning the brainstorming session, the case study was discussed with everyone to see if they were familiar with the problem or if they had an issue with it; this took about 10 minutes. After this, participants split up into their groups to discuss the case study and the aspects they thought were important to understand the problem and to generate ideas that would target the problem statement correctly. At the end of the discussion, a formatted paper was distributed to help participants document their ideas.

Then, participants were provided with 45 minutes to come up with as many solutions to the problem as possible. In the brainstorming session, participants continued discussing different aspects of the problem. Groups often asked for more time, to which they were answered, “As long as you believe you will solve the problem.” Each group returned from the brainstorming session with at least five ideas (in some cases, only 1-2 ideas) and these were recorded.

At the end of the brainstorming session, a 15-minute break was provided to the participants. Next on the agenda was the TRIZ training session. At the beginning of the TRIZ training, summaries of the TRIZ training slides were distributed to the participants to help them understand TRIZ tools. A total of one hour and thirty minutes were spent lecturing the participants on using TRIZ tools and methodologies; handouts covering all the tools and principles were distributed to the participants to be used during the training as well as in their groups later. Before the end of the first day of TRIZ training, the participants were asked to come up with TRIZ contradictions that they thought would be helpful for their case study problem. Each group came up with one contradiction for each idea from their brainstorming session which gave them multiple TRIZ principles for their solutions. The TRIZ contradiction discussion took 20 minutes. Participants were asked to review the principles generated from the TRIZ contradictions as they would be implemented in the TRIZ idea session the next day.

The next day, a brief summary discussion (5 minutes) was held to determine participants’ familiarity with TRIZ and how they thought it would be implemented in the case problem. The TRIZ lecture was reviewed to refresh the participants’ minds on how

to apply TRIZ. At the end of the lecture, another discussion on TRIZ principles (20 minutes) was held to help participants understand the principles generated from TRIZ and how to apply them to the case study problem. Examples of real-life solutions were presented in this session, outlined to help participants understand the principles. After a 15- minute break with refreshments, a TRIZ session (45 minutes) was held in which each group discussed the principles they had generated and how they could be applied to the case study. Most of the solutions were developed by combining the ideas generated in the brainstorming sessions with the principles of TRIZ. This resulted in the improvement of some of the ideas and the improved ideas were considered to be new ideas. At the end of the session, group participants were allowed a break time until all the groups were done.

After the TRIZ session, participants were again asked to fill out surveys; they completed the survey regarding their perceptions on being able to apply TRIZ and filled out questionnaires on knowledge management practices and organizational change. Before ending the second session, all the ideas were collected (from both the brainstorming session and the TRIZ session) for further evaluation (using idea-generation metrics which had also been demonstrated in the training session). At the end of the second session, all participants were thanked for attending.

TRIZ Training Outcomes and Observations

In this section, all the observations made during the TRIZ training sessions held in the targeted UAE companies, all the responses received on the various surveys, and all the analysis outcomes will be discussed. This includes qualitative observations of the participants during and after the training was held.

Abu Dhabi Airport Companies

- Regardless of the differences in position, area of work and internship (talent team), or actual worker, all group members were included in problem-solving.
- Participants shared knowledge as well as examples of previous experience during the TRIZ lecture. These experiences were helpful to other members in the problem-solving process.
- Groups shared knowledge with other groups. Sharing this knowledge helped the members of other groups gain better understanding of the situation that was occurring in the problem statement.
- During the brainstorming session, group members were actively generating ideas rather than validating these ideas with the problem statement provided. During the TRIZ session, these ideas evolved and were included in problem statement.
- After the training ended, many participants asked for contact information so that they could communicate should they have any further concerns. After two months of training, a session was held with the Quality Manager during which he praised what the training session had produced and expressed appreciation for the ideas that had been generated by the workers. The Quality Manager also gave an update on the projects and the participants were asked to again apply TRIZ to the situation.

Angel Wings Medical Center

- Participants were focused on generating ideas for the problem they were given. They understood and used the TRIZ methodology, but they were not exposed to any further problems after the training was held.
- Participants listened attentively to the TRIZ lecture and group leaders encouraged participation in the lecture.
- The brainstorming session was the focal point for the participants; it helped them to understand their problem, and as a result they were able to generate ideas related to the problem. After generating TRIZ principles, they realized that some of the ideas were not practical and therefore they turned them down.
- Knowledge was shared by the leaders with the participants; however, there was no knowledge sharing from one group to another.

Urban Planning and Municipalities

- Groups shared knowledge among the members. Leaders shared knowledge during both lecture and problem-solving sessions.
- A number of leaders reached out after the training, asking for more examples of TRIZ application for either new products or services. These communications continued after the training course through email.
- Groups shared knowledge with other groups during the refreshment breaks. Some groups were interested in further discussion with other groups in order to attain better solutions.

- Many participants were thankful after the TRIZ training session, showing satisfaction and appreciation for the effort made to help people understand TRIZ for the first time. Many of these participants were willing to fill out an official rating on the TRIZ session for a national survey on training workshops provided by an organization.
- A previous TRIZ training had been held at UP not long before, but it was not successful. Since the responses for the provided TRIZ training were satisfactory, a formal certification was presented to the TRIZ trainer/s from the organization in appreciation as well as in full support of the thesis research. Furthermore, plans are currently being made for a highly organized TRIZ training workshop, recommended by upper management for senior managers from different Emirates.

General Directorate of Residency and Foreigners Affairs (GDRFA)

- Groups were formed from different departments in the organization so that most members only knew the members of their own group, which limited knowledge sharing between the different groups during the lecture or during the problem-solving. On the other hand, there was much knowledge sharing within the groups, between the members and their leaders. Some of the groups asked the presenter to demonstrate more examples to be applied in the problem-solving.
- Groups included the ideas from the brainstorming sessions in the second-day TRIZ session but in a more improved form through further communication between participants. Some of the groups culled ideas they didn't like so they could be more efficient with the rest.

- At the end of the TRIZ session, the groups asked for more time to apply TRIZ to another problem they were facing at work. The groups generated feasible ideas which they submitted to upper management for work evaluation. Half of the TRIZ solutions were rejected by the senior managers because they believed they would be too difficult to implement. Nevertheless, three of the ideas generated from TRIZ principles were adopted by the senior managers for further evaluation. The senior managers were very satisfied with the results of the TRIZ training and asked for contacts to discuss the process and the development of the three ideas.
- There was one participant that was misinformed about the deliverables of the TRIZ workshop (due to a misleading statement in the announcement). Nevertheless, this participant showed satisfaction in his rating of the training-and-development. He stated that he still needs practice in applying TRIZ, but with the help of the knowledge shared between the members of his group, he was able to generate ideas for the provided problem.
- An appreciation meeting for the presenter was held with the senior manager of the Training-and-Development department of GDRF. At this meeting, the senior manager heard all the feedback from the participants regarding the two-day training session.

Ajman Companies (Etisalat)

- Group members were mostly outsourced from other companies to help Etisalat in their problem-solving. These outsourced workers were selected for the specific purpose of participating in the TRIZ workshop.

- Knowledge sharing occurred within groups and between groups as well. Many of these members were not familiar with the problem area.
- Participants shared many examples between the groups during the TRIZ lectures regarding the problem solving that they believed had occurred during the brainstorming session.
- Many of the participants had never been exposed to TRIZ before the training, but they researched (the origin of) this methodology prior to attending to prepare themselves
- Participants provided recommendations for future TRIZ training workshops as they recognized that TRIZ could also be helpful in many other organizations.

Abu Dhabi Chamber

- Ideas and knowledge were shared between groups that created conflict within groups when the ideas were not well explained or not fully accepted by all the group members. Nevertheless, it was recognized that the discussions of the problem-solving lead to no real conflict but rather towards positive criticism.
- Knowledge of different practices was shared by experts in the work field and also by group leaders based on discussions with other group leaders.
- The senior manager of Abu Dhabi Chamber was satisfied with the results after interviewing many of his workers regarding the TRIZ training and the solutions which were delivered. He issued and signed a formal appreciation certificate. His satisfaction with the results helped to build a good reputation with other organizations, encouraging them to also be involved in TRIZ training.

Monitor and Control

- Group members focused their attention on learning TRIZ and applied it to their work during the TRIZ lecture, sharing their knowledge and ideas with each other
- Groups were focused on understanding how to apply TRIZ to their given problem and also to further projects. One of the groups continued their discussion of the problem during the break to try to figure out how they could apply TRIZ.
- Many participants asked for contact information so that they could continue to build their understanding of TRIZ and get more practice applying TRIZ.
Participants expressed appreciation for the effort given in delivering the TRIZ lecture.
- One participant had been outsourced to the MC center to help improve their IT system and many of the TRIZ training deliverables were targeted towards the IT-system improvement objectives. This proved helpful for the improvement of the IT system.

General Authority of Islamic Affairs & Endowments

- Groups mostly shared knowledge during the brainstorming and TRIZ sessions.
The summarized presentation (second day of TRIZ training) was helpful for further knowledge sharing on the problem.
- Experts and leaders asked for examples in the TRIZ session which evolved into sharing knowledge and generating many ideas.
- An official paper was issued and signed by the senior manager of GAIAE after he saw a highly satisfactory response regarding the training delivery from the

participants. He also asked for all ideas to be scanned and copied to be shown as solutions for the problems during discussions with government authorities.

- One of the groups requested to have their TRIZ session time extended to solve another case study problem. They selected a problem similar to the GAIAE-AD problem. After they had concluded their initial case study in the TRIZ session, they used the remaining time to solve the selected problem (Improving the Cleanliness of the Carpets in Crowded Mosques). They used the principles of TRIZ to come up with ideas without using a brainstorming session and then came up with solutions. These ideas were recorded in their respective groups and were not added to the initial case study.

Measuring Generated Ideas

The ideas collected from the participants were evaluated using measurements developed by Shah et al. (2003): Novelty, Variety, Quality, and Quantity. The analysis of these metrics is scored on a scale from 1 as the lowest to 10 as the highest. These metrics are good indicators for the idea generation process and for determining which ideas can best be implemented.

Novelty

Novelty is something new and unusual that the idea represents. The novelty equation developed by Shah et al., (2003) is composed of two scores: one score is determined before analysis (M1 Priori) based on the desirability of novelty, and the

second score (M1 Posteriori) by calculating the frequency of each solution in the entire collection of ideas.. The equations for M1 Priori & M1 Posteriori are shown here:

$$M_1 = \sum_{j=1}^4 f_j S_{1j}. \quad (1)$$

M1 Priori where; f_j : weight, S_{1j} : Stage weight

$$M_1 = \sum_{j=1}^m f_j \sum_{k=1}^n S_{1jk} p_k. \quad (2)$$

$$S_{1jk} = \frac{T_{jk} - C_{jk}}{T_{jk}} \times 10. \quad (3)$$

M1 Posteriori where; f_j : Weight, p_k : Stage weight, C_{jk} : Count of current solutions, T_{jk} : Total of ideas in the function

Variety

Variety is the quality or state of being different or diverse. Variety is determined based on novelty scores, which are divided into a high and low novelty sets so that Variety (M3) can be measured using the following equation:

$$M_3 = \sum_{j=1}^m f_j \sum_{k=1}^4 S_k b_k / n. \quad (4)$$

M3 where; f_j : Weight, S_k : Score level, b_k : Number of branches, n : Total # of ideas

The novelty score of each individual idea is categorized as low set (1) or high set (2) based on the M1 Priori and M1 Posteriori scores, and their average. To determine the variety score, the sets are compared using the function set weights, with developing branches for the following levels: psychical principles, working principles, embodiment,

and detail. Each branch is assigned with a value score that should be reduced for branches with a lower level. The number of branches is multiplied with each score provided and multiplied with the weight that is assigned to the function in the novelty analysis, and all the functions are added together at the end of the calculation. Note that if a branch contains a single category, it is assumed that the variety is equal to zero in that level, according to Shah et al. (2003). In addition, a score of 10, 6, 3 and 1 for each variety branch are kept, as recommended by Shah et al. (2003).

Quality

Quality of idea is the origin of idea value based on the problem-solving initials ”.

It is measured as shown in the following equation:

$$M_2 = \frac{\sum_{j=1}^m f_j \sum_{k=1}^2 S_{jk} p_k}{n * \sum_{j=1}^m f_j} \quad (5)$$

*M₂ where; f_j: Weight for function j, S_{jk}: Score for quality of function j in stage k
p_k: Weight for stage k, m: Total number of functions*

The quality of an idea is determined based on rating the constraints of a problem; raters consider ideas with high novelty set scores that have been categorized in the variety section.to determine their quality. . The participants determine a rating from 3 (high importance) to 1 (low importance). The total rates are based on adding up the pros and cons of the idea with respect to the problem constraints. Each idea is constrained by the following parameters: Distance (estimated achievable distance), Operation (violation of operation rules defined in the problem statement), Manufacturing (how difficult it is to

construct), and Material (how difficult it is to acquire the materials). The quality of an idea with these parameters will be compared to the quality of the best idea generated (based on novelty and variety). There can be a maximum of five best ideas and the idea baseline from 1-5 is 10, 8, 5, 3, and 1 for best five ideas, as recommended by Shah et al. (2003).

A total of 27 ideas were measured from the pilot study of the first two companies. The ideas were gathered and rated to create a basis of comparison between ideas generated from the brainstorming session and ideas generated from the TRIZ session. The constraint values were decided and agreed upon by the team participants after they generated these ideas. A 30-minute discussion was held after the TRIZ session for each group to come up with a reasonable constraint value. After receiving the values from each group, the average value of the rating was calculated to determine the final constraint value for measuring the effectiveness of ideas. [The values for quality in term of novelty were measured between the brainstorming and TRIZ sessions using the ANOVA table for both M1 Priori and M1 Posteriori values.] The analysis of idea effectiveness has been suggested as an area for future research. Appendix F shows detailed calculations of the pilot ideas.

Participant Demographics

The training that was provided for TRIZ only targeted companies in the UAE region. Eight companies agreed to participate in the TRIZ training course and 205 participants were trained in total. 40 participants from two companies were considered as a pilot study for testing the reliability of each instrument and the correlation effect

between the instruments based on the hypothesis provided. All the team assignments and formations were signed and agreed upon by the Human Resource Department in these companies or, in some situations, the Training Department. Each group was headed by one leader; all other details regarding team formations are summarized in Table 15.

Table 15: Team Formation for Each Company

Company	Participants	Groups	Members	Ideas Generated Using Brainstorming	Ideas Generated Using TRIZ
ADAC	21	Group1	4	5	5
		Group 2	3	6	6
		Group 3	3	6	6
		Group 4	3	5	5
		Group 5	3	5	5
AWMC	19	Group1	4	5	2
		Group 2	4	1	2
		Group 3	4	4	5
		Group 4	3	3	2
UP1	14	Group1	3	3	8
		Group 2	4	1	2
		Group 3	4	2	4
UP2	14	Group1	3	2	2
		Group 2	3	1	3
		Group 3	2	1	4
		Group 4	2	2	5
UP3	9	Group1	5	2	1
		Group 2	2	2	3
UP4	14	Group1	4	3	5
		Group 2	3	5	4
		Group 3	4	3	7
GDRFA	20	Group1	3	3	6
		Group 2	3	5	8
		Group 3	3	1	3
		Group 4	3	2	5
		Group 5	3	3	6
Etisalat Ajman	16	Group1	3	1	1
		Group 2	3	6	4
		Group 3	3	2	2

Company	Participants	Groups	Members	Ideas Generated Using Brainstorming	Ideas Generated Using TRIZ
		Group 4	3	3	5
AD Chamber	22	Group1	3	1	2
		Group 2	3	2	5
		Group 3	3	2	4
		Group 4	4	2	2
		Group 5	4	2	4
MC	17	Group1	2	5	4
		Group 2	2	2	7
		Group 3	2	3	7
		Group 4	3	7	11
		Group 5	3	6	7
GAIAIE-AD	18	Group1	3	9	4
		Group 2	3	6	6
		Group 3	4	8	6
		Group 4	4	7	4
GAIAIE-AA	21	Group1	5	5	7
		Group 2	5	3	3
		Group 3	2	9	6
		Group 4	2	4	12
		Group 5	2	4	3
Total	205	49	156	180	230

The demographic analysis was developed to compare the sample size obtained with the UAE population. Table 16 shows the characteristics and frequencies of different areas in age, gender, nationality region and more. The demographic analysis of the sample size will be compared to the general demographics of the UAE and can represent the total population as good as possible.

Table 16: Participant Demographics N=205

Descriptive Statistics			
Demographics	Characteristics	Frequency	Percentage
Age	15-25	13	6.30%
	26-35	112	54.60%
	36-45	63	30.70%
	46-55	17	8.30%
Gender	Male	89	43.40%
	Female	116	56.60%
Nationality Region	South Asia	19	9.30%
	UAE Citizenship	185	90.20%
	Africa	1	0.50%
English Proficiency Level	Very High	18	8.80%
	High	68	33.20%
	Moderate	116	56.60%
	Low	3	1.50%
Total Work Experience	Under 1 Year	8	3.90%
	2-5 Years	53	25.90%
	6-10 Years	62	30.20%
	11-15 Years	43	21%
	More than 15 years	39	19%
Area of Work in the Organization	Engineering	20	9.80%
	Science	9	4.40%
	Production	1	0.50%
	Information Technology (IT)	18	8.80%
	Marketing	5	2.40%
	Human Resources	46	22.40%
	Training and Development	9	4.40%
	Others	97	47.30%
Other Areas of Work in the Organization	Accounting	1	0.50%
	Administration	2	1%

Descriptive Statistics			
Demographics	Characteristics	Frequency	Percentage
	Airport		
	Immigration	5	2.40%
	Office		
	Aviation	1	0.50%
	Business	1	0.50%
	Administration		
	Client Relations	1	0.50%
	Manager		
	Commerce	2	1%
	Computer	1	0.50%
	Accounting		
	Computer		
	Information	1	0.50%
	Security		
	Computer		
	Information	1	0.50%
	System		
	Customer	7	3.40%
	Service		
	Endowment:		
	Islamic	2	1%
	Events	2	1%
	Excellence	1	0.50%
	Office		
	Finance	2	1%
	Front Office	1	0.50%
	Government		
	Regulation	7	3.40%
	Enforcement		
	Health	1	0.50%
	Administration		
	Legal	1	0.50%
	Compliance		
	Leader &		
	Preacher at the	6	2.90%
	Mosques		
	Management	5	2.40%
	Planning		
	Mass	5	2.40%
	Communication		

Descriptive Statistics			
Demographics	Characteristics	Frequency	Percentage
	Medical Personnel	1	1.00%
	Monitor & Inspection	4	2%
	Executive Director	1	0.50%
	Operation and Maintenance	1	0.50%
	Operations	6	2.90%
	Procurement & Contracts	1	0.50%
	Project Management	1	0.50%
	Public Community Service	9	4.40%
	Public Relations	1	0.50%
	Quality	4	2%
	Security Of Organization	1	0.50%
	Strategy & Planning	3	1.50%
	Support Service	5	2.40%
	Tourism	2	1%
Highest Education Qualification	Primary School	3	1.50%
	Secondary School	20	9.80%
	Bachelor's Degree	111	54.10%
	Master's Degree	41	20%
	PhD	6	2.90%
	Bachelor's Graduate With Diploma	20	9.80%
	Diploma	2	1%
	Trade/Technical Certification	2	1%

Descriptive Statistics			
Demographics	Characteristics	Frequency	Percentage
Total Time Employed by the Organization	Less than 1 Years	20	9.80%
	1-2 Years	16	7.80%
	3-5 Years	51	24.90%
	6-10 Years	66	32.20%
	11-20 Years	41	20%
	21 or more Years	11	5.40%
Skill Level in the Organization	Beginner	17	8.30%
	Junior	34	16.60%
	Intermediate	100	48.80%
	Senior	54	26.30%

As shown in the demographic table, the majority of the workers were based in the United Arab Emirates (UAE Citizenship), the areas in which the companies targeted by this dissertation operated. Most participants had at least moderate proficiency in English. This is because the UAE considers English as a second language, whereas Arabic is used as the official language of communication between companies. The variety of specializations and areas of work shown in the table indicates the variety of industries that were tested. Work specialties varied from engineering, business accounting, and information technology to aviation, where a high knowledge of English terminology is required. The demographic results show that most of the workers had a well-established level of experience in their area of work (between six to ten years). This also implies that the participants could relate their daily work to the TRIZ training.

Demographic analysis between the sample population for the study and the general population in the targeted companies helps to give a comparison for applying the results throughout the organizations. The demographic analysis for the general

population of the targeted UAE companies in 2018 is shown in Table 17. Figure 24 shows the employment-population of work for local and nonlocal UAE.

Table 17: General Population of the Targeted UAE Companies in 2018

UAE Population in 2018	
Total Population	9.54 Million (Based on WorldBank.ORG)
Age	From 25-54 (6.29 Million), Median Age is 33.5 years
Gender	72% Male (6.89 Million), 28% Female (2.65 Million)
Nationality Region	11.48 % Emirati, 26.93% All other Countries, 61.59 % South and East Asia
English Proficiency	The official language of the UAE is Arabic, and the population also uses Persian, English, Hindi, and Urdu.

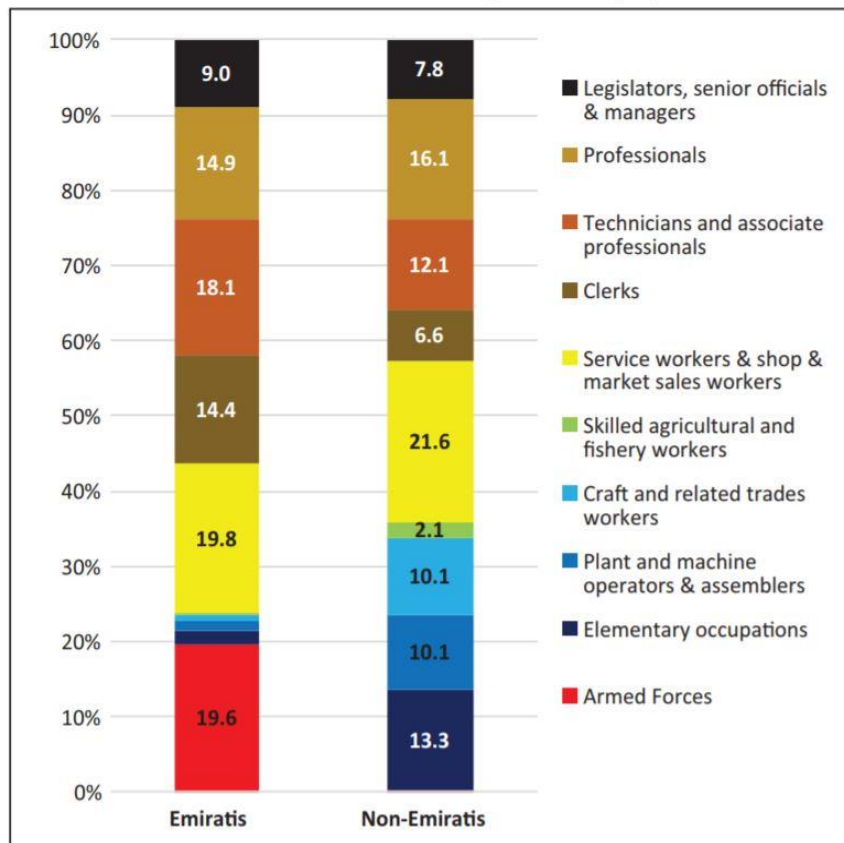


Figure 24: Employed Population by Nationality (Emirati/Non-Emirati) and Occupation Category (2009). [adopted from Gulf Labor Markets and Migration No. 7/2015]

Table 17 shows that the median age of the population of targeted companies - is 34 years, similar to that of the sample population which was frequently recorded between 26 to 35 (112 samples). The total locals in UAE are 11.48% of the whole UAE populations and percentages of male and female are similar to the sample size. It is also stated that the official language is Arabic and the population does use English as a second language, the sample shows high to modern English level which ties with general population statement. Figure 24 shows that most UAE locals works in technical, professional and service organizations, the sample shows that most of participants education background are in similar fields.

Reliability and Validity

Before the data can be used to make inferences regarding the study hypotheses, the reliability and validity of the data must be determined. The reliability is calculated as one minus the proportion of total observed variance due to random error (Kline, 2015). The reliability analyses for the Diversity Climate Survey, the Multi-Factor Leadership Questionnaire, Perception of Being Able to Apply TRIZ (TRIZ Feedback Survey) and the Community Innovation Survey showed acceptable Cronbach's alpha values greater than 0.7 for each instrument but not each construct. Individual consideration constructs in the MLQ, time consumption constructs in the TRIZ Feedback Survey, and group diversity levels in the Diversity Climate Survey all showed Cronbach's alpha values less than or equal to 0.7. The individual level of Diversity Climate had a very low Cronbach's alpha value of 0.284 indicating no reliability.

Table 18 focuses on the reliability analysis for the DCS instrument. The DCS measures workers' perceptions of being respected, being treated equally and their attitudes about diversity at the individual, the group and the organizational level. Furthermore, discrimination and conflict are measured for each level of diversity climate. Due to its low reliability, the variable of individual diversity was deleted from the hypothesis analysis. Group and organizational diversity showed acceptable Cronbach's values and therefore remained in the hypothesis analysis.

Table 18: Reliability Analysis for the Diversity Climate Survey

Category	Sub Category	Cronbach's Alpha	Reliability Analysis Based on Literature
Instrument	Diversity Climate Survey	0.795 > 0.7	Sparrow and Gaston (1996) gathered data from 93 organizations and 3030 individuals using the DCS
Variable 1	<i>Individual Diversity Climate</i>	0.284 < 0.7	-
Construct 1	Respect		
Construct 2	Equality		
Construct 3	Conflict		
Construct 4	Discrimination		
Construct 5	Feeling about Diversity		
Variable 2	<i>Group Diversity Climate</i>	0.647 < 0.7	0.855 > 0.7. A total of 5615 responses were collected (4072 students, 493 faculty, 924 staff, and 126 administration) (Worthington, 2008)
Construct 1	Respect		
Construct 2	Equality		
Construct 3	Conflict		
Construct 4	Discrimination		
Construct 5	Feeling about Diversity		
Variable 3	<i>Organizational Diversity Climate</i>	0.753 > 0.7	-
Construct 1	Respect		
Construct 2	Equality		

Category	Sub Category	Cronbach's Alpha	Reliability Analysis Based on Literature
Construct 3	Conflict		
Construct 4	Discrimination		
Construct 5	Feeling about Diversity		

The MLQ measures transformational leadership, transactional leadership, and laissez-faire leadership. Transformational leadership consists of idealized influence and behavior, inspirational motivation, intellectual stimulation, and individual consideration. The transactional leadership constructs are contingent reward, management by exception: passive and active. The reliability analysis showed an acceptable Cronbach's alpha for the MLQ instrument. The variables of transformational leadership, transactional leadership, and laissez-faire leadership satisfied the acceptable criteria of Cronbach's $\alpha \geq 0.7$; however, the individual construct under transformational leadership showed an alpha value ≤ 0.7 ($\alpha = 0.614$). The reliability analysis for MLQ is shown in Table 19 .

Table 19: Reliability Analysis for Multifactor Leadership Questionnaire

Category	Sub Category	Cronbach's alpha	Reliability Analysis Based on Literature
Instrument	Multi Factor Leadership Questionnaire (MLQ 5X)	0.880 > 0.7	MLQ 5X based from (Tejeda et al., 2001)
Variable 1	<i>Transformational Leadership</i>	0.903 > 0.7	-
Construct 1-A	Idealized Influence (attribute)	0.811 > 0.7	0.86 > 0.7
Construct 1-B	Idealized Influence (Behavior)		
Construct 2	Inspiration Motivation	0.752 > 0.7	0.90 > 0.7
Construct 3	Intellectual Stimulation	0.709 > 0.7	0.86 > 0.7
Construct 4	Individual Consideration	0.614 < 0.7	0.91 > 0.7
Variable 2	<i>Transactional Leadership</i>	0.829 > 0.7	-
Construct 1	Contingent Reward	0.72 > 0.7	0.87 > 0.7

Category	Sub Category	Cronbach's alpha	Reliability Analysis Based on Literature
Construct 2-A	Management by Exception (Passive)	0.841 > 0.7	0.82 > 0.7
Construct 2-B	Management by Exception (Active)		
Variable 3	<i>Laissez-Faire Leadership</i>	0.782 > 0.7	0.82 > 0.7

The TRIZ feedback measured the participant's perception of being able to apply the TRIZ methodology. The constructs measures were problem-solving, time consumed applying the methodology, systematic guidance, and degree to which the methodology was accepted by the participants (positive evaluation). The reliability analysis showed acceptable Cronbach's values for most of these constructs, with the exception of the time consumption construct, which showed an alpha value ≤ 0.7 ($\alpha = 0.604$). Table 20 shows the reliability analysis for the TRIZ feedback survey.

Table 20: Reliability Analysis for TRIZ Feedback Survey

Category	Sub Category	Cronbach's alpha	Reliability Analysis Based on Literature
Instrument	TRIZ Feedback Survey	0.903 > 0.7	Based from 12 graduate participants
Variable	<i>Perception of Being Able to Apply TRIZ</i>		
Construct 1	Problem Solving	0.843 > 0.7	-
Construct 2	Degree of Adoption	0.786 > 0.7	-
Construct 3	Time Consumption	0.604 < 0.7	-
Construct 4	Systematic Guidance	0.697 < 0.7	-
Construct 5	Degree of Acceptance	0.916 > 0.7	-

The Community Innovation Survey measures the variables of knowledge management practices and organizational change. Knowledge management practices consists of measuring the process, technology and people involved in sharing knowledge.

Organizational change involves changes in the knowledge management system, decision making, management structure, and public relationship. The reliability analysis showed Cronbach's alpha values >0.7 on the Community Innovation Survey for knowledge management practices and for organizational change. All the constructs for both knowledge management practices and organizational change had alpha values ≥ 0.7 as well. Table 21 shows the reliability of the CIS instrument.

Table 21: Reliability Analysis for the Community Innovation Survey

Category	Survey	Cronbach's alpha	Reliability Analysis Based on Literature
Instrument	Community Innovation Survey (CIS4)	0.904 > 0.7	-
Variable 1	<i>Knowledge Management Practices</i>	0.857 > 0.7	-
Construct 1	Knowledge		
Construct 2	People		
Construct 3	Process		
Construct 4	Technology		
Variable 2	<i>Organizational Change</i>	0.901 > 0.7	-
Construct 1	Knowledge Management System		
Construct 2	Decision Making		
Construct 3	Management Structure		
Construct 4	Public Relationship		

Structural Equation Model

A Structural Equation Model (SEM) is summarized as: "a hybrid of factor analysis and path analysis" (Weston & Gore Jr, 2006, p. 720) which allows the researcher to build, test and confirm models of complex relationships. SEM's goal is to provide a brief summary of the interrelationships among variables (Kahn, 2006). Kahn further

states that SEM is a confirmatory approach to data analysis that requires a prior assignment of the inter-variable relationship. It tests a hypothesized model statistically to determine the extent to which the proposed model is consistent with the sample data (Wisner, 2003). SEM provides an assignment of predictive validity, specifies the direct and indirect relations among the latent variables, and describes the amount of explained and unexplained variance in the model (Byrne, 2013; Lomax & Schumacker, 2004).

A two-step building approach was used in this analysis, by which the required measurement models were tested prior to testing the structural model. Jöreskog and Sörbom (1993, p. 113) made the point that “the testing of the structural model, i.e., the testing of the initially specified theory, may be meaningless unless it is first established that the measurement model holds.” The advantage of the two-step approach over a one-step approach is that problems associated with a one-step approach, such as interpretational confounding and misspecification, can be more easily detected. However, it is important to state that two-step approaches are not independent because the estimated paths that link the indicators to latent variables are involved in computing the structural path estimates (Hair, Black, Anderson, & Tatham, 1998). The two-step approach and the concept of separating the measurement models and the structural model are now accepted and have become the foundation of other extended methods, like the four-step modeling approach, the five-stage approach, and the six-stage approach. The decision of which approach to use is largely based upon personal preference, with no clear indication in the literature for the preference of one approach over another (Gallagher, Ting, & Palmer, 2008).

This study used the two-step approach. First, confirmatory factor analysis was used to test the data and the underlying construct. Once a satisfactory measurement model was obtained, the theoretical relationship could then be tested using SEM.

Confirmatory Factor Analysis

Confirmatory Factor Analysis (CFA) is a technique that is used to test if the data fit the hypothesized model and its underlying construct. This approach helps researchers to show if the factor loading for each of the indicators fits under the respective construct. It also serves to separate the instruments of the Structural Equation Model to confirm that they fit within it (Thompson, 2004). This approach was suggested by Anderson and Gerbing (1988) when they questioned the one-step approach which estimates the measurement and structural component of the Structural Equation Model (SEM) in a single analysis. They stated that there is no prior specification of the number of factors and proposed the separation of the measurement and relationship estimates. In the first phase, the analysis starts by examining the measurement model using CFA, allowing the factors to inter-correlate freely. Once a satisfactory measurement model is obtained, the theoretical relationship structure is then tested (Gallagher et al., 2008).

CFA consists of different indices which measure the Goodness of Fit (GOF) in the model. One of the important factors to consider is the sample size because it has a large impact on achieving statistical significance. Some common fit indices are the Normed Fit Index (NFI), Non-Normed Fit Index (NNFI), also known as Tucker Lewis Index -, (TLI), Incremental Fit Index (IFI), Comparative Fit Index (CFI), and Root Means Square Error of Approximation (RMSEA).

The CFA analysis was developed for each instrument to test how well the measured variables represent the latent constructs since each instrument has a specific number of constructs and indicators. The Maximum Likelihood Estimation Method was used as it has a desirable asymptotic property (minimum variance and unbiasedness) and it is scale-free. It also assumes multivariate normality of the observed variables (Glaser, 2008). Researchers have specified comparisons between model fits a model has a low fit index. These comparisons are summarized by Zhang (2014) and shown in Table 22:

Table 22: Detailed Model Fit Indices [Adopted from (Zhang, 2014)]

Fit Index	Shorthand	General Rule for Acceptable Fit
Chi-Square	χ^2	p-values: ≥ 0.05 (Bagozzi and Yi, 2012) p-values: significance expected (Hair et al., 2010)* p-values: 0.05~ 1.00 for Good Fit; 0.01 ~ 0.05 for acceptable fit (Schermelleh-Engel et al., 2003)
Relative Chi-Square	χ^2 / df	≤ 2 or 3 (Schreiber et al., 2006) 0 ~ 2 for Good Fit; 2 ~ 3 for acceptable fit (Schermelleh-Engel et al., 2003)
Standardized Root Mean Square Residual	SRMR	≤ 0.07 (Bagozzi and Yi, 2012) < 0.09 with CFI > 0.92 (Hair et al., 2010)* ≤ 0.08 (Hu and Bentler, 1999; Schreiber et al., 2006) 0 ~ 0.05 for good fit; 0.05 ~ 0.10 for acceptable fit (Schermelleh-Engel et al., 2003)
Root Mean Square Error of Approximation	RMSEA	≤ 0.07 with SRMR ≤ 0.07 (Bagozzi and Yi, 2012) < 0.08 with CFI > 0.92 (Hair et al., 2010)* ≤ 0.06 (Hu and Bentler, 1999); < 0.06 ~ 0.08 with confidence interval (Schreiber et al., 2006) 0 ~ 0.05 for good fit; 0.05 ~ 0.08 for acceptable fit (Schermelleh-Engel et al., 2003)
Comparative Fit Index	CFI	≥ 0.93 with SRMR ≤ 0.07 (Bagozzi and Yi, 2012) > 0.92 (Hair et al., 2010)* ≥ 0.95 (Hu and Bentler, 1999; Schreiber et al., 2006) 0.97 ~ 1.00 for Good Fit; 0.95 ~ 0.97 for Acceptable Fit (Schermelleh-Engel et al., 2003)

To ensure model identification, there must be a separation between each measurement model and the structural model. If each measurement model is identified independently, then the structure model is identified (Maruyama, 1997). Models are defined using exogenous and endogenous variables: exogenous variables are types of latent variables that act as predictors to other latent variables, but were not predicted by any other variables; endogenous variables are types of latent variables that are predicted by other variables and are an outcome of those variables (Gallagher et al., 2008). The arrow from the factor to the variables represent linear coefficient or factor loading while

the double arrows represent covariance between latent variables or error terms. Each instrument proposed was tested using CFA indices. An analysis for each construct and each model is developed. The analyses show that each instrument fits its underlying constructs. CFA goodness-of-fit results show that all constructs for the Multifactor Leadership Questionnaire, the Diversity Climate Survey and the Community Innovation Survey instruments are valid. For the perception of being able to apply TRIZ instrument, the constructs of degree of adoption, time consumption, and systematic guidance are not available for chi-square and standardized root square residual. This is due that construct with less than four indicator shows no chi-square results (refer to CFA analysis table). To address this concern, the three constructs were correlated together and showed satisfactory results. Furthermore, the three constructs show validation when combined with the remain constructs in the TRIZ feedback instrument.

The result of the CFA for the Multifactor Leadership instrument shows that transformational, transactional and laissez-faire leadership indicators had factors that are mostly ≤ 0.7 standardized factor loading. The transformational leadership indicators of Idealized influence 2 (Q18) and Individual consideration (attribute 2 Q19 and attribute3 Q29) show lower factor loading than 0.7. The CFA model for transformational leadership is shown in Figure 25. transactional leadership and laissez-faire results show that all indicators are mostly equal to 0.7 standardized factor loading. The CFA model for transactional and laissez-faire are shown in Figure 26 and Figure 27 respectively.

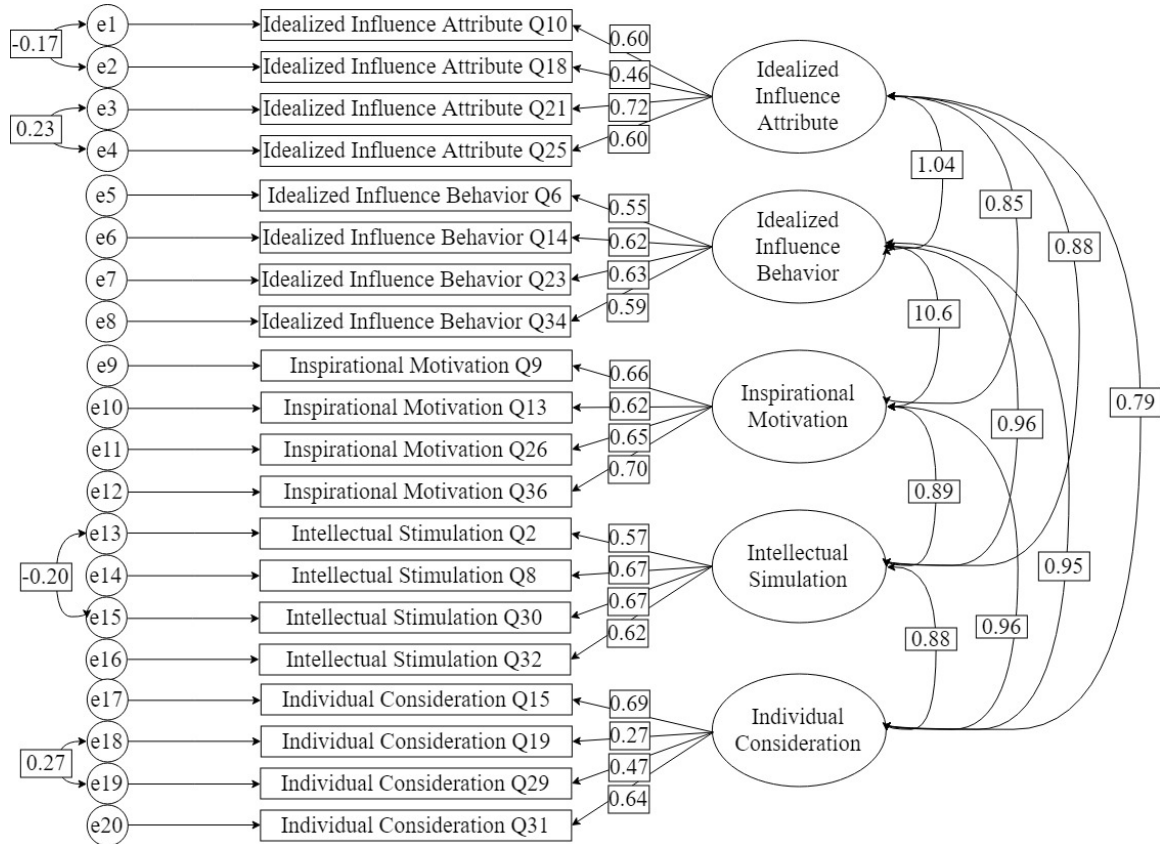


Figure 25: CFA Model for Transformational Leadership

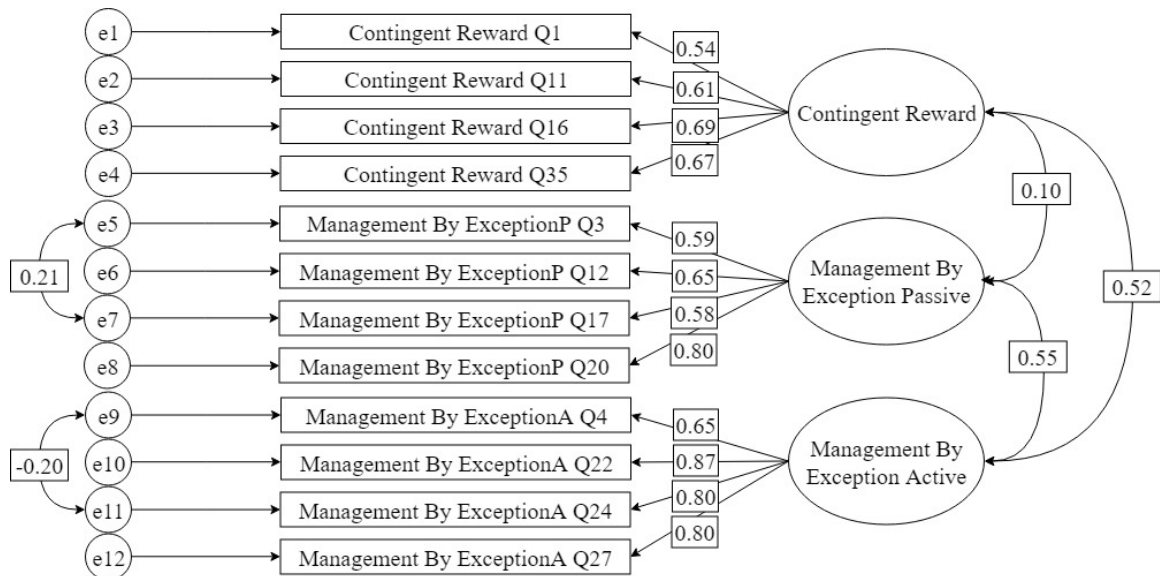


Figure 26: CFA Model for Transactional Leadership

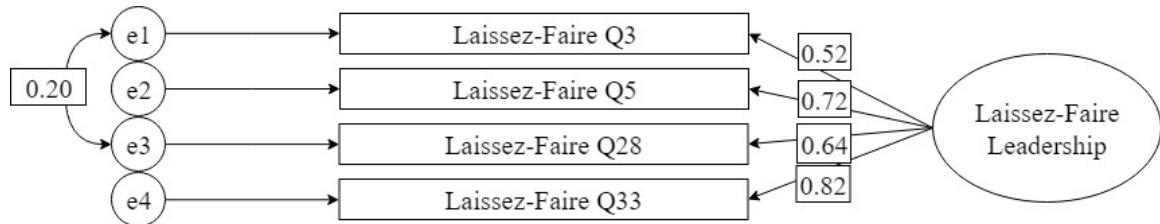


Figure 27: CFA Model for Laissez-Faire Leadership

The Community Innovation Survey instrument for knowledge management practices and organizational change shows that most indicators satisfy 0.7 standardized factor loading. Figure 28 shows CFA model for knowledge management practices and Figure 29 shows the model for organizational change.

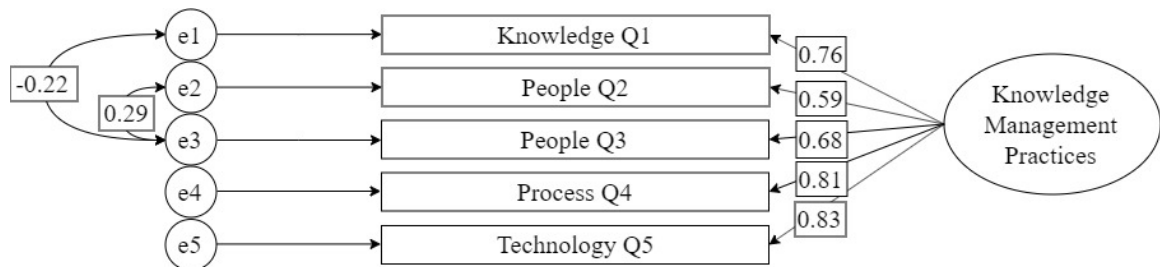


Figure 28: CFA Model for Knowledge Management Practices

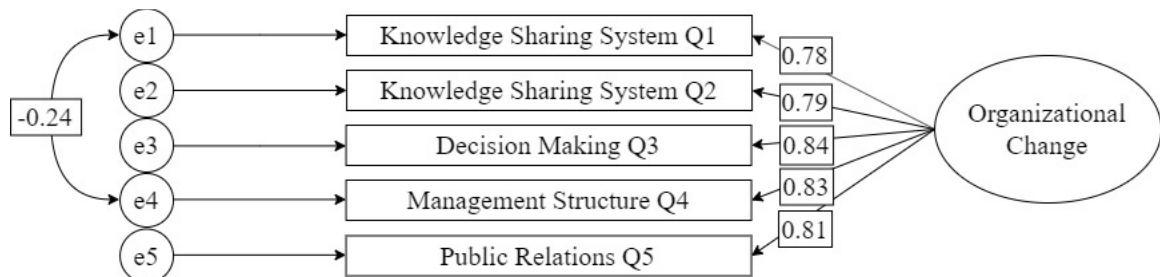


Figure 29: CFA Model for Organizational Change

The CFA results for the Diversity Climate Survey show that conflict constructs at the individual, group and organizational level are ≤ 0.7 standardized factor loading. On the other hand, the construct under diversity climate showed a satisfactory for the group and organizational level (> 0.7). However, the individual level did not satisfy the

reliability analysis nor the CFA factor loading, which further demonstrates the need to remove the individual level of diversity climate from the Structural Equation Model.

Figure 30 shows the CFA model for Individual, Group and Organizational Diversity Climate.

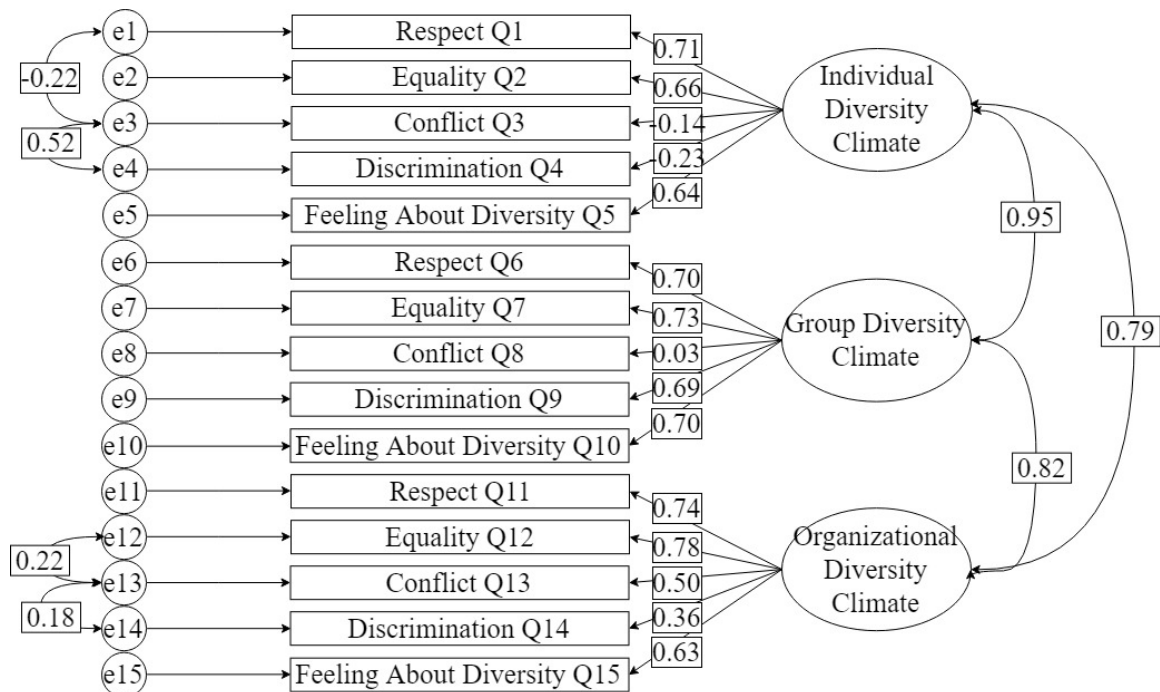


Figure 30: CFA Analysis for Individual, Group and Organizational Diversity Climate

The factor loading for the TRIZ Feedback Survey instrument shows that most of the indicators satisfy a minimum value of 0.7. Time Consumption 1 and 2 (Q10 and Q11) show less than 0.7 values, indicating that they can be removed from the Structural Equation Model. Figure 31 shows the CFA model for the perception of being able to apply TRIZ.

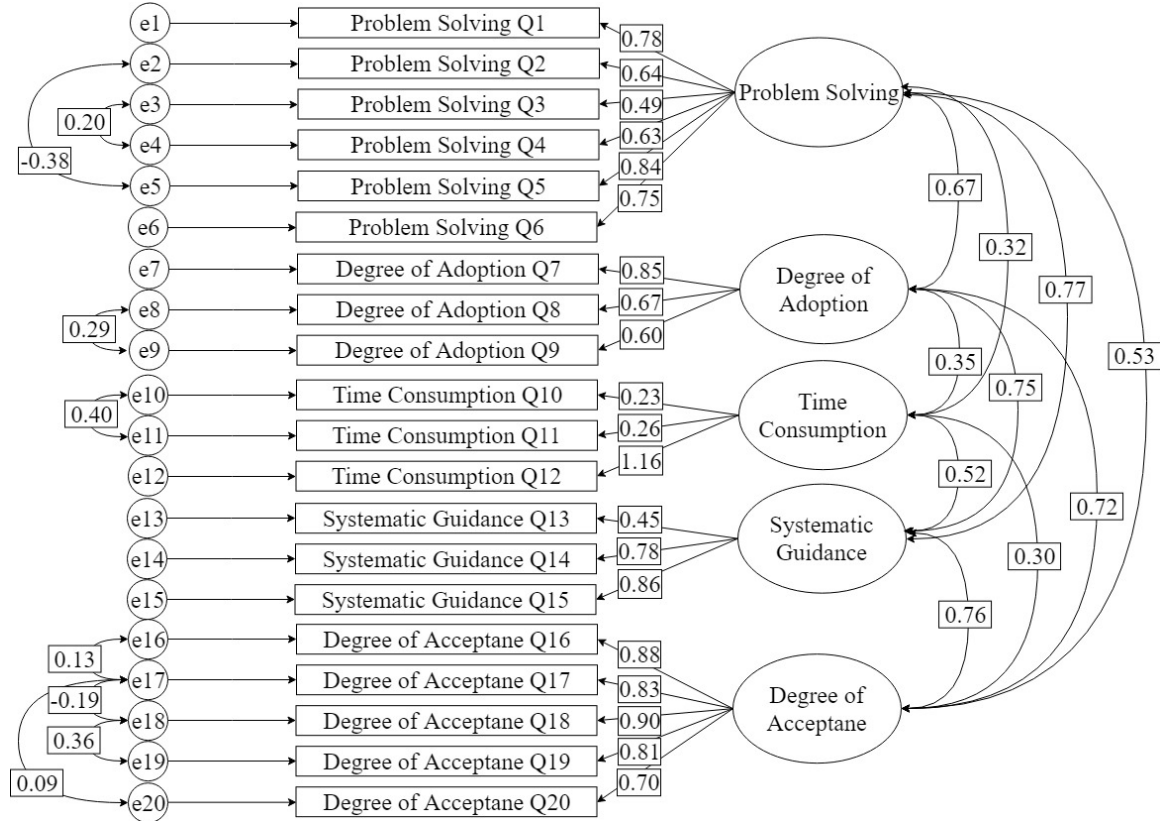


Figure 31: CFA Model for Perception of Being Able to Apply TRIZ

A Modified Indices test was run for each instrument and construct to measure if the instrument fits its underlying constructs and indicators. Table 23 shows the full analysis for each instrument and construct. Based on the analysis comparison proposed by Zhang (2014) the instruments were compared as follows:

- Chi-square should be as low as possible (χ^2 Low)
- P-value should be greater than 0.05 ($P > 0.05$).
- Root mean square residual should be less than 0.08 ($RMR < 0.08$).
- The goodness of fit test, adjusted goodness of fit and comparative fit index should be higher than 0.95 for acceptable fit (GFI, AGFI, and CFI > 0.95).
- Tucker-Lewis index should be greater than 0.05 ($P-CLOSE > 0.05$)

- Root mean square error approximation should be less than 0.05 ($RMSEA < 0.05$).

The model-fit analysis showed that most of the constructs meet the thresholds defined in the fit indices recommended in the research literature. Moreover, all targeted instruments show acceptable scores. Some of the constructs showed insignificant P-value scores because of the high chi-square score, which was due to the sample size. Nevertheless, these constructs show highly acceptable values for the remaining indices (RMR, GFI, AGFI, CFI, P-Close, and RMSEA). Thus, CFA confirmed that these constructs should be accepted for the Structural Equation Modeling.

Table 23: Detailed Model Fit Analysis for Each Construct and for Instrument

Model Fit	Chi-square χ^2	P-Value	Root Mean Square Residual	Goodness of Fit Index	Adjusted Goodness of Fit Index	Comparative Fit Index	Tucker Lewis Index	Root Mean Square Error Of Approximation	Cronbach's Alpha
Group Diversity Climate	3.464	0.483	0.028	0.993	0.974	1	0.701	0	0.647 < 0.7
Organizational Diversity Climate	7.105	0.13	0.04	0.986	0.947	0.987	0.323	0.062	0.753 > 0.7
Diversity Climate Survey	69.376	0.023	0.044	0.946	0.913	0.976	0.566	0.047	0.795 > 0.7
Idealized Influence Attribute	3.838	0.147	0.021	0.99	0.951	0.988	0.287	0.067	0.811 > 0.7
Idealized Influence Behavior	1.483	0.476	0.011	0.996	0.982	1	0.63	0	0.811 > 0.7
Inspirational Motivation	1.468	0.734	0.008	0.997	0.983	1	0.633	0	0.752 > 0.7
Intellectual Stimulation	2.421	0.298	0.012	0.994	0.97	0.997	0.464	0.032	0.709 > 0.7
Individual Consideration	1.769	0.184	0.017	0.996	0.957	0.992	0.29	0.061	0.614 < 0.7

Model Fit	Chi-square χ^2	P-Value	Root Mean Square Residual	Goodness of Fit Index	Adjusted Goodness of Fit Index	Comparative Fit Index	Tucker Lewis Index	Root Mean Square Error Of Approximation	Cronbach's Alpha
Transformational Leadership	132.2	0.073	0.023	0.938	0.904	0.984	0.954	0.031	0.903 > 0.7
Contingency reward	1.075	0.584	0.01	0.997	0.987	1	0.718	0	0.72 > 0.7
Management by Exception Passive	5.728	0.057	0.05	0.986	0.928	0.982	0.148	0.096	0.841 > 0.7
Management by Exception Active	3.514	0.173	0.039	0.992	0.959	0.996	0.321	0.061	0.841 > 0.7
Transactional Leadership	69.454	0.029	0.069	0.948	0.917	0.975	0.606	0.045	0.829 > 0.7
Laissez Faire Leadership	2.176	0.14	0.025	0.995	0.947	0.995	0.238	0.076	0.782 > 0.7
Knowledge Management Practices	1.627	0.653	0.009	0.997	0.984	1	0.799	0	0.857 > 0.7
Problem Solving	6.684	0.463	0.015	0.99	0.696	1	0.784	0	0.843 > 0.7
Degree of Adoption	None	None	0	1	None	1	0	0.534	0.786 > 0.7

Model Fit	Chi-square χ^2	P-Value	Root Mean Square Residual	Goodness of Fit Index	Adjusted Goodness of Fit Index	Comparative Fit Index	Tucker Lewis Index	Root Mean Square Error Of Approximation	Cronbach's Alpha
Time Consumption	None	None	0	1	None	1	0	0.323	0.604 < 0.7
Systematic Guidance	None	None	0	1	None	1	0	0.501	0.697 < 0.7
Degree of Adoption, Time Consumption, and Systematic Guidance Correlated	23.365	0.177	0.039	0.976	0.941	0.991	0.644	0.038	0.76 > 0.7
Degree of Acceptance	1.713	0.634	0.005	0.997	0.983	1	0.786	0	0.916 > 0.7
Perception of Being Able to Apply TRIZ (TRIZ Feedback Survey)	135.28	0.003	0.045	0.93	0.886	0.98	0.619	0.046	0.903 > 0.7
Organizational Change	4.125	0.389	0.012	0.992	0.0971	1	0.622	0.012	0.901 > 0.7

The Confirmatory Factor Analysis shows that almost every construct satisfies the criteria required to be included in the Structural Equation Model. This is also true for each instrument. However, the highlighted constructs (time consumption, degree of adoption and systematic guidance) in the CFA analysis did not show the required values in the analysis. Based on an observation made by Hair et al., (1998) latent variables with only three indicators may show CFA values with a higher sample size ($N > 300$). To address this situation, another CFA was run that combined these three constructs. The combination occurred by establishing a correlation between an indicator of one of the constructs with an indicator of a different construct. The results of the three combined constructs showed an acceptable value of fitting for the indices. The relationship of the three combined constructs was placed under to the Perception of Being Able to Use TRIZ instrument. The final result of the analysis indicated that the indices for each (of these three) construct(s) fit the TRIZ Feedback instrument. Therefore, based on the reliability analysis and CFA, the constructs of time consumption, degree of adoption and systematic guidance will be included, in combination and under the TRIZ Feedback Survey Instrument, and are considered in the Perception of Being Able to Apply TRIZ variable in the Structural Equation Model.

Structural Equation Model Analysis

After satisfying the validity and reliability of the CFA, the final stage of the SEM approach was assessing the proposed model. This involved converting CFA into a structural model, adding an error term to the endogenous (dependent) variables, and assessing the model using Goodness of Fit (GOF) indices. The first thing to check was

the statistical significance of the regression weight to test the significance of the proposed hypothesis. The second thing to check was the standardized regression weight for the constructs to show the strength of the relationship between the endogenous (dependent) and exogenous (independent) variables. The last thing to check was the assessment of Squared Multiple Correlations (R^2), which explains the amount of variance in the endogenous (dependent) variables. Table 24 shows the regression analysis.

Table 24: Regression Analysis of the SEM Model, (* P-Value <0.1, ** P-Value <0.05, *** P-Value <0.01)

Regression Analysis						
			Standardized Estimate	S.E.	C.R.	P
Knowledge Management Practices	←	Transactional Leadership	-0.181	0.077	-1.727	0.084*
Knowledge Management Practices	←	Transformational Leadership	0.112	0.147	1.34	0.18
Knowledge Management Practices	←	Group Diversity Climate	0.298	0.186	1.812	0.07*
Knowledge Management Practices	←	Organizational Diversity Climate	0.226	0.161	1.436	0.151
Knowledge Management Practices	←	Laissez Faire Leadership	0.219	0.099	1.945	0.052*
Perception Of Being Able to Apply TRIZ	←	Transactional Leadership	0.071	0.054	0.687	0.492
Perception Of Being Able to Apply TRIZ	←	Laissez Faire Leadership	-0.129	0.068	-1.188	0.235
Perception Of Being Able to Apply TRIZ	←	Organizational Diversity Climate	0.07	0.078	1.755	0.079*

Regression Analysis						
			Standardized Estimate	S.E.	C.R.	P
Perception Of Being Able to Apply TRIZ	←	Group Diversity Climate	0.301	0.131	1.863	0.062*
Perception Of Being Able to Apply TRIZ	←	Knowledge Management Practices	0.082	0.065	1.889	0.059*
Perception Of Being Able to Apply TRIZ	←	Transformational Leadership	0.252	0.11	2.9	0.004***
Perception Of Being Able to Apply TRIZ	←	Organizational Change	0.276	0.074	2.667	0.008***

The result of the regression analysis showed that eight of the twelve relationships between the instruments were found significant at a 90% confidence level. The four remaining relationships, between transformational leadership and knowledge sharing, transactional leadership, and perception of being able to Apply TRIZ, laissez-faire leadership, and perception of being able to Apply TRIZ, and organizational diversity climate and knowledge management practices, were found to be unsupported in the SEM regression analysis. The remaining four unsupported relationships were further investigated using correlation analysis which can fill the areas of SEM that did not show clear findings. Table 25 shows the standardized regression weight for each indicator.

Table 25: Standardized Regression Weight for Each Indicator

Standardized Regression Weights			
			Estimate
TransformIIAQ25	<---	IdealizedInfluenceAttribute	0.554
TransformIIAQ21	<---	IdealizedInfluenceAttribute	0.67
TransformIIAQ18	<---	IdealizedInfluenceAttribute	0.36
TransformIIAQ10	<---	IdealizedInfluenceAttribute	0.573
TransformIIBQ34	<---	IdealizedInfluenceBehavior	0.618

Standardized Regression Weights			
			Estimate
TransformIIBQ23	<---	IdealizedInfluenceBehavior	0.659
TransformIIBQ14	<---	IdealizedInfluenceBehavior	0.657
TransformIIBQ6	<---	IdealizedInfluenceBehavior	0.559
TransformIMQ36	<---	InspirationalMotivation	0.707
TransformIMQ26	<---	InspirationalMotivation	0.644
TransformIMQ13	<---	InspirationalMotivation	0.611
TransformIMQ9	<---	InspirationalMotivation	0.638
TransformISQ32	<---	IntellectualStimulation	0.592
TransformISQ30	<---	IntellectualStimulation	0.622
TransformISQ8	<---	IntellectualStimulation	0.637
TransformISQ2	<---	IntellectualStimulation	0.534
TransformICQ31	<---	IndividualConsideration	0.608
TransformICQ29	<---	IndividualConsideration	0.451
TransformICQ19	<---	IndividualConsideration	0.253
TransformICQ15	<---	IndividualConsideration	0.64
TranscationalCRQ1	<---	ContingentReward	0.226
TranscationalCRQ11	<---	ContingentReward	0.293
TranscationalCRQ16	<---	ContingentReward	0.366
TranscationalCRQ35	<---	ContingentReward	0.404
TranscationalMEPQ3	<---	ManagementByExceptionPassive	0.351
TranscationalMEPQ12	<---	ManagementByExceptionPassive	0.404
TranscationalMEPQ17	<---	ManagementByExceptionPassive	0.385
TranscationalMEPQ20	<---	ManagementByExceptionPassive	0.44
TranscationalMEAQ4	<---	ManagementByExceptionActive	0.645
TranscationalMEAQ22	<---	ManagementByExceptionActive	0.846
TranscationalMEAQ24	<---	ManagementByExceptionActive	0.82
TranscationalMEAQ27	<---	ManagementByExceptionActive	0.802
LFLeadershipQ5	<---	LaissezFaireLeadership	0.561
LFLeadershipQ7	<---	LaissezFaireLeadership	0.7
LFLeadershipQ28	<---	LaissezFaireLeadership	0.664
LFLeadershipQ33	<---	LaissezFaireLeadership	0.812
GroupDiverQ5	<---	GroupDiversityClimate	0.713
GroupDiverQ4	<---	GroupDiversityClimate	0.698
GroupDiverQ3	<---	GroupDiversityClimate	0.036
GroupDiverQ2	<---	GroupDiversityClimate	0.719
GroupDiverQ1	<---	GroupDiversityClimate	0.687
OrganizationDiverQ5	<---	OrganizationalDiversityClimate	0.642
OrganizationDiverQ4	<---	OrganizationalDiversityClimate	0.475
OrganizationDiverQ3	<---	OrganizationalDiversityClimate	0.524
OrganizationDiverQ2	<---	OrganizationalDiversityClimate	0.8
OrganizationDiverQ1	<---	OrganizationalDiversityClimate	0.724

Standardized Regression Weights			
			Estimate
KnowldgeQ1	<---	KnowledgeManagementPractices	0.754
KnowldgeQ2	<---	KnowledgeManagementPractices	0.625
KnowldgeQ3	<---	KnowledgeManagementPractices	0.678
KnowldgeQ4	<---	KnowledgeManagementPractices	0.801
KnowldgeQ5	<---	KnowledgeManagementPractices	0.835
PersTRIZQ1	<---	ProblemSolving	0.622
PersTRIZQ2	<---	ProblemSolving	0.644
PersTRIZQ3	<---	ProblemSolving	0.354
PersTRIZQ4	<---	ProblemSolving	0.463
PersTRIZQ5	<---	ProblemSolving	0.571
PersTRIZQ6	<---	ProblemSolving	0.537
PersTRIZQ7	<---	DegreeOfAdoption	0.671
PersTRIZQ8	<---	DegreeOfAdoption	0.494
PersTRIZQ9	<---	DegreeOfAdoption	0.436
PersTRIZQ10	<---	TimeConsumption	0.179
PersTRIZQ11	<---	TimeConsumption	0.071
PersTRIZQ12	<---	TimeConsumption	0.52
PersTRIZQ13	<---	SystematicGuidance	0.83
PersTRIZQ14	<---	SystematicGuidance	0.785
PersTRIZQ15	<---	SystematicGuidance	0.416
PersTRIZQ16	<---	DegreeOfAcceptance	0.689
PersTRIZQ17	<---	DegreeOfAcceptance	0.606
PersTRIZQ18	<---	DegreeOfAcceptance	0.671
PersTRIZQ19	<---	DegreeOfAcceptance	0.693
PersTRIZQ20	<---	DegreeOfAcceptance	0.631
OrganizationalQ1	<---	OrganizationalChange	0.819
OrganizationalQ2	<---	OrganizationalChange	0.762
OrganizationalQ3	<---	OrganizationalChange	0.799
OrganizationalQ4	<---	OrganizationalChange	0.807
OrganizationalQ5	<---	OrganizationalChange	0.841

The result of the standardized regression weight analysis indicated that most of the indicators under the multifactor leadership questionnaire, the TRIZ Feedback Survey and the Community Innovation Survey show high factor loading, which validates the SEM model between instruments. Under the Diversity Climate Survey, the indicators at the individual level of diversity climate showed low factor loading while the remaining

indicators were higher than 0.7. Based on the reliability analysis of the instrument, individual diversity climate was deleted from the SEM and hypothesis analysis. Table 26 shows the covariance's estimates between the error terms of each indicator.

Table 26: Covariance Estimates for the SEM Model

Covariance estimates			
			Estimate
TransformationalLeadership	<-->	TransactionalLeadership	0.22
LaissezFaireLeadership	<-->	TransformationalLeadership	-0.133
LaissezFaireLeadership	<-->	TranscationalLeadership	0.56
GroupDiversityClimate	<-->	OrganizationalDiversityClimate	0.78
e84	<-->	e83	-0.757
e84	<-->	e57	0.221
e75	<-->	e77	0.654
e74	<-->	e75	0.699
e67	<-->	e68	0.427
e65	<-->	e66	0.454
e62	<-->	e63	0.45
e58	<-->	e62	0.479
e38	<-->	e39	0.528
e53	<-->	e54	0.251
e53	<-->	e56	-0.133
e78	<-->	e81	-0.352
e71	<-->	e72	-0.017
e76	<-->	e77	0.555
e74	<-->	e77	0.553
e60	<-->	e61	0.241
e1	<-->	e2	0.289
e2	<-->	e3	0.224
e5	<-->	e7	-0.213
e18	<-->	e19	0.282
e48	<-->	e51	-0.199
e52	<-->	e54	-0.197
e75	<-->	e76	0.413
e25	<-->	e26	0.29
e25	<-->	e27	0.402
e25	<-->	e28	0.388
e26	<-->	e27	0.295
e26	<-->	e28	0.441
e29	<-->	e31	-0.231

Covariance estimates			
			Estimate
e21	<-->	e22	0.345
e21	<-->	e23	0.342
e21	<-->	e24	0.268
e22	<-->	e23	0.346
e22	<-->	e24	0.322
e23	<-->	e24	0.346
e27	<-->	e28	0.346
e33	<-->	e35	0.156
e37	<-->	e40	-0.002
e58	<-->	e61	0.269
e58	<-->	e63	0.273
e59	<-->	e63	0.175
e60	<-->	e63	0.182
e61	<-->	e63	0.286
e64	<-->	e65	0.351
e64	<-->	e66	0.315
e68	<-->	e69	0.305
e74	<-->	e76	0.398
e78	<-->	e82	-0.339
e61	<-->	e62	0.311
e67	<-->	e69	0.213

Although the model-fit indices showed that most of the indicators do not satisfy the requirements suggested by Zhang's Indices, the results still showed an acceptable fit for Root Mean Square of Approximation with a value of 0.06 which was shown to be acceptable by Zhang (2014). Table 27 Shows Structure Equation Model.

Table 27: Model Fit Indices for the SEM

Chi-square χ^2 Low	4812
Degree of Freedom	2717
P-Value >0.05	0
Root Mean Square Residual (RMR < 0.08)	0.118
Goodness of Fit Index (GFI)	0.628
Adjusted Goodness Of Fit Index (AGFI)	0.60
Comparative Fit Index (CFI >0.95)	0.75
Tucker-Lewis Index (PCLOSE >0.05)	0
Root Mean Square Error Of Approximation (RMSEA < 0.08)	0.06

The SEM analysis showed that all variables are significant between knowledge management practices, group and organizational diversity climate, organizational change and perceptions of being able to apply TRIZ. Reliability Analysis, CFA and modified indices tests between variables shows that the overall structural equation model to be satisfactory. Figure 32 shows the overall SEM analysis. The results of the SEM were further supported using correlation analysis. Appendix E shows the structural model in more detail.

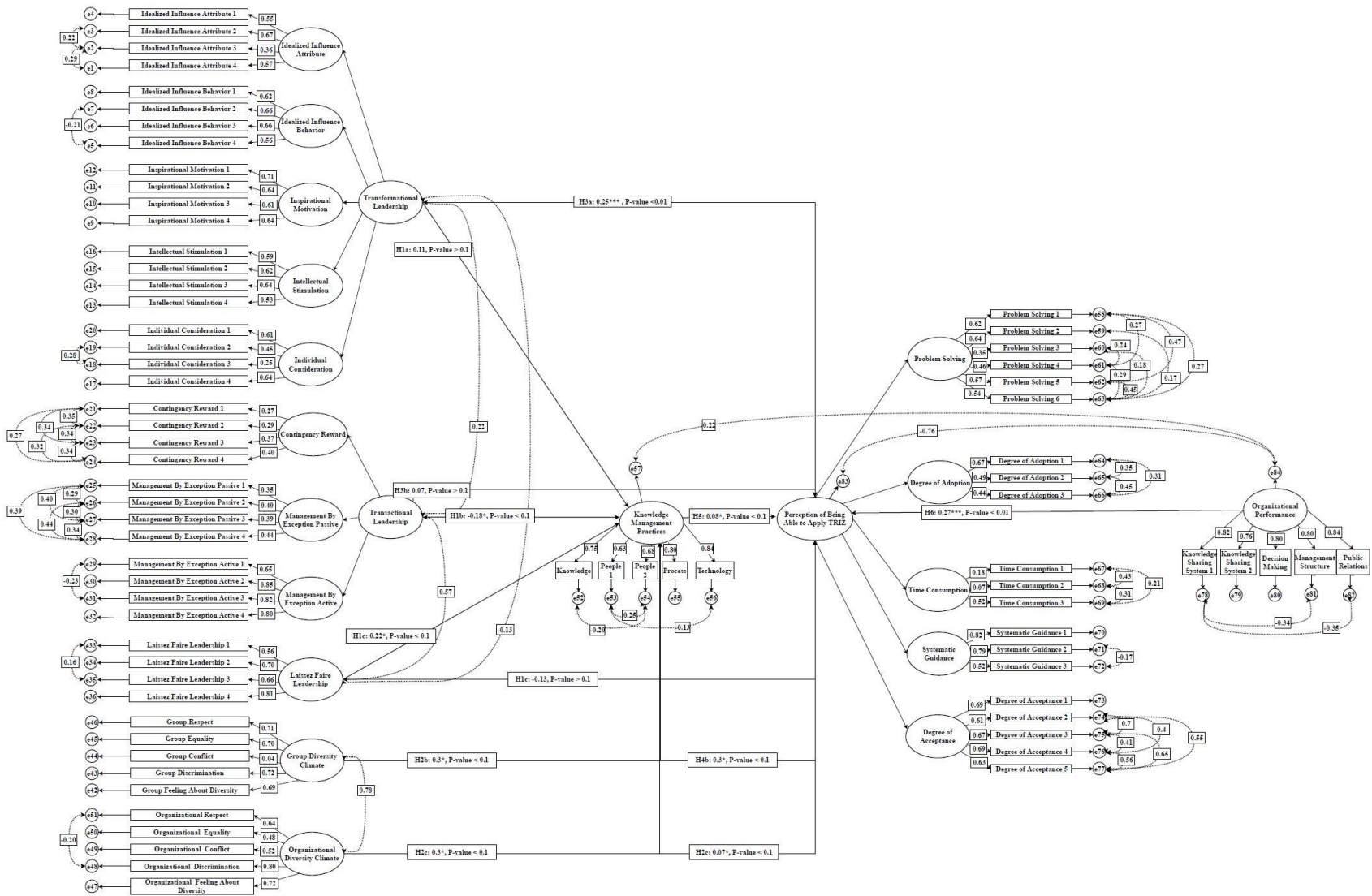


Figure 32: Structural Equation Model Analysis

Correlation Analysis

While the SEM analysis showed a significant relationship between most of the variables, four relationships did not meet the threshold. To further study the relationship between these variables (the four relationships that did not meet the threshold) the correlation analysis was compared between the instruments to show the effect of each indicator within the constructs. The purpose of this analysis was to measure the closeness of the linear relationship between the variables in the proposed instruments. The correlation coefficient indicates how closely the data fit a linear pattern for an existing relationship between the instruments (Taylor, 1990). Although correlation analysis does not measure the strength of a nonlinear relationship, it can help in showing if any outliers are formed between the relationships (Kuzma & Bohnenblust, 1992). The distribution of the data in the correlation analysis was tested and found to be valid for the required assumption of being considered as a multivariate normal distribution. The linear relationship is considered as follows: a survey scale item (indicator) acts as a continuous measurement for independent and dependent variables. This was demonstrated by Nimon (2012) who provided a summarized table for statistical assumption associated with substantive analysis across the general linear model. Table 28 shows that the correlations between variables must be continuous for independent and dependent variables:

Table 28: Statistical Analysis Linear Assumptions [Adopted from (Nimon, 2012)]

Statistical analysis ^a	Independence	Measurement Level of variable(s) ^b		Normality	Linearity	Variance
		Dependent	Independent			
CHI-SQUARE						
Single sample	Independent observations	Nominal+	N/A			
2+ samples	Independent observations	Nominal+	Nominal+			
T-TEST						
Single sample	Independent observations	Continuous	N/A	Univariate		
Dependent sample	Independent paired observations	Continuous	N/A	Univariate		
Independent sample	Independent observations	Continuous	Dichotomous	Univariate		Homogeneity of variance
OVA-RELATED TESTS						
ANOVA	Independent observations	Continuous	Nominal	Univariate		Homogeneity of variance
ANCOVA ^c	Independent observations	Continuous	Nominal	Univariate	✓	Homogeneity of variance
RM ANOVA	Independent repeated observations	Continuous	Nominal (opt.)	Multivariate	✓	Sphericity
MANOVA	Independent observations	Continuous	Nominal	Multivariate	✓	Homogeneity of covariance matrix
MANCOVA ^c	Independent observations	Continuous	Nominal	Multivariate	✓	Homogeneity of covariance matrix
REGRESSION						
Simple linear	Independent observations	Continuous	Continuous	Bivariate	✓	
Multiple linear	Independent observations	Continuous	Continuous	Multivariate	✓	Homoscedasticity
Canonical correlation	Independent observations	Continuous	Continuous	Multivariate	✓	Homoscedasticity

^aAcross all analyses, data are assumed to be randomly sampled from the population. ^bData are assumed to be reliable. ^cANCOVA and MANCOVA also assumes homogeneity of regression and continuous covariate(s). Continuous refers to data that may be dichotomous, ordinal, interval, or ratio (cf. Tabachnick and Fidell, 2001).

The correlations were analyzed using three different types of coefficients:

Pearson, Kendall's tau-b and Spearman. Pearson estimates are the most widely-used correlation statistic for measuring the degree of the relationship between linearly related variables, while Kendall's tau-b and Spearman are non-parametric tests used to measure the degree of association between two variables (Bishara & Hittner, 2012; Chok, 2010). The data were analyzed using IBM SPSS Statistics for the whole instruments in this study. Table 29 gives a summary of the results; Appendix-C shows the full correlation analysis table for each hypothesis. The summarized correlation table shows the number of correlated indicators for each pair of variables.

Table 29: Summarized Correlation Analysis (All Correlated Indicators are Significant at $P < 0.05$ and $P < 0.01$)

Hypothesis	Instrument	Independent Variable	Instrument Correlated	Dependent Variable (Correlated)	Total Number of Relationship in the Correlation Matrix	Number of Relationship Correlated
H1a	Multi Factor Leadership Questionnaire	Transformational Leadership	Community Innovation Survey	Knowledge Management Practices	100 (20x5)	40
H1b	Multi-Factor Leadership Questionnaire	Transactional Leadership	Community Innovation Survey	Knowledge Management Practices	60 (12x5)	11
H1c	Multi Factor Leadership Questionnaire	Laissez- Faire Leadership	Community Innovation Survey	Knowledge Management Practices	20 (4x5)	1
H2a	Diversity Climate Survey	Individual Diversity Climate	Community Innovation Survey	Knowledge Management Practices	25 (5x5)	19
H2b	Diversity Climate Survey	Group Diversity Climate	Community Innovation Survey	Knowledge Management Practices	25 (5x5)	20
H2c	Diversity Climate Survey	Organizational Diversity Climate	Community Innovation Survey	Knowledge Management Practices	25 (5x5)	23
H3a	Multi Factor Leadership Questionnaire	Transformational Leadership	TRIZ Feedback Survey	Perception of Being Able to Apply TRIZ	400 (20x20)	284
H3b	Multi Factor Leadership Questionnaire	Transactional Leadership	TRIZ Feedback Survey	Perception of Being Able to Apply TRIZ	240 (12x20)	105
H3c	Multi-Factor Leadership Questionnaire	Laissez-Faire Leadership	TRIZ Feedback Survey	Perception of Being Able to Apply TRIZ	80 (4x20)	21

Hypothesis	Instrument	Independent Variable	Instrument Correlated	Dependent Variable (Correlated)	Total Number of Relationship in the Correlation Matrix	Number of Relationship Correlated
H4a	Diversity Climate Survey	Individual Diversity Climate	TRIZ Feedback Survey	Perception of Being Able to Apply TRIZ	100 (5x20)	59
H3b	Diversity Climate Survey	Group Diversity Climate	TRIZ Feedback Survey	Perception of Being Able to Apply TRIZ	100 (5x20)	75
H3c	Diversity Climate Survey	Organizational Diversity Climate	TRIZ Feedback Survey	Perception of Being Able to Apply TRIZ	100 (5x20)	85
H5	Community Innovation Survey	Knowledge Management Practices	TRIZ Feedback Survey	Perception of Being Able to Apply TRIZ	100 (5x20)	81
H6	Community Innovation Survey	Organizational Change	TRIZ Feedback Survey	Perception of Being Able to Apply TRIZ	100 (5x20)	96

The results of the correlation analysis show the number of relationships correlated compared to the total number of relationships between each instrument in the correlation matrix. The linear relationship was indicated using the person analysis while Kendall's tau-b and Spearman nonlinear relationship served as a further support that a relationship between the variables are valid.

The linear relationship established between the independent and dependent variables is shown through the number of indicators correlated within the established

relationship. If the total number of indicators is similar to the number of correlated indicators, this means that most of the indicators for a linear relationship between the independent and dependent variable. According to the results, for all the leadership variables less than half of the indicators formed a linear relationship with knowledge sharing, which means there were more outliers. For the same leadership variables, half of the indicators form a linear relationship with the perception of being able to apply TRIZ. Both group and organizational diversity climate showed strong formation of linear relationship with both knowledge sharing and perception of being able to apply TRIZ variables. Lastly, both knowledge management practices and organizational change also showed a strong linear relationship with the perception of being able to apply TRIZ.

CHAPTER SIX

RESULTS, CONCLUSION & FUTURE RESEARCH

This study was designed to test and evaluate the relationship of the effects of Transformational, Transactional and Laissez-Faire Leadership, and Group and Organizational Diversity Climate on work teams in Knowledge Management Practices for problem-solving and in the Perception of Being Able to Apply TRIZ to their work. The Organizational Change variable was analyzed to show further effects on the participants' perception of being able to apply TRIZ. Data sets were collected for 205 participants from targeted companies in the UAE region where all participants were trained on the basics of applying TRIZ in problem-solving. The research began with six hypotheses:

- 1) Transformational Transactional and Laissez-Faire Leadership will positively affect Knowledge Management Practices.
- 2) Individual, Group and Organizational Diversity Climate will positively affect Knowledge Management Practices.
- 3) Transformational Transactional and Laissez-Faire Leadership will positively affect the Perception of Being Able to Apply TRIZ.
- 4) Individual, Group and Organizational Diversity Climate will positively affect the Perception of Being Able to Apply TRIZ.
- 5) Knowledge Management Practices will positively affect the Perception of Being Able to Apply TRIZ

- 6) Organizational Change will positively affect the Perception of Being Able to Apply TRIZ.

These hypotheses were tested and analyzed as follows: First, the hypotheses were examined using SEM. The results of this analysis were then interpreted and discussed. Second, a correlation analysis was run to further examine the relationships between the hypotheses in those cases where SEM did not show clear findings. These results were then interpreted and discussed. The overall SEM analysis of the hypothesized model is shown in Figure 33.

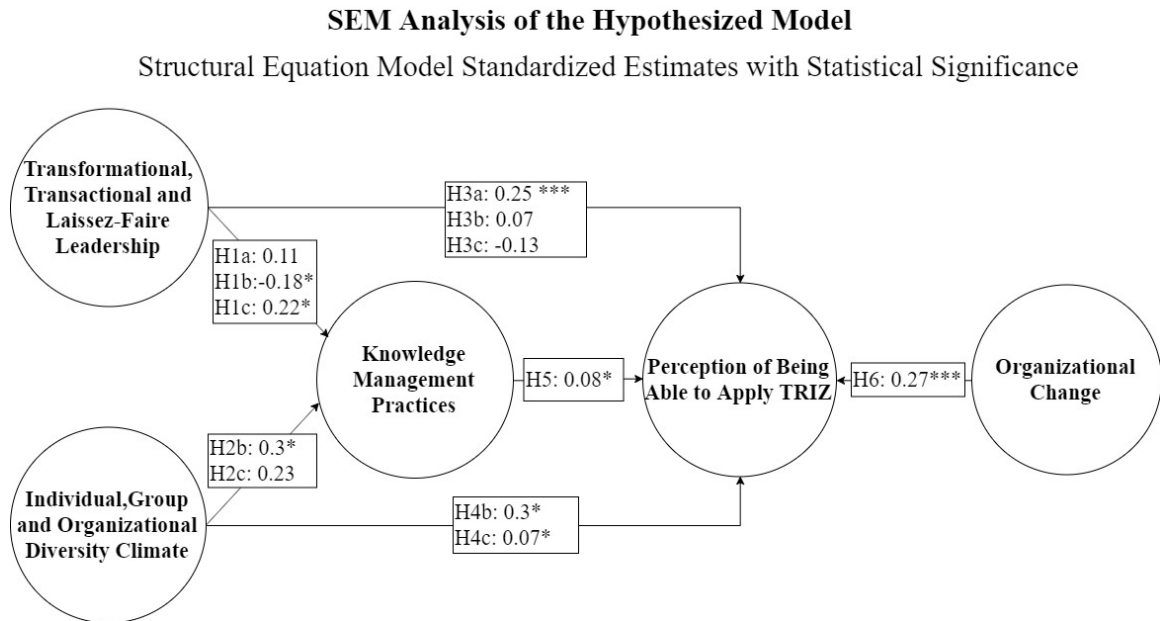


Figure 33: SEM Analysis of the Hypothesized Model, [* P-Value <0.1, ** P-Value <0.05, *** P-Value <0.01]

Results of Hypothesis Testing Using SEM

The statistical analysis provided support confirming the impact of leadership and diversity climate behavior on how knowledge management practices between team members in problem-solving (H1 and H2). It also confirmed the impact of both leadership and diversity climate in changing the perception of being able to use TRIZ (H3 and H4), as well as the impact of organizational change and knowledge management practices on the user's perception of being able to apply TRIZ (H5 and H6). Each hypothesis was analyzed using standardized regression weight in the model.

Effect of Transformational, Transactional and Laissez-Faire Leadership on Knowledge Management Practices

The variable of knowledge management practices reflects the knowledge, process, people and technology used to share any information between group members or in the organization as a whole. The variable of knowledge management practices reflects both what (the knowledge) and how (the process, people and technology used) involved in the interchange of information within a group or within an organization as a whole. Leadership style impacts knowledge sharing by influencing group dynamics. The Community Innovation Survey was used to measure the knowledge management practices of in the organizations. The Multifactor(al) Leadership Questionnaire was used to measure the leadership style within the organizations.

Hypothesis 1a (H1a) stated that Transformational Leadership will positively affect knowledge management practices. The result of this study did not confirm this relationship ($\beta = 0.11$, $P \text{ value} = 0.114$). Hypothesis 1b (H1b) stated that Transactional

Leadership will positively affect knowledge management practices. The results of this study also did not support this claim, However, the transactional leadership showed a statistically significant relationship with knowledge management practices in an unexpected way, namely that transactional leadership has a negative impact on knowledge management practices ($\beta = -0.181$, $P \text{ value} = 0.084$). Hypothesis 1c (H1c) stated that Laissez-Faire Leadership will positively affect knowledge management practices, this result was confirmed by the analysis which is was found to be supported ($\beta = 0.219$, $P \text{ value} = 0.052$).

Effect of Group and Organizational Diversity Climate on Knowledge Management Practices

Each participant was asked to rate their experience of diversity climate using the Diversity Climate Survey. Respect, equality, discrimination, conflict, and feelings about diversity were measured for each participant at the group level and at the organizational level. The Community Innovation Survey was used to measure knowledge management practices and participants were asked to rate the knowledge that occurred at the group level and at the organizational level.

Hypothesis 2b (H2b) stated that group diversity climate will positively affect knowledge management practices. The analysis supported this claim with knowledge management practices ($\beta = 0.298$, $P \text{ value} = 0.07$). Hypothesis 2c (H2c) stated that organizational diversity climate positively affects knowledge management practices, which was not supported in the SEM hypothesis analysis ($\beta = 0.226$, $P \text{ value} = 0.151$).

Effect of Transformational, Transactional and Laissez-Faire Leadership on Perception of Being Able to Apply TRIZ

The dependent variable is the Perception of Being Able to Apply TRIZ. Each member applied TRIZ as they practiced problem-solving in the TRIZ session (45-60 minutes). All participants filled out a survey on which they were asked on how well they did at problem-solving, the amount of systematic guidance and time consumption required, their degree of adoption of the methodology, and their degree of acceptance of the methodology.

Hypothesis 3a (H3a) stated that transformational leadership will positively affect the perception of being able to apply TRIZ. The analysis strongly supports this hypothesis ($\beta = 0.252$, $P \text{ value} = 0.004$). Hypotheses 3b and 3c (H3b, H3c) stated that transactional leadership and laissez-faire leadership will positively affect the perception of being able to apply TRIZ. Neither Transactional leadership ($\beta = 0.071$, $P \text{ value} = 0.492$) nor Laissez-Faire leadership ($\beta = -0.129$, $P \text{ value} = 0.235$) showed a significant effect on the perception of being able to apply TRIZ.

Effects of Group and Organizational Diversity Climate on Perception of Being Able to Apply TRIZ

Hypothesis 4b (H4b) stated that the group diversity climate will positively affect the perception of being able to apply TRIZ in problem-solving. The result positively supported the stated hypothesis ($\beta = 0.301$, $P \text{ value} = 0.062$). In addition, Hypothesis 4c (H4c) stated that organizational diversity climate will positively affect the perception of being able to apply TRIZ. Again, the result showed that organizational diversity also positively impacts the perceptions of being able to apply TRIZ ($\beta = 0.07$, $P \text{ value} = 0.079$).

Effect of Knowledge Management Practices on Perception of Being Able to Apply TRIZ

Hypothesis 5 (H5) stated that knowledge management practices will positively affect the perception of applying TRIZ. The result provides some support to the stated hypothesis ($\beta = 0.082$, P value=0.059) as knowledge management practices was a mediator between the perception of being able to apply TRIZ and leadership & diversity climate effect.

Effects of Organizational Change on Perception of Being Able to Apply TRIZ

To measure organizational change, participants rated the performance of the organization at different levels: decision making, knowledge sharing policy, public relations and management structure.

Hypothesis 6 (H6) stated that organizational change will positively affect the perception of being able to apply TRIZ. The result of the analysis strongly supported the proposed hypothesis ($\beta = 0.276$, P value<0.001). Table 30 summarizes the result of each hypothesis test.

Table 30: Hypothesis Summary Based on SEM

Type of Support	P-Value	Hypothesis	Result of SEM Analysis
Significant in Expected Direction	0.1*	H1c	Laissez-Faire Leadership affects Knowledge Management Practices
		H2b	Group Diversity affects Knowledge Management Practices
		H4b	Group Diversity affects the Perception of Being Able to Apply TRIZ
		H4c	Organizational Diversity affects the Perception of Being Able to Apply TRIZ
		H5	Knowledge Management Practices affect the Perception of Being Able to Apply TRIZ

Type of Support	P-Value	Hypothesis	Result of SEM Analysis
	0.01***	H3a	Transformational Leadership strongly affects the Perception of Being Able to Apply TRIZ
		H6	Organizational Change strongly affects the Perception of Being Able to Apply TRIZ
Significant in Unexpected Direction	0.1*	H1b	Transactional Leadership affects Knowledge Management Practices

Hypothesis Testing Using Correlation Analysis

The hypothesis analysis using SEM showed that a total of eight hypotheses were supported, two of which showed a strong effect and one showing a negative effect, and that four hypotheses were unsupported. The purpose of the correlation analysis was to measure the closeness of the linear relationship between the variables in the instrument. Furthermore, it served as an augmentation to further explore the areas where SEM did not show clear findings. Hypothesis 1a, 2c, 3b, and 3c did not show significant effect using SEM analysis. Therefore, correlation tables for these areas were developed to examine relationships at an item level instead of a construct level as shown in Table 31. All correlated indicators were significant at $P < 0.05$ and $P < 0.001$:

Table 31: Summarized Correlation Analysis Supporting Hypothesis Analysis

Hypothesis	Instrument	Independent Variable	Instrument Correlated	Dependent Variable (Correlated)	Relationships in Correlation Matrix	Relationships Correlated
H1a	Multi-Factor Leadership Questionnaire	Transformational Leadership	Community Innovation Survey	Knowledge Management	100 (20x5)	40

Hypothesis	Instrument	Independent Variable	Instrument Correlated	Dependent Variable (Correlated)	Relationships in Correlation Matrix	Relationships Correlated
H2c	Diversity Climate Survey	Organizational Diversity Climate	Community Innovation Survey	Perception of Being Able to Apply TRIZ	25 (5x5)	23
H3b	Multi-Factor Leadership Questionnaire	Transactional Leadership	TRIZ Feedback Survey	Perception of Being Able to Apply TRIZ	240 (12x20)	105
H3c	Multi-Factor Leadership Questionnaire	Laissez-Faire Leadership	TRIZ Feedback Survey	Perception of Being Able to Apply TRIZ	80 (4x20)	21

For H1a, less than half of the indicators were significantly correlated and more than half of the indicator's points are far from forming a linear relationship. This implies that transformational leadership and knowledge management practices have a weak to moderate linear relationship. Thus, correlation analysis also did not support hypothesis H1a. For H2c, on the other hand, the relationship between organizational diversity climate and knowledge management practices formed a strong linear trend. Almost all of the indicators were close to forming a linear relationship, and therefore, based on the correlation analysis, H2c is supported; organizational diversity climate does impact knowledge management practices.

As for H3b and H3c, according to correlation analysis, less than half of the indicators showed a significant linear relationship between transactional or laissez-faire leadership and the perception of being able to apply TRIZ. More than half to almost 65% of the indicators of both H3b and H3c did not form a linear pattern, and therefore, the

results do not support the claim that transactional or laissez-faire leadership have a significant effect on the perception of being able to apply TRIZ.

In summary, the hypothesis analysis obtained from SEM results showed that most of the hypotheses are supported. Of the remaining four unsupported hypotheses in SEM, one could be supported using the correlation analysis. A final summary of the hypothesis testing, based on both the SEM analysis and the correlation analysis, is shown in Table 32:

Table 32: Summary of the Hypothesis Testing, based on SEM and Correlation Analyses, (* P-Value <0.1, ** P-Value <0.05, *** P-Value <0.01)

	Hypothesis	Support	Type of Analysis Used
H1a	Transformational Leadership positively affects Knowledge Management Practices	Not supported	SEM & Correlation
H1b	Transactional Leadership positively affects Knowledge Management Practices	Not supported, negative effect*	SEM
H1c	Laissez-Faire Leadership positively affects Knowledge Management Practices	Supported*	SEM
H2a	Individual Climate Diversity positively affects Knowledge Management Practices	Deleted	SEM
H2b	Group Diversity Climate positively affects Knowledge Management Practices	Supported*	SEM
H2c	Organizational Diversity Climate positively affects Knowledge Management Practices	Supported**	Correlation
H3a	Transformational Leadership positively affects the Perception of Being Able to Apply TRIZ	Strongly Supported***	SEM
H3b	Transactional Leadership positively affects the Perception of Being Able to Apply TRIZ	Not supported	SEM & Correlation
H3c	Laissez-Faire Leadership positively affects the Perception of Being Able to Apply TRIZ	Not supported	SEM & Correlation

	Hypothesis	Support	Type of Analysis Used
H4a	Individual Diversity Climate positively affects the Perception of Being Able to Apply TRIZ	Deleted	SEM
H4b	Group Diversity Climate positively affects the Perception of Being Able to Apply TRIZ	Strongly Supported***	SEM
H4c	Organizational Diversity Climate positively affects the Perception of Being Able to Apply TRIZ	Supported*	SEM
H5	Knowledge Management Practices positively affects the Perception of Being Able to Apply TRIZ	Supported*	SEM
H6	Organizational Change positively affects the Perception of Being Able to Apply TRIZ	Strongly Supported***	SEM

The following points explain the reason for supporting H2c based on correlation analysis despite the unsupported results from SEM:

- SEM focuses on developing a hypothetical construct in which a latent, underlying variable is assumed to have a correlation value of 1. The path from the latent variable to the measured variables is set as a constant (Bentler & Stein, 1992). Adding an error term between two factors will affect the correlation result of the latent variable (Kline, 2015), thus justifying the use of correlation analysis to further examine the relationship.
- Previous research literature has provided evidence that models with many variables and a minimum sample size of $N > 200$ can cause problems in SEM in which the results would change if an indicator is added or removed from a variable. To address this, constructs should be reduced to show significant values between variables (Deng, Yang, & Marcoulides, 2018).

- The results shown using correlation analysis were established between independent and dependent variables without moderators (Smithson, 2012), while SEM uses moderators and establishes a relationship based on the model indices.

Discussion

This research investigated the impact of both leadership behavior and diversity climate on workers in the targeted companies. The effect of these variables on knowledge management practices in the organization and between members of problem-solving groups was measured, and then the impact of those effects as well as the impact of organizational change on users' perception of being able to apply TRIZ in problem-solving was determined.

Based on the model and the results obtained from Hypothesis 1, transformational leadership did not show significant effect on knowledge management practices. On the other hand, transactional leadership had a significant negative effect on knowledge management practices. Transactional leadership encourages followers to meet expectations by achieving a negotiated level of performance to earn a predefined reward, while transformational leadership encourages followers to perform beyond expectations because of their commitment to the leader and to the mission of the organization. Even if group members were previously established with a respective leader in previous projects, the leadership acted as a transactional more than transformational. Transactional contingent reward puts efforts into the development of an organization, clarify expectations and provide necessary resources which enforces knowledge management, which is supported in the SEM analysis. These results may also show that a transactional

leadership set mutually agreed upon goals that enforces knowledge in the organization. This also indicates that changing to a transformational leadership style does not happen in a short period of time and it requires time to build up trust in team members, as well. The negative impact of transactional leadership may indicate that workers will resist or refuse to participate (for instance, share knowledge) if the leader tries to force or require them to do something they are unwilling to do. When transactional leadership was demonstrated in a group, members either did not share knowledge or they shared to satisfy their reward goals. Laissez-faire leadership showed significant effect on knowledge management practices. This indicates that members of the group did not need the influence of a leadership style to share knowledge between themselves; knowledge management seems most likely to occur without the presence of a strong leader. This creates a climate in which workers can freely share their knowledge and opinions, believing that all thoughts will be equally considered.

The results from Hypothesis 2 could be explained as follows. The diversity climate at the group and organization levels showed significant impact on knowledge management practices in the organization. The belief that they were respected and equal in the group and in the organization influenced members to exchange knowledge, to listen and to share, in the case study provided. The effect of group diversity influenced sharing ideas among workers. Group members felt more included in problem-solving when there was no leadership effect; this indicates that the group members were influenced by group diversity climate and therefore shows an affected relationship to the knowledge management. Lastly, organizational diversity showed significant positive

effect on knowledge management practices, as being respected within the organization despite being different is an influence on the knowledge management inside the organization and enforces for sharing ideas between workers. Organization that are open to diversity are open to the variety of ideas shared its workers.

The largest contribution of this study were the results obtained with Hypothesis 3, where most of the literature gaps were addressed. The availability and influence of leadership were found to significantly impact the perception of being able to apply TRIZ. According to the results, transformational leadership influenced the group members' perception of being able to apply TRIZ in problem-solving. Leadership that is transformational in style treats people equally and includes them in problem-solving, seeking a variety of ways to solve a problem. Transformational leaders led their members to a better understanding of TRIZ principles and the theoretical background of TRIZ and helped them to apply TRIZ in their problem-solving, leading to better idea generation using TRIZ. Furthermore, the availability of transformational leadership changed the preconceived perceptions of users who had had previous exposure to the methodology and lead them to adopt or to recommend adopting it in different UAE industries. Neither transactional leadership nor laissez-faire leadership showed any significant impact in changing users' perception of being able to apply TRIZ in problem-solving. This means that TRIZ problem solving could most easily be applied and understood by team members that had a transformational leadership influence on their members.

The results from Hypothesis 4 show that diversity climate significantly influenced the perception of being able to apply TRIZ in problem-solving. At the group level,

diversity climate results in feeling involved and included in the group which influences further understanding of the methodology and changes the users' perception of being able to apply TRIZ in problem-solving. This is correlated with the effect of transformational leadership, as the members of the group need to have the influence of a transformational leader to understand and apply TRIZ in problem-solving. Lastly, organizational diversity climate also showed a significant effect on perceptions of being able to apply TRIZ in problem-solving. Organizations that are open to change and treat workers with respect and equality directly affect workers' perception of understanding and being able to apply TRIZ.

Based on the results obtained from Hypothesis 5, knowledge management practices shows significant effect on users' perception of being able to apply TRIZ in problem-solving. This could be explained as follows: first, knowledge management practices inside the organization helped group members share information to further their understanding of the TRIZ methodology. The process of sharing this information, either by the experts who taught the lectures or by those who had had previous experience or practice, helped workers to change their perception of being able to apply TRIZ in problem-solving. Second, knowledge management practices incentives inside the organization enforces changes to perception of being able to apply TRIZ. Through updating the organization internal database and manual, Participants had access to previous practices and expert advises which directly affect workers' perception of understanding and being able to apply TRIZ.

In the case of Hypothesis 6, the results indicate that organizational change norms significantly influences the perception of being able to apply TRIZ. These norms are knowledge management structure which involves a system to exchange information, decision making, which involves change in the organization to increase workers decision making, management structure, which involves creating new divisions and integrating new network structure and public relationship, which involves alliances, partnership, sub-sourcing and outsourcing with other firms. Organizations which implemented an effective knowledge management system inside the organization were able to help workers better understand and apply TRIZ. In addition, changes in the organization which allowed workers to have a greater role in decision-making impacted their perceptions of being able to apply TRIZ in problem-solving. Changing the management structure by creating and integrating different departments made it easier to hold the necessary discussions for problem-solving using the TRIZ methodologies. Last, partnership and alliances with other firms helped to outsource different expertise in the work field and helped workers to apply and accept TRIZ.

Implication for Practitioners

This study is one of the first applications of TRIZ in the UAE industry. Many organizations inside the UAE region had never heard of or applied TRIZ in their daily work, which makes this research unique from both the academic and the practical sides. In developing TRIZ training for the targeted companies, the researchers learned that the workers wanted to attend the training session to learn a new approach to problem-solving and to further their experience. Training institutes are always searching for new courses

and training sessions to improve workers' ability to face problems in their day-to-day work. As this thesis was successfully developed in different sectors in the UAE region, it will open more opportunities to conduct further research in other UAE organizations. This creates a door between the academic and the industrial worlds inside the UAE. Many targeted organizations felt that this research could easily be applied to problem areas within the organizations other than the ones covered in this research. They recognized that the TRIZ methodology can be combined with other common methodologies, like focus groups, in their daily work practice. For instance, they could generate an idea using TRIZ and have a focus-group session for further evaluation of that idea.

Based on the results of the hypothesis analysis, practitioners could improve the application of TRIZ inside the organization by encouraging transformational leadership in team problem-solving. The transformational leadership style can increase understanding and acceptance of the methodology in problem-solving. Furthermore, increasing the diversity climate at the group and organization levels helps improve the application of TRIZ in problem-solving. Furthermore, increasing the diversity climate, by encouraging equality, respect, and the feeling of being included, at the group and organization levels helps improve the application of TRIZ in problem-solving. Improving the knowledge sharing process and changing policies inside the organization were also shown to be helpful in influencing acceptance of TRIZ. Despite the complexity of gaining approval inside UAE companies, research involving both academic and real-world application can be mutually beneficial. Researchers who want to target UAE

industries must propose models that focus on satisfying the organization's requirements as well as push the existing knowledge in the academic literature., This research has opened doors for practitioners to do academic research in TRIZ applications at the same time that they build their training reputation for certified institutes inside the UAE. The developed model could also be used to introduce and encourage application of other creative idea-generating tools besides TRIZ, like Mind-Mapping, Quality Function Deployment (QFD), Kawakita Jiro (KJ Method), The Morphological Matrix and the Theory of Constraints, in UAE industries.

Limitations

The research addressed the hypotheses proposed, but the findings and implications suggested are limited in a number of ways. First, the structural equation model is considered a large sample technique (Kline, 2015). Much effort was spent with the participants teaching and applying TRIZ in the training session; however, the final sample size was 205 from only eight targeted companies with a total of twelve sessions (two companies provided more than one session). For a complex SEM with more than six latent variables, it is suggested to have more than 500 participants in the study (Hair et al., 1998). While a SEM model was found that satisfied the Goodness of Fit indices, it would have been more robust with a larger sample.

Second, most of the participants were first-time TRIZ users and the case study provided for each TRIZ session was different, based on the organization's needs. This means that the case problem in some training sessions may have been harder or less relevant than in others. In some cases, participants may have believed that the problem

needed an immediate solution, and thus, they determined that it was too complicated to solve in the time provided. This did not prevent participants from discussing and seeking a solution to the problem, but the approach to finding a solution provided by the training seemed overly complex, which is affected perceptions of the approach for first-time TRIZ users.

Lastly, this research targeted different sectors and practices which means there were different applications of TRIZ based on the organization and the field. For the purpose of this research, all targeted companies were combined in one analysis, but in practice, many of these companies had different applications, and thus, participant responses differed accordingly. Furthermore, in some cases, participants asked for more clarifications, but in others, they did not. The extra time in TRIZ training provided more exposure to TRIZ, further application of TRIZ, and in some cases, more problems to practice using the TRIZ methodology on, which thereby affected perceptions of being able to apply TRIZ.

General Source of Bias

In addition to these limitations, the study had several potential sources of bias that must be considered. The data collected from this study were associated with an approved TRIZ training course. The potential sources of bias are summarized as follows:

- The surveys were submitted at the beginning of training and at the end of the second day of training. This is a relatively short training period, and a longer period of training may have yielded different evaluation results. Furthermore, the

long-term impact of TRIZ, beyond what occurred in the two-day training period, was not measured.

- The training courses were presented and lectured by the same person who developed this study (the dissertation author). This may have created a bias in the data collection process as the presenter may have seen a team member with transformational leadership potential and focused on this member more than on other members of the group in problem-solving. In addition, another source of bias may have occurred in the presentation, as the presenter may have emphasized a certain point in the training course that would have influenced the survey responses. This could have created a deviation between what was measured and the actual effect.
- In some cases of problem-solving, certain participants may not have enthusiastically participated in the training because of uncontrolled influences (for instance, the influence of managers who attended the training). This could have created a source of bias from the perspective of participant attendance at the training, as certain factors, such as attendance, may have been more greatly affected by influencers that were not measured in the study, for example, job obligation.
- The training courses were held over two days, which creates a gap during which participants could have forgotten a certain point in TRIZ application. The second day, a summarized TRIZ training presentation was held that may have created a bias of what they needed to understand and be able to apply in the TRIZ session.

On the other hand, the gap between the two sessions may also have created the potential for participants to further understand, clarify and apply the principles of TRIZ. It may also have allowed participants to generate ideas through other tools that were not introduced in the training, like mind mapping and focus groups. Moreover, this gap could also have influenced the responses to the remaining instruments in this study.

- Since the presenter of the TRIZ lecture and the author of this study is the same person, participants may have politely appreciated his efforts in the training courses, as the demographics were mostly UAE citizens (the same as the presenter). On the other hand, this created easier communication of the TRIZ principles, as the presenter and the participants shared the same language and the same background.
- The previous bias, regarding the presenter of TRIZ lecture having a similar nationality background (UAE) as most of the participants involved, could have affected the ease with which the participants were able to apply TRIZ in problem-solving.
- The research methodology is limited to findings that were obtained from specific problem cases in UAE industries. While the training session provided a theoretical finding from participant responses to applying TRIZ at work; it did not consider any practices of TRIZ over time. This means that there is no record or indication that participants used the principles for other projects.

Common Method Bias

Bagozzi and Yi (1991, p. 426) defined Common Method Bias (CMB) as the “variance that is attributable to the measurement method rather than to the construct of interest.” Surveys often request information used to measure both independent and dependent variables of analysis. However, using a single survey as the source for both independent and dependent data introduces a possibility of bias caused by using a single method of data collection (Podsakoff, MacKenzie, & Podsakoff, 2012; Richardson, Simmering, & Sturman, 2009). Using the same respondents to measure both the independent and dependent variables creates a positive correlation between the two variables; therefore, the estimates are affected by the CMB (Meier & O'Toole Jr, 2013).

The reason for considering the importance of the CMB is that the researcher's conclusions are at risk of being invalidated because of errors in the relationship between the instruments. These errors come in the form of using all the instrument in one survey to be filled by the respondent, so that, despite the significant results obtained in, the hypothesized model, it needs to be investigated (Campbell & Fiske, 1959). Cote and Buckley (1987) studied the estimates of an average correlation to demonstrate that if a CMB is present in the analysis, two perfectly correlated constructs in the model analysis could show a low observed correlation coefficient. On the other hand, two constructs which have no correlation could show a high correlation coefficient if CMB is present. Not only may the bias cause the correlation relationship between constructs to increase or decrease, but the direction of the correlation effect may also be impacted. These variances can increase both types I and type II errors (Eichhorn, 2014).

Podsakoff, MacKenzie, Lee, and Podsakoff (2003) discussed sources of Common Method Bias in surveys; their findings are summarized as follows:

- The use of a common rater source (one rater who provides both independent and dependent variables) introduces a self-reporting bias;
- The survey instrument's design, complexity, ambiguity, and scale format can deviate the rater's response.
- The survey item's context (positioning within the sequence of questions and the number of questions) can affect the rater's response.
- The survey's measurement context can introduce covariants between measurements. It includes whether the independent and dependent variables are captured at the same point in time, in the same location.
- The survey instrument's ambiguity can influence the rater's response. For instance, a rater's motivation to answer accurately can be impacted by such survey characteristics as the rater's knowledge of the subject, , the rater's ability to process and understand the subject, the length of the survey instrument, and response options that encourage non-engagement (i.e., "Not Applicable" or "I don't know" options).

Ashkanasy (2008, p. 264) stated that "authors need to address at a minimum the potential threats to validity occasioned by CMB; while the common methods issues are controversial in some respects, they cannot be ignored." Craighead, Ketchen, Dunn, and Hult (2011) stated that the Common Method Bias distorts correlation relationships and causes researchers to reach an erroneous conclusion. The goal for testing CMB is to

determine to what degree the bias exist. One type of CMB testing is the Analytical technique, which estimates the degree to which the data may be influenced by biases caused by the survey methods (Eichhorn, 2014).

Another analysis technique that is widely used with the Structural Equation Model is the Common Latent Factor (CLF) by which a new latent variable (a common factor) is introduced in the Common Factor Analysis for each instrument in such a way that it relates to all manifest variables. The paths are constrained to be equal and the variance of the common factor is constrained to be one. The common variance is estimated as the square of the common factor of each path before standardization (the square of unstandardized factor loading). If the introduced common latent factor shows more than 50% variance, then Common Method Bias may be present. The second approach using the Common Latent Factor is to compare the standardized loading when CMB is latent and without CMB, with each factor loading having less than 50% variance. The CLF technique focuses on measurement errors without the need to identify and measure the specific factor responsible for the Common Method Bias effects. As the technique assumes no interaction between constructs, it may indicate multiple biases, similar to the Harman- Single- Factor- technique, which measures the CMB by examining the unrotated factor solution to determine the number of factors that are necessary to account for the variance in the variables (Eichhorn, 2014). CLF analysis for each instrument and variable, using both approaches, is shown in Table 33. The full CLF analysis is shown in Appendix G.

Archimi, Reynaud, Yasin, and Bhatti (2018) indicated that the difference between the standardized regressions weights with and without CLF should have a minimum threshold of no more than 30%. If the difference is more extreme, it means that the variables are compromised and any subsequent analysis with them may be biased. The CLF analysis of this research indicates that constructs in the structural equation model have factors that exceed the 30% threshold. This means that these factors may have bias in the results. The factors that were shown to have more than the 30% threshold were under Transactional Leadership (Q1, Q11, Q16) and under Perception of Being Able to Apply TRIZ (Q7, Q13, Q14, Q15, Q16,). As for the unstandardized factor loading, it was shown that organizational change and laissez-faire leadership show more than 50% variance. These results may explain that due to CMB, the significance of some variables were not shown in SEM and correlation analyses. Transactional leadership and laissez-faire leadership shows significant results for knowledge management but not for the perception of being able to apply TRIZ. As for the perception of being able to apply TRIZ, some of the indicators showed high variance due to the survey alignment and the positioning of the questionnaires in the survey response. Question 13-15 (under Perception of Being Able to Apply TRIZ) address the systematic approach of problem-solving construct and may have affected the responses due to the position of these questions in the survey (the degree of acceptance and degree of adoption questions). These results may prove the necessity of reducing the factors in the model providing a better overall fit for the Goodness of Fit analysis.

Table 33: Summary of the CLF Analysis of the TRIZ Study in the UAE

	Factor Loadings Affected by CLF	Type of Effect
Instrument	Multifactor Leadership Questionnaire	Unstandardized Regression < 0.5
Variable	Transactional Leadership	
Construct	Contingent Reward	Standardized difference <0.3
Instrument Item Number	TranscationalCRQ16	
	TranscationalCRQ11	
	TranscationalCRQ1	
Instrument	TRIZ Feedback Survey	Standardized difference <0.3
Variable	Perception of Being Able to Apply TRIZ	
Construct	Degree of Adoption	
Instrument Item Number	PersTRIZQ7	
Construct	Systematic Guidance	
Questionnaires	PersTRIZQ13	
	PersTRIZQ14	
	PersTRIZQ15	
Construct	Degree of Acceptance	
Instrument Item Number	PersTRIZQ16	
Instrument	Community Innovation Survey	Unstandardized Regression < 0.5
Variable	Organizational Change	
Instrument	Multi Factor Leadership Questionnaire	
Variable	Laissez- Faire Leadership	

Future Research

The model of the hypotheses proposed in this dissertation was built on theory and provides insight for evaluating the gaps discovered in the research literature. This section will provide propositions for future research and suggest a new model for future researchers to consider.

TRIZ Training

First, the training that was developed for the targeted organizations provided them with a solid background in applying TRIZ. The researcher suggests that the same participants be targeted for further application of TRIZ over a longer period of time, so that perceptions of being able to apply TRIZ could be measured on a longitudinal base. This will help researchers to determine the optimal amount of time needed for participants to master and apply TRIZ in their day-to-day work. Based on the results from the proposed model, future researchers could implement a methodology or a model which measures the influence of transformational leadership on applying TRIZ over a period of time, where the TL effect on TRIZ is compared over different timelines/periods.

Second, based on the feedback from the training sessions, many participants felt that TRIZ needed to be applied for more than one session. The researcher suggests holding two or three TRIZ sessions with one of the TRIZ session being a full-involvement problem-solving session in which all participants discuss and solve one problem. However, other participant feedback suggested that each team in a session should have a separate problem case to solve. Alternatively, some participant feedback suggested that the problem solving conducted in the TRIZ session and in the brainstorming session should be separated so that either some groups use TRIZ technique while other use brainstorming techniques, or so that two different case studies are used for the brainstorming and TRIZ sessions.

Finally, TRIZ generated highly innovative ideas based on the problem-solving case studies provided in the training session. Those ideas were either recorded or saved in

the organization's archives. Future researchers should propose models that could help in moving those ideas (feasible solutions) from the idea-generation to the idea-selection stage. Furthermore, researchers should measure the impact of those ideas on the organization's performance.

Adopting TRIZ in the Participating Organizations

With positive feedback on the perception of being able to apply TRIZ and the degree of adoption of TRIZ-generated ideas, future research in the UAE should focus on adoption of the methodology in UAE companies. This study shows the potential for researchers in the UAE to continue to study the methodology of TRIZ in the targeted companies. With a solid base of companies that are familiar with the TRIZ methodology, researchers could continue research on TRIZ by considering how often application of the TRIZ process would be beneficial in each project and what might influence the choice to apply TRIZ real-life problem-solving.

This study has also introduced a model that could be implemented in other organizations in the UAE region, besides the original targeted eight companies. Using this model, researchers could expect that TRIZ training will benefit other UAE companies and provide a solid base for further research.

Effectiveness of TRIZ in Product and Process Innovation

TRIZ showed applicable in problem-solving in the perception of the users when influenced by variables like leadership, diversity climate, organization change, and knowledge sharing. The cases that were introduced and studied in this research focused on demonstrating the effectiveness of TRIZ application in process innovation. Future

researchers need to further introduce and develop cases that show the effectiveness of TRIZ application in product innovation. By focusing on increasing the rate of solution development in order to increase product and process innovation inside an organization, the effectiveness of TRIZ application will be further demonstrated. Researchers could include instruments to measure problem solving in both process and product innovation using the TRIZ methodology and they could also develop a new model to demonstrate the influence and the effectiveness of TRIZ application in process and product innovation performance in (various) organizations.

Introducing Other Creativity Methods in UAE Organizations

This study focused on introducing TRIZ in UAE organizations to investigate users' perceptions of applying and adopting the methodology. The developed model in this study could also help researchers in introducing other creativity methods and tools that still are not widely used in the industry. Several creativity techniques and tools were introduced in the research literature that could be introduced in the workplace, or perhaps be integrated with the TRIZ methodology. Brainstorming was used and integrated with TRIZ in this study, but researchers could further integrate other creativity tools with TRIZ. One example would be Quality Functional Deployment. QFD showed a satisfying integration with TRIZ, where it further helped workers identify the problems based on customer feedback and preference. As the problems are identified, workers could use TRIZ to solve them and come up with solutions that satisfy customer needs (Wang, Chen, Lin, & Wang, 2005).

Mind mapping is another tool that could be integrated with TRIZ. Mind mapping also plays an important role in the process of defining a problem. A Mind Map is used to define the center of a super-system and work outwards and down to the sub-system level. By focusing on each part of the system, the problem can be broken down to the root causes. These causes are then further solved through TRIZ application, using contradictions and principles.

Researchers need to integrate TRIZ with creativity tools that involve developing matrices like the Morphological Matrix. Researchers could use the Morphological Matrix to come up with an idea of what kind of problem currently exists in the organization and then use TRIZ to solve that problem. Another tool is the Kawakita Jiro (KJ Method), where teams can priorities the most important parts of a problem, then use TRIZ to solve the most important parts selected.

Model and Measure Changes

Future research should consider narrowing the scope of the full model and eliminating indicators that do not exceed the 0.7 standardized factor loading. Furthermore, the researcher suggests reducing the latent variables to less than six latent variables in the full model or increasing the sample size to be more than 600 total participants. (Hair et al., 1998). is the researcher also suggests having an equivalent model with a different theoretical explanation and different iterations (MacCallum & Browne, 1993).

As this study generated a number of ideas from each training session, future research should focus on measuring any significant change between the ideas that are

generated in the common idea-generating sessions (brainstorming) and in the TRIZ idea-generating sessions. One highly valuable measurement metrics for idea generation considers the effectiveness of the idea generation in the problem-solving effectiveness in problem-solving (Shah et al., 2003). Hernandez, Shah, and Smith (2010) developed a valid proof analysis showing that the metrics (Novelty, Variety, Quality, and Quantity) effectively measures the final results of the idea generation and recommended that the approach be taught and used for research and workplace application. Using the metrics, each idea is scored from 1 as the lowest to 10 as highest, and the best five ideas are then selected based on the rating. Further research could determine the impact of TRIZ on idea generation by using these metrics to measure the ideas generated in brainstorming session against those generated with TRIZ. This study analyzed the linear relationship between the idea generation from the TRIZ sessions and from the common brainstorming sessions for the pilot testing companies (first two companies in this study serves as a pilot study), from which a total of 27 ideas were collected and rated using the suggested metrics. An ANOVA table was developed and is shown in Table 34 and Table 35. The results indicate a significant (improvement) in (novelty, variety, and quality) from the ideas generated in the brainstorming session to the ideas generated in the TRIZ session. Appendix F shows the analysis of the ideas generated according to Novelty, Variety, and Quality.

Table 34: ANOVA Table for the Ideas Generated in the Pilot Testing M1 Priori

ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	4.617	1	4.617	7.787	.010 ^b
	Residual	14.822	25	.593		
	Total	19.439	26			

a. Dependent Variable: Novelty of Ideas TRIZ M1 Priori

b. Predictors: (Constant), Novelty of Ideas Brainstorming M1 Priori

Table 35: ANOVA Table for the Ideas Generated in the Pilot Testing M1 Posteriori

ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	.648	1	.648	1.509	.231 ^b
	Residual	10.733	25	.429		
	Total	11.380	26			

a. Dependent Variable: Novelty of Ideas TRIZ M1 Posteriori

b. Predictors: (Constant), Novelty of Ideas Brainstorming M1 Posteriori

Conclusion

In this dissertation, three gaps were introduced based on the research literature on innovation, diversity climate, leadership, and TRIZ. These gaps needed to be investigated to further understand the application of TRIZ in problem-solving, in this case in industry in the UAE. Gap 1 revealed the need to study the effects of each element of the full-range leadership model (transformational, transactional and laissez-faire leadership) and each element of diversity climate (group and organizational) on both group knowledge management practices and the perception of being able to apply TRIZ in problem-solving. Gap 2 revealed the need to study the impact of knowledge management practices

on the users' perception of being able to apply TRIZ in problem-solving. Gap 3 revealed the need to examine the impact of organizational change on the perception of being able to apply TRIZ.

The methodology conducted a certified, two-day TRIZ training session to targeted companies in the UAE industry and measured each of the variables (leadership, diversity, knowledge management, the perspective of TRIZ and organization change) suggested in the literature review. Each company provided a real-life case study for a brainstorming session, and then a training session in applying TRIZ was held. On the second day, another TRIZ session was held during which the problem was considered again and further ideas were generated. All ideas were recorded and then collected to be held in the organization's archives. Eight companies participated in this research with a total of 205 participants and twelve TRIZ problem-solving sessions.

According to this study, 90% of the participants came from the UAE citizens. The results obtained regarding users' perception of being able to apply TRIZ can, therefore, be generalized to all UAE workers in each industry. Furthermore, the results of this study can be generalized to all workers in UAE organizations in two of the seven emirates (Abu Dhabi and Dubai). The study was done in two of the emirates and can be applied across the border of these two emirates to include the remaining emirates of UAE. The demographic analysis in this study showed that there is a low ratio of foreigners in the UAE, only 11.48% of the whole population. Thus, the results obtained in this study can be generalized to only the UAE region and only the Semi-Government Companies that the UAE authorities support, represent. The two targeted companies used

in the pilot testing operate in the two emirates (Abu Dhabi and Dubai) with the largest population (3.32 and 3.23 million, respectively); most UAE companies are represented in these two cities.

The participants who attended the workshops (leaders and workers) were carefully selected by senior managers with the hope that they would return to benefit the organization and their peer-workers after finishing the training session. The participants' feedback to the training (on a survey conducted by the organization) strongly suggested that the deliverables of the training would continue to be applied in the workplace.

The results obtained from this study addressed the hypotheses and the literature gaps. Using both a Structural Equation Model and correlation analysis, the relationship between variables was found to be significant. The specified gaps and the contribution of the study are shown in Table 36:

Table 36: Gaps and Contribution

Gaps	Hypotheses	Contribution
#1 Study the effects of transformational leadership and diversity climate on knowledge management practices and perceptions of being able to apply TRIZ	H1, H2, H3, H4	Diversity climate significantly affects both knowledge management practices and perceptions of being able to apply TRIZ; transformational leadership only affects the perception of being able to apply TRIZ
#2 Study the impact of knowledge management practices on the perception of being able to apply TRIZ	H5	The impact of knowledge management practices on applying TRIZ is strongly supported by the findings. This effect is created by the initial influences of transactional, laissez-faire leadership and group & organizational diversity climate on knowledge management practices.

Gaps	Hypotheses	Contribution
#3 Examine how the perception of being able to apply TRIZ is affected by organizational change indications	H6	The findings showed that organizational change highly influences the perception of being able to apply TRIZ in group problem-solving. Changes in the knowledge management system, decision making and in management structure inside the organization can change the perception of being able to apply TRIZ

By breaching the gaps discovered in the literature review, this study showed that the Fuzzy-Front-End stage of innovation could be improved by creating a diverse climate among members in group problem solving, which will influence the knowledge management and sharing information between them. Through the influence of transformational leadership, transactional leadership and laissez-faire leadership, group and organizational diversity climate, organizational change, and knowledge management practices, the perception of being able to apply TRIZ in problem-solving changes. A Common Bias Method analysis was conducted to indicate the degree of bias in this study. The implications and contributions of this study were demonstrated in light of the potential bias recorded. Each potential bias was addressed through further processing of the data. Table 37 shows validation of the study on application of TRIZ in UAE industry.

Table 37: Validation of the Study on Application of TRIZ in UAE Industry

General Source of Bias	Solution Implemented in Study
Evaluating the TRIZ training over a short period of time	Answered participant concerns and providing extra examples for participants
Presenter's group preference	Provided the same amount of time to answer concerns between groups in brainstorming and TRIZ sessions
Participant Enthusiasm	Involved participants in brainstorming and showed appreciation of the ideas generated. This was also done in the TRIZ training where appreciation was shown for the involvement of the participants (sharing previous practices of similar problems).
Managers' influence in selecting groups	Scheduled meetings with managers to discuss reasoning and benefits of group formation
Time gap between the two days of lecture	Emphasized the importance of reading the principles after the first day of training. Provided a summarized presentation of the Day 1 lecture on Day 2 and answered concerns before the TRIZ application session
Presenter's group-member preference	Included a survey from the organization that measures the presenter's performance in the training session. Measured the training feedback.
Presenter's demographics	Lectured in English to ensure a general understanding of the TRIZ training for those with other demographics

Determining bias in this study revealed uncontrolled values in the research; however, the essence of the study was still shown to be valid as the preparation, planning, and execution of the training sessions were run through a process of validation within the organizations. The training was accepted in each UAE organization after it was ascertained that workers would benefit from the training; otherwise, the time wasted in

the training would impact the work within the organization. The trainer of TRIZ presenter was first selected based on credibility for providing training, and then on research interest and topic of concern.

Other than breaching the gaps and establishing the Structural Equation Model, this study has provided another contribution in establishing research areas inside each organization where the training can be applied. With workers who understand and can apply TRIZ inside these organizations, familiarity with TRIZ is higher in them than in other organizations, which influences them to further apply TRIZ on their projects. The observations of the TRIZ training sessions obtained in this study provide knowledge to future researchers regarding workers' perception of the methodology and their ability to apply it.

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APPENDICES

APPENDIX A

FORMAL APPROVAL PAPERS



Figure 34: TRIZ Associate Certificate



Figure 35: Training of Trainers Certificate

For use by Abdulla AlDhaheeri only. Received from Mind Garden, Inc. on October 4, 2016



To whom it may concern,

This letter is to grant permission for the above named person to use the following copyright material for his/her thesis or dissertation research:

Instrument: *Multifactor Leadership Questionnaire*

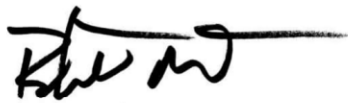
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Sincerely,

A handwritten signature in black ink, appearing to read 'Robert Most', with a long horizontal line extending to the right.

Robert Most
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Figure 36: Mind Garden Copyright Approval



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MEMORANDUM

TO: Abdulla AlDhaheri and William Schell

FROM: Mark Quinn *Mark Quinn*
 Chair, Institutional Review Board for the Protection of Human Subjects

DATE: July 20, 2018

RE: "The Influence of Transformational Leadership and Group Diversity on Generating Innovative Ideas Using TRIZ - a Case Study in UAE Companies" [AA072018-EX]

The above research, described in your submission of July 19, 2018, is exempt from the requirement of review by the Institutional Review Board in accordance with the Code of Federal regulations, Part 46, section 101. The specific paragraph which applies to your research is:

- ☐ (b) (1) Research conducted in established or commonly accepted educational settings, involving normal educational practices such as (i) research on regular and special education instructional strategies, or (ii) research on the effectiveness of or the comparison among instructional techniques, curricula, or classroom management methods.
- ☒ (b) (2) Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures or observation of public behavior, unless: (i) information obtained is recorded in such a manner that human subjects can be identified, directly or through identifiers linked to the subjects; and (ii) any disclosure of the human subjects' responses outside the research could reasonably place the subjects at risk of criminal or civil liability, or be damaging to the subjects' financial standing, employability, or reputation.
- ☐ (b) (3) Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures, or observation of public behavior that is not exempt under paragraph (b)(2) of this section, if: (i) the human subjects are elected or appointed public officials or candidates for public office; or (ii) federal statute(s) without exception that the confidentiality of the personally identifiable information will be maintained throughout the research and thereafter.
- ☐ (b) (4) Research involving the collection or study of existing data, documents, records, pathological specimens, or diagnostic specimens, if these sources are publicly available, or if the information is recorded by the investigator in such a manner that the subjects cannot be identified, directly or through identifiers linked to the subjects.
- ☐ (b) (5) Research and demonstration projects, which are conducted by or subject to the approval of department or agency heads, and which are designed to study, evaluate, or otherwise examine: (i) public benefit or service programs; (ii) procedures for obtaining benefits or services under those programs; (iii) possible changes in or alternatives to those programs or procedures; or (iv) possible changes in methods or levels of payment for benefits or services under those programs.
- ☐ (b) (6) Taste and food quality evaluation and consumer acceptance studies, (i) if wholesome foods without additives are consumed, or (ii) if a food is consumed that contains a food ingredient at or below the level and for a use found to be safe, or agricultural chemical or environmental contaminant at or below the level found to be safe, by the FDA, or approved by the EPA, or the Food Safety and Inspection Service of the USDA.

Although review by the Institutional Review Board is not required for the above research, the Committee will be glad to review it. If you wish a review and committee approval, please submit 3 copies of the usual application form and it will be processed by expedited review.

SUBJECT CONSENT FORM FOR
PARTICIPATION IN HUMAN RESEARCH AT
MONTANA STATE UNIVERSITY

Project title: THE INFLUENCE OF TRANSFORMATIONAL LEADERSHIP AND GROUP DIVERSITY ON GENERATING INNOVATIVE IDEAS USING TRIZ – A CASE STUDY IN UAE COMPANIES.

Objective: This study aims to focus on the impacts of training semi government workers on the principles of TRIZ and measuring the feedback of using this technique. It also collects information regarding members of the team including perspectives on diversity and leadership on individual, team and organizational level as a diversity climate. A community innovation survey is also provided to indicate the innovation performance on the organizational and management level.

Subjects: You were identified as a possible subject to participate in a survey as you were recommended for training on the basic principles of TRIZ by your organization.

Procedure: Your participation is voluntary. If you agree to participate you will be asked to complete surveys that will take your feedback from applying TRIZ, the diversity climate and the innovation performance. Please, feel free to ask questions at any time or provide your feedback.

Risks: There are no foreseen risks.

Benefits: The study is of no direct benefit to you.

Support: There is not cost associated to you.

Confidentiality: All confidential records identifying the subject will be stored in a computer which will be protected with a password. Only Abdulla Al-Dhaheeri and his advisor Dr. William J Schell will have access to this data.

Injuries: There is no risk of injuries outside the minimal risk associated to your daily operations.

Contact Information: If you have questions about the research, please contact Abdulla Al-Dhaheeri at (202)7630180 [as.sahbani@gmail.com] or Dr. William J Schell at (406)994-5938 [wschell@ie.montana.edu]. For additional information about rights of human subjects, you may contact the Chair of Institutional Board, Mark Quinn, at (406) 994-4707 [mquinn@montana.edu].

AUTHORIZATION: I have read the above and understanding the discomforts, inconvenience and risky of this study.

I _____, agree to participate in this research. I understand that I may later refuse to participate, and that I may withdraw from the study at any time. I have received a copy of this consent form my own records.

Signed: _____

Investigator: _____

Date: _____

APPROVED
MSU IRB
07/20/2018
Date approved



26 Sep 2018

To whom it may concern:

Greetings!

This letter is to certify that **Abdulla Al-Dhaheeri** conducted the **Introduction to Basic TRIZ Course** in **Gulf Centre for Aviation Studies (GCAS)** from **20th – 21st November 2017** for 2 days.

This request is issued upon his request without any liability on the part of GCAS.

Best regards,

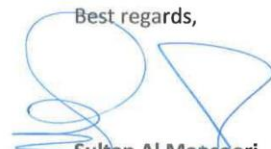

Sultan Al Mansoori
 Acting GM – GCAS



Figure 39: Formal Paper for conducting Research in ADAC



Participation on TRIZ Training - AWMC

To whom it may concern,

This letter shows that Angel Wings Medical Center had participated in a training program in TRIZ provided by Abdulla Al-Dhaheeri from March-21st 2018 to March-22nd 2018 to in partial fulfillment of the requirements for the degree of Ph.D. in Industrial and Management System Engineering.

AWMC had gained access for Abdulla to train our employees in solving problems using TRIZ, where our employees became familiar with the method and therefore used into solving one of our case problems inside the company. The solutions of the provided problem had been submitted for our higher management for further evaluation.

Abdulla had also provided a survey that was filled out by our employees for research purpose. A result copy of the surveys was handed out to the company for security procedures. The original is determined to only be used for the research purpose.

Please do not hesitate to contact me if you have any further inquiry

Kind Wishes

Mr. Suganth Raj Simon
Deputy CEO and Chief Operating Officer

Signature

Date

30/07/18



Figure 40: Formal Paper for conducting Research in AWMC



Mr. Abdulla Saeed Al Dhaheri

السيد / عبدالله سعيد الظاهري

الموضوع: شكر و تقدير
Subject: Thanks & Appreciation

Greetings,

تحية طيبة وبعد...

Al Ain Municipality is pleased to presents its compliments, many sincere thanks and gratitude for your participation in presenting a workshop or "Introduction to Basic TRIZ" that implemented on, **13 To 21 February 2018** in Al Ain City Municipality.

تهديكم بلدية مدينة العين أطيب تحياتها وتتقدم لكم بالشكر الجزيل و الامتنان لمشاركتكم لنا في تقديم ورشة عمل "مقدمة في اساسيات تريز" والتي تم تنفيذها خلال الفترة من 13 فبراير / 2018 حتى 21 / فبراير / 2018 مبنى بلدية مدينة العين.

We wish you abundant success in your work and the more you progress and prosperity.

ونرجو لكم وافر النجاح في اعمالكم والمزيد من التقدم والرفقي.

Sincerely,

وتفضلوا بقبول فائق التحية والتقدير.



محمد سعيد هلال الظاهري
MOHAMED SAEED HILAL ALZAHRY
Director of Human Resources Services
Al Ain City Municipality.

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Figure 41: Formal Paper for conducting Research in Alain Municipality



غرفة أبوظبي
ABU DHABI CHAMBER

الرقم: ١٨ / ٤٤ / ٨٠٠

التاريخ: ٢٦ يونيو ٢٠١٨

Mr. Abdulla Saeed Al Dhaheri

السيد/ عبد الله سعيد الطاهري المحترم

الموضوع : شكر وتقدير
Subject: Thanks & Appreciation

Greetings,

تحية طيبة وبعد،،،

Abu Dhabi Chamber-Al Ain Branch is pleased to presents its compliments, many sincere thanks and gratitude for your participation in presenting a workshop on "Introduction to Basic TRIZ" that implemented on Tuesday & Wednesday, 25-26 June 2018 in Abu Dhabi Chamber in Al Ain City

تهديكم غرفة أبوظبي - فرع العين أطيب تحياتها وتقدير لكم بالشكر الجزيل والإمتنان لمشاركتكم لنا في تقديم ورشة عمل "مقدمة في أساسيات تريز" والتي تم تنفيذها يومين الثلاثاء و الأربعاء الموافق 25-26 يونيو 2018 مبنى غرفة أبوظبي بمدينة العين.

We wish you abundant success in your work and the more you progress and prosperity.

ونرجو لكم وافر النجاح في أعمالكم والمزيد من التقدم والرفي.

Sincerely,

وتفضلوا بقبول فائق التحية والتقدير،

غرفة
ABU DHABI CHAMBER
محمّد سيف بن هاشل الخيلي
Mohammed Saif Bin Hashel Al Khaili
Executive Director for Al Ain Branch
المدير التنفيذي لفرع العين
Al Ain Branch

٨٠٠/ف.ش

Figure 42: Formal Paper for conducting Research in Abu Dhabi Chamber

UNITED ARAB EMIRATES
General Directorate of Residency
and Foreigners Affairs - Dubai



دولة الإمارات العربية المتحدة
وزارة الداخلية
الإدارة العامة للإقامة وشؤون الأجانب - دبي

شهادة شكر وتقدير
للمستاذ / عبدالله سعيد الظاهري
بكل التقدير والعرفان نتقدم بعميق الشكر

على تفضله بتغطية محاور برنامج (التميز في حل المشكلات و اتخاذ القرارات الابتكارية) الذي عقد بالإدارة العامة للإقامة وشؤون الأجانب - دبي بتاريخ "08/04/2018" ونغاية "09/04/2018" بواقع (10) ساعات تدريبية التي من شأنها رفع مستوى الأداء وتزويد المشاركين بمزيد من المعرفة ، وفكهم الله وسدد على طريق الخير دائماً وأبداً خطاكم.

With all appreciation and recognition, we hereby express our thanks and gratitude for your lectures to raise the level of performance and to furnish the participants with important information. My God almighty bless you strengthen your steps.

النواء/ محمد احمد راشد المرسي
مدير علم الإقامة وشؤون الأجانب - دبي
٢٠١٨/٠٤/٠٩ هـ

٢٠١٦/٧/٣٠ الإصدار: ٠١ GDRFA-QP-22-12

Figure 43: Formal Paper for conducting Research in GDRFA



Figure 44: Formal Paper for conducting Research in Ajman Companies



مركز المراقبة والتحكم
MONITORING & CONTROL CENTRE



شبكة وقاية
Certificate of Cyber Association

Monitoring and control Centre is pleased to presents its compliments, sincere thanks and gratitude to

Mr. Abdulla Saeed Al Dhaheri

For his participation in presenting a workshop on "TRLZ: Problem Solving Methodology" that implemented on 29 To 30 July 2018 in Monitoring and control Centre.



Support Service Director
Mohamed Hassan Bin Safwan



صدر في ١١ / ٧ / ١٤٤٠

Figure 45: Formal Paper for conducting Research in Monitor and Control

الهيئة العامة للشؤون الإسلامية والأوقاف
GENERAL AUTHORITY OF ISLAMIC AFFAIRS & ENDOWMENTS



Mr. Abdulla Saeed Al Dhaheri

السيد / عبدالله سعيد الظاهري

الموضوع : شكر وتقدير
Subject: Thanks & Appreciation

Greetings,

تحية طيبة وبعد،،،

General Authority for Islamic Affairs & Endowments is pleased to presents its compliments, many sincere thanks and gratitude for your participation in presenting a workshop on "Introduction to Basic TRIZ" that implemented on, 10 To 11 september 2018 in Al Ain City branch. We wish you abundant success in your work and the more you progress and prosperity. Sincerely,

يسر الهيئة العامة للشؤون الإسلامية والأوقاف ان تتقدم لكم بالشكر والتقدير وذلك لتقديمكم الدورة التدريبية "مقدمة اساسيات تريز" والتي تم تنفيذها من 10 سبتمبر 2018 إلى 11 سبتمبر 2018. في مبنى الهيئة العامة للشؤون الإسلامية والأوقاف بالعين.

وتفضلوا بقبول فائق التحايا والاحترام،،،

ناصر محمد المعمرى
مدير فرع الهيئة بمنطقة العين



Federal Programme

برنامج الفادي

هاتف 762 8111 : 971 +
فاكس 762 5652 : 971 +

صندوق بريد 1405، العين، الإمارات العربية المتحدة
PO Box 1405, Al Ain, United Arab Emirates

Figure 46: Formal Paper for conducting Research in GAIAE Abu Dhabi

الهيئة العامة للشؤون الإسلامية والأوقاف
GENERAL AUTHORITY OF ISLAMIC AFFAIRS & ENDOWMENTS



Mr. Abdulla Saeed Al Dhaheri

السيد/ عبدالله سعيد الظاهري

الموضوع : شكر وتقدير
Subject: Thanks & Appreciation

Greetings,

تحية طيبة وبعد،،،

General Authority for Islamic Affairs & Endowments is pleased to presents itscompliments, many sincere thanks and gratitudefor your participation in presenting a workshop on “Introduction to Basic TRIZ” that implemented on, 10 To 11 september 2018 in Al Ain City branch. We wish you abundant success in your work and the more you progress and prosperity.
Sincerely,

يسر الهيئة العامة للشؤون الإسلامية والأوقاف ان تتقدم لكم بالشكر والتقدير وذلك لتقديمكم الدورة التدريبية " مقدمة أساسيات تريز "والتي تم تنفيذها من 14 سبتمبر 2018 إلى 15 سبتمبر 2018. في مبنى الهيئة العامة للشؤون الإسلامية والأوقاف بالعين.

وتفضلوا بقبول فائق التحايا والاحترام،،،

ناصر محمد المعمرى
مدير فرع الهيئة بمنطقة العين



Federal Programme

برنامج اتحادي

هاتف 762 8111 +971 3
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صندوق بريد 1405، العين، الإمارات العربية المتحدة
PO Box 1405, AlAin, United Arab Emirates

Figure 47: Formal Paper for conducting Research in GAIAE Alain

APPENDIX B

SURVEY INSTRUMENTS

MultiFactor Leadership Questionnaire Sample Instrument (Leader and Rater Form)	
Variable	Transformational Leadership
Construct	Idealized Influence Attribute
Sample Item#1	The person I am rating goes beyond self-interest for the good of the group
Construct	Inspirational Motivation
Sample Item#2	The person I am rating expresses confidence that goals will be achieved
Construct	Intellectual Stimulation
Sample Item#3	The person I am rating seeks differing perspectives when solving problems
Variable	Transactional Leadership
Construct	Contingent Reward
Sample Item#4	The person I am rating discusses in specific terms who is responsible for achieving performance targets
Variable	Laissez-Faire Leadership
Sample Item#5	The person I am rating avoids making decisions

Figure 48: Multi Factor Leadership Questionnaire Sample Items

Diversity Climate Survey, TRIZ Feedback Survey and 4th Community Innovation Survey

**Conducted Survey in partial fulfillment of the requirements of the PhD in
Engineering/ Industrial Management System Engineering in Montana State
University**

The following questions ask you about the individual. Group and organizational experience of diversity climate. Then a survey to indicate the transformational leadership effects is been provided. At the end of the training, this survey also asks about your perception of being able to apply Theory of Inventive Principle (TRIZ). Further questions on knowledge management and organization change are provided.

What area of the organization do you work in?

☐ Engineering ☐ Sciences ☐ Production ☐ Information Technology	☐ Marketing ☐ Human Resources ☐ Training & Development ☐ Other: _____
---	--

What is your age?

☐ 15-25 ☐ 26-35 ☐ 36-45	☐ 46-55 ☐ 56-70
--	--

How long have you worked at this organization?

☐ Less than 1 ☐ 3-5 ☐ 11-20	☐ 1-2 ☐ 6-10 ☐ 21 or more
--	--

What is your gender?

☐ Male	☐ Female
-------------------------------	---------------------------------

Figure 49: Survey Instrument – Demographic Page 1

What is your region of birth?

☐	Australia	☐	Europe & Former USSR
☐	Oceania (New Zealand, Polynesia)	☐	Middle East & North Africa
☐	United Kingdom	☐	Africa
☐	North Asia	☐	North America
☐	South Asia	☐	South America

What is your highest education qualification?

☐	Primary School	☐	Diploma
☐	Secondary School	☐	Graduate Diploma
☐	Trade/Technical Certification	☐	Bachelor's Degree
☐	Other Certificate	☐	Masters Degree
☐	PhD		

What is your English Proficiency level?

☐	Very High
☐	High
☐	Moderate
☐	Low
☐	Very Low

What is your total Work Experience?

☐	Under 1 Year
☐	2-5 Years
☐	6-10 Years
☐	11-15 Years
☐	More than 15 Years

What is your Skill Level inside the organization?

☐	Beginner
☐	Junior
☐	Intermediate
☐	Senior

Figure 50: Survey Instrument – Demographic Page 2

The following 5-Likert Survey is for Individual level of Diversity Climate:

Circle the correct numeric response to each question

#	Question	1	2	3	4	5
1	I am treated with respect and dignity at work					
2	The work provided me with equal opportunity for training and carrier development.					
3	I hear offensive racist ,sex jokes or inappropriate behavior based on people's differences					
4	I personally experienced harassment, bullying or discrimination from other employee					
5	I feel positive about diversity in this workplace					

Survey Scale: 1=Strongly Disagree 2=Disagree 3=Neutral 4=Agree 5=Strongly Agree

The following 5-Likert Survey is for Group level of Diversity Climate:

Circle the correct numeric response to each question

#	Question	1	2	3	4	5
1	My manager and team leader includes all members of the group in solving problems					
2	The way we work shows that we understand the different needs and expectations of all type of customers					
3	My work group experiences relationship problems or mistaken caused by differences between people in the group					
4	The training that I receive at work helps me deal with the diversity of our workforces					
5	I feel included by my workgroup					

Survey Scale: 1=Strongly Disagree 2=Disagree 3=Neutral 4=Agree 5=Strongly Agree

Figure 51: Survey Instrument – Diversity Climate Survey Page 1

The following 5-Likert Survey is for Organization level of Diversity Climate

Circle the correct numeric response to each question

		Survey Scale: 1=Strongly Disagree 2=Disagree 3=Neutral 4=Agree 5=Strongly Agree
#	Question	
1	My manager treats all employees with respect, regardless of their differences or positions.	1 2 3 4 5
2	Senior management shows practical support for Equal opportunities, Anti-Discrimination and Diversity Management policy.	1 2 3 4 5
3	I can talk openly with managers about concerns relating to issues of diversity.	1 2 3 4 5
4	Managers visibly challenge any incident of racism, sexism or other forms of discrimination.	1 2 3 4 5
5	The organization is open for change	1 2 3 4 5

Figure 52: Survey Instrument – Diversity Climate Survey Page 2

The following 5-Likert Survey is to indicate the Knowledge Management in your work:

Circle the correct numeric response to each question

		Survey Scale: 1=Strongly Disagree 2=Disagree 3=Neutral 4=Agree 5=Strongly Agree
#	Question	
1	My work provides written knowledge management policy	1 2 3 4 5
2	My work provides incentives for employee to share knowledge with the organization	1 2 3 4 5
3	My work has a dedicated amount of resource to monitor and obtain knowledge outside the organization	1 2 3 4 5
4	My work has a policy of importing expertise from universities, research institute or other firms to participate in project teams as needed	1 2 3 4 5
5	My work has a regular updates of internal database or manual for good practices, lesson learned or expert advice.	1 2 3 4 5

Figure 53: Survey Instrument –Community Innovation Survey (CIS4) Knowledge Management Practices

The following 5-Likert Survey is for your opinion and Perception of being able to apply Theory of Inventive Problem Solving (TRIZ):

		Survey Scale: 1=Strongly Disagree 2=Disagree 3=Neutral 4=Agree 5=Strongly Agree				
#	Question					
1	I am very good at problem solving	1	2	3	4	5
2	Problem solving skills are of vital importance	1	2	3	4	5
3	I am never intimidated by unknown problems	1	2	3	4	5
4	I am unable to tackle unfamiliar problems	1	2	3	4	5
5	So far, I have resolved every problem I faced	1	2	3	4	5
6	I am certain that I am able to resolve any problem I will face	1	2	3	4	5
7	I clearly understood how to apply TRIZ problem solving tools	1	2	3	4	5
8	TRIZ is easy to apply in my work	1	2	3	4	5
9	TRIZ can be adopted into my daily life or work	1	2	3	4	5
10	TRIZ consumes a lot of time	1	2	3	4	5
11	I find it hard to use TRIZ within a given period of time	1	2	3	4	5
12	With having couple of practices, TRIZ can applied on shorter periods of time	1	2	3	4	5
13	The training provides me with clear systematic guidance to apply TRIZ	1	2	3	4	5

Figure 54: Survey Instrument - TRIZ Feedback Survey Page 1

14	TRIZ training can be easily understood if the systematic approach is provided.	1	2	3	4	5
15	I find hard to understand TRIZ without having a systematic guidance	1	2	3	4	5
16	TRIZ can be helpful in generating innovative ideas	1	2	3	4	5
17	I believe that TRIZ must be applied in my organization	1	2	3	4	5
18	I believe that my co workers should also apply TRIZ	1	2	3	4	5
19	TRIZ should be applied in different UAE industries	1	2	3	4	5
20	My organization should emphasize on applying TRIZ in different problem solving.	1	2	3	4	5

The following 5-Likert Survey indicates the Organization Change in your work:

Circle the correct numeric response to each question

Survey Scale: 1=Strongly Disagree 2=Disagree 3=Neutral 4=Agree 5=Strongly Agree

#	Question					
1	My work provides new or significant improved knowledge management system to better understand or exchange information, knowledge and skills.	1	2	3	4	5
2	My work provides new management systems for the production or supply operation.	1	2	3	4	5
3	My work had significant changes to the organization of work , where it increased employee decision making and responsibility for their work	1	2	3	4	5
4	My work has significant change to the management structure of the entrepreneur, such as creating new divisions or departments, integrating different departments of activities and adopting of a new networked structure.	1	2	3	4	5
5	My work provides new or significant changes in the relations with other firms or public instructions, such as through alliances, partnership, outsourcing or sub-sourcing.	1	2	3	4	5

Figure 55: Survey Instrument - TRIZ Feedback Survey Page 2 and Community Innovation Survey (4th CIS) Organizational Change

APPENDIX C

CORRELATION ANALYSIS TABLES

Table 38: Correlation analysis for H1 Between Transformational Leadership & Knowledge Management Practices

Questions	Correlation Type	Coefficient	Idealized influence Q10	Idealized influence Q18	Idealized influence Q21	Idealized influence Q25	Idealized influence Q6	Idealized influence Q14	Idealized influence Q23	Idealized influence Q34	Inspirational Motivation Q9	Inspirational Motivation Q13	Inspirational Motivation Q26	Inspirational Motivation Q36	Intellectual Stimulation Q2	Intellectual Stimulation Q8	Intellectual Stimulation Q30	Intellectual Stimulation Q32	Individual Consideration Q15	Individual Consideration Q19	Individual Consideration Q29	Individual Consideration Q31
Knowledge Q1	Pearson	Correlation Coefficient		.205**										.183**								
		Sig. (2-tailed)		.003										.008								
		N		205										205								
	Kendall's Tau_b	Correlation Coefficient	.147*	.197**		.161*		.135*		.192**	.142*	.138*	.126*	.199**	.132*	.124*			.126*		.130*	
		Sig. (2-tailed)	.018	.002		.011		.033		.002	.023	.029	.045	.002	.032	.047			.042		.034	
		N	205	205		205		205		205	205	205	205	205	205	205			205		205	
	Spearman	Correlation Coefficient	.165*	.220**		.179*		.147*		.219**	.159*	.153*	.141*	.218**	.150*	.141*			.141*		.144*	
		Sig. (2-tailed)	.018	.002		.010		.036		.002	.023	.028	.044	.002	.032	.044			.044		.039	
		N	205	205		205		205		205	205	205	205	205	205	205			205		205	
People Q2	Pearson	Correlation Coefficient													.163*						.147*	
		Sig. (2-tailed)													.020						.035	
		N													205						205	
	Kendall's Tau_b	Correlation Coefficient														.146*					.119*	
		Sig. (2-tailed)														.018					.049	
		N														205					205	
	Spearman	Correlation Coefficient														.164*					.138*	
		Sig. (2-tailed)														.019					.049	
		N														205					205	
People Q3	Pearson	Correlation Coefficient	.180**												.146*	.173*						
		Sig. (2-tailed)	.010												.037	.013						
		N	205												205	205						
	Kendall's Tau_b	Correlation Coefficient						.129*								.126*						
		Sig. (2-tailed)						.039								.043						
		N						205								205.000						
	Spearman	Correlation Coefficient						.143*								.140*						
		Sig. (2-tailed)						.041								.046						
		N						205								205						
Process Q4	Pearson	Correlation Coefficient	.156*												.176*	.148*	.190**	.138*	.156*	.156*	.208**	
		Sig. (2-tailed)	0.03												.011	.035	.006	.048	.025	.026	.003	
		N	205												205	205	205	205	205	205	205	
	Kendall's Tau_b	Correlation Coefficient		.135*		.144*				.127*	.141*				.164**		.184**	.124*	.158*	.146*	.183**	
		Sig. (2-tailed)		.029		.022				.040	.024				.009		.003	.048	.011	.017	.003	
		N		205		205				205	205				205	205	205	205	205	205	205	
	Spearman	Correlation Coefficient		.150*		.161*				.141*	.158*				.183**		.206**	.137*	.178*	.166*	.208**	
		Sig. (2-tailed)		.031		.021				.044	.023				.009		.003	.050	.011	.017	.003	
		N		205		205				205	205				205	205	205	205	205	205	205	
Technology Q5	Pearson	Correlation Coefficient	.177*	.141*				.146*							.181**						.190**	
		Sig. (2-tailed)	0.01	0.04				0.04							.009						.006	
		N	205	205				205							205						205	
	Kendall's Tau_b	Correlation Coefficient	.144*			.152*		.169**		.144*					.190**				.132*		.140*	
		Sig. (2-tailed)	0.02			.016		.007		.022					.002				.033		.022	
		N	205			205		205		205					205				205		205	
	Spearman	Correlation Coefficient	.158*			.168*		.187**		.160*					.214**				.150*		.154*	
		Sig. (2-tailed)	.023			.016		.007		.022					.002				.032		.027	
		N	205			205		205		205					205				205		205	

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Questions	Correlation Type	Coefficient	Contengency Reward Q1	Contengency Reward Q11	Contengency Reward Q16	Contengency Reward Q35	Managem ent By Exception Passive Q3	Managem ent By Exception Passive Q12	Managem ent By Exception Passive Q17	Managem ent By Exception Passive Q20	Managem ent By Exception Active Q4	Managem ent By Exception Active Q22	Managem ent By Exception Active Q24	Managem ent By Exception Active 27	Laissez Faire Leadershi p Q3	Laissez Faire Leadershi p Q5	Laissez Faire Leadershi p Q28	Laissez Faire Leadershi p Q33
Knowledge Q1	Pearson	Correlation Coefficient					-.193**											
		Sig. (2-tailed)					.005											
		N					205											
	Kendall's Tau_b	Correlation Coefficient		.143*		.131*	-.177**											
		Sig. (2-tailed)		.020		.033	.003											
		N		205		205	205											
	Spearman	Correlation Coefficient		.157*		.147*	-.204**											
		Sig. (2-tailed)		.025		.036	.003											
		N		205		205	205											
People Q2	Pearson	Correlation Coefficient						.197**										
		Sig. (2-tailed)						0.00465										
		N						205										
	Kendall's Tau_b	Correlation Coefficient		.136*	.144*			.138*										
		Sig. (2-tailed)		.026	.018			.020										
		N		205	205			205										
	Spearman	Correlation Coefficient		.151*	.162*			.161*										
		Sig. (2-tailed)		.031	.020			.021										
		N		205	205			205										
People Q3	Pearson	Correlation Coefficient						.248**							.144*			
		Sig. (2-tailed)						.000							.039			
		N						205							205			
	Kendall's Tau_b	Correlation Coefficient						.200**							.133*			
		Sig. (2-tailed)						.001							.030			
		N						205							205			
	Spearman	Correlation Coefficient						.231**							.150*			
		Sig. (2-tailed)						.001							.032			
		N						205							205			
Process Q4	Pearson	Correlation Coefficient		.170*	.178*													
		Sig. (2-tailed)		.015	.011													
		N		205	205													
	Kendall's Tau_b	Correlation Coefficient		.173**	.163**													
		Sig. (2-tailed)		.005	.007													
		N		205	205													
	Spearman	Correlation Coefficient		.197**	.185**													
		Sig. (2-tailed)		.005	.008													
		N		205	205													
Technology Q5	Pearson	Correlation Coefficient																
		Sig. (2-tailed)																
		N																
	Kendall's Tau_b	Correlation Coefficient		.141*		.124*												
		Sig. (2-tailed)		.022		.043												
		N		205		205												
	Spearman	Correlation Coefficient		.158*		.140*												
		Sig. (2-tailed)		.024		.046												
		N		205		205												

Table 40: Correlation analysis for H2 Between Individual, Group and Organizational Diversity Climate & Knowledge Management

Questions	Correlation Type	Coefficient	Individual Respect Q1	Individual Equality Q2	Individual Conflict Q3	Individual Discrimination Q4	Individual Feeling about diversity Q5	Group Respect Q6	Group Equality Q7	Group Conflict Q8	Group Discrimination Q9	Group Feeling about diversity Q10	Organizational Respect Q11	Organizational Equality Q12	Organizational Conflict Q13	Organizational Discrimination Q14	Organizational Feeling about diversity Q15
Knowledge Q1	Pearson	Correlation Coefficient	.337**	.330**	-.190**	-.180**	.278**	.174*	.151*		.383**	.273**	.320**	.293**			.352**
		Sig. (2-tailed)	.000	.000	.006	.010	.000	.013	.030		.000	.000	.000	.000			.000
		N	205	205	205	205	205	205	205		205	205	205	205			205
	Kendall's Tau_b	Correlation Coefficient	.292**	.314**	-.148*	-.122*	.254**	.155*	.145*		.301**	.232**	.289**	.300**		.164**	.315**
		Sig. (2-tailed)	.000	.000	.014	.042	.000	.010	.017		.000	.000	.000	.000		.005	.000
		N	205	205	205	205	205	205	205		205	205	205	205		205	205
	Spearman	Correlation Coefficient	.325**	.362**	-.172*	-.141*	.290**	.175*	.164*		.343**	.257**	.318**	.338**		.185**	.356**
		Sig. (2-tailed)	.000	.000	.014	.043	.000	.012	.019		.000	.000	.000	.000		.008	.000
		N	205	205	205	205	205	205	205		205	205	205	205		205	205
People Q2	Pearson	Correlation Coefficient	.231**	.272**			.245**	.237**	.264**		.320**		.298**	.300**	.197**		.230**
		Sig. (2-tailed)	.001	.000			.000	.001	.000		.000		.000	.000	.005		.001
		N	205	205			205	205	205		205		205	205	205		205
	Kendall's Tau_b	Correlation Coefficient	.188**	.252**			.185**	.208**	.229**		.299**	.152*	.277**	.270**	.192**	.155**	.215**
		Sig. (2-tailed)	.002	.000			.002	.000	.000		.000	.012	.000	.000	.001	.008	.000
		N	205	205			205	205	205		205	205	205	205	205	205	205
	Spearman	Correlation Coefficient	.209**	.290**			.213**	.233**	.257**		.341**	.169*	.308**	.305**	.216**	.173*	.245**
		Sig. (2-tailed)	.003	.000			.002	.001	.000		.000	.015	.000	.000	.002	.013	.000
		N	205	205			205	205	205		205	205	205	205	205	205	205
People Q3	Pearson	Correlation Coefficient	.237**	.304**			.223**	.181**	.203**		.331**	.156*	.182**	.272**		.171*	.331**
		Sig. (2-tailed)	.001	.000			.001	.009	.004		.000	.025	.009	.000		.014	.000
		N	205	205			205	205	205		205	205	205	205		205	205
	Kendall's Tau_b	Correlation Coefficient	.230**	.272**			.200**	.153*	.195**		.271**	.170**	.188**	.244**		.170**	.308**
		Sig. (2-tailed)	.000	.000			.001	.011	.001		.000	.005	.002	.000		.004	.000
		N	205	205			205	205	205		205	205	205	205		205	205
	Spearman	Correlation Coefficient	.260**	.307**			.222**	.172*	.217**		.307**	.189**	.212**	.274**		.195**	.347**
		Sig. (2-tailed)	.000	.000			.001	.014	.002		0.000	0.007	0.002	0.000		0.005	0.000
		N	205	205			205	205	205		205	205	205	205		205	205
Process Q4	Pearson	Correlation Coefficient	.295**	.283**	-.186**		.226**	.238**	.219**		.399**	.241**	.237**	.323**			.342**
		Sig. (2-tailed)	.000	.000	.008		.001	.001	.002		.000	.000	.001	.000			.000
		N	205	205	205		205	205	205		205	205	205	205			205
	Kendall's Tau_b	Correlation Coefficient	.249**	.270**	-.182**		.198**	.207**	.184**		.345**	.229**	.231**	.276**		.151**	.302**
		Sig. (2-tailed)	.000	.000	.002		.001	.001	.002		.000	.000	.000	.000		.010	.000
		N	205	205	205		205	205	205		205	205	205	205		205	205
	Spearman	Correlation Coefficient	.282**	.313**	-.215**		.227**	.236**	.207**		.391**	.258**	.259**	.311**		.171*	.347**
		Sig. (2-tailed)	.000	.000	.002		.001	.001	.003		.000	.000	.000	.000		.014	.000
		N	205	205	205		205	205	205		205	205	205	205		205	205
Technology Q5	Pearson	Correlation Coefficient	.278**	.246**	-.165*		.360**	.262**	.224**		.403**	.215**	.253**	.310**		.163*	.418**
		Sig. (2-tailed)	.000	.000	.018		.000	.000	.001		.000	.002	.000	.000		.019	.000
		N	205	205	205		205	205	205		205	205	205	205		205	205
	Kendall's Tau_b	Correlation Coefficient	.260**	.256**	-.149*		.326**	.267**	.242**		.367**	.245**	.273**	.348**	.129*	.199**	.397**
		Sig. (2-tailed)	.000	.000	.013		.000	.000	.000		.000	.000	.000	.000	.031	.001	.000
		N	205	205	205		205	205	205		205	205	205	205	205	205	205
	Spearman	Correlation Coefficient	.289**	.293**	-.173*		.373**	.298**	.272**		.418**	.270**	.304**	.391**	.143*	.225**	.451**
		Sig. (2-tailed)	.000	.000	.013		.000	.000	.000		.000	.000	.000	.000	.040	.001	.000
		N	205	205	205		205	205	205		205	205	205	205	205	205	205

Table 41: Correlation Analysis for H3 Between Transformational Leadership & Problem Solving Construct of Perception of Being Able to Apply TRIZ

Questions	Correlation Type	Coefficient	Idealized influence Q10	Idealized influence Q18	Idealized influence Q21	Idealized influence Q25	Idealized influence Q6	Idealized influence Q14	Idealized influence Q23	Idealized influence Q34	Inspirational Motivation Q9	Inspirational Motivation Q13	Inspirational Motivation Q26	Inspirational Motivation Q36	Intellectual Stimulation Q2	Intellectual Stimulation Q8	Intellectual Stimulation Q30	Intellectual Stimulation Q32	Individual Consideration Q15	Individual Consideration Q19	Individual Consideration Q29	Individual Consideration Q31	
Problem Solving Q1	Pearson	Correlation Coefficient	.147*					.172*			.147*	.188**	.154*	.334**	.167*	.237**		.225**	.150*		.170*	.161*	
		Sig. (2-tailed)	.036					.014			.035	.007	.027	.000	.017	.001		.001	.032		.015	.021	
		N	205					205			205	205	205	205	205	205		205	205		205	205	
	Kendall's Tau_b	Correlation Coefficient						.169**				.155*	.155*	.268**	.133*	.197**		.210**	.153*		.141*	.181**	
		Sig. (2-tailed)						.008				.016	.015	.000	.034	.002		.001	.015		.024	.004	
		N						205				205	205	205	205	205		205	205		205	205	
	Spearman	Correlation Coefficient						.182**				.169**	.168**	.290**	.148*	.216**		.226**	.167*		.157*	.196**	
		Sig. (2-tailed)						.009				.016	.016	.000	.034	.002		.001	.017		.024	.005	
		N						205				205	205	205	205	205		205	205		205	205	
Problem Solving Q2	Pearson	Correlation Coefficient	.207**		.213**	.172*	.148*	.197**	.211**	.154*	.251**	.176*	.214**	.374**			.200**	.168*	.237**	.091	.202**	.218**	
		Sig. (2-tailed)	.003		.002	.014	.034	.005	.002	.027	.000	.012	.002	.000			.004	.016	.001	.195	.004	.002	
		N	205		205	205	205	205	205	205	205	205	205	205			205	205	205	205	205	205	
	Kendall's Tau_b	Correlation Coefficient	.214**	.146*	.264**	.197**	.172**	.187**	.234**	.212**	.250**	.172**	.190**	.306**			.178**	.158*	.222**		.219**	.254**	
		Sig. (2-tailed)	.001	.024	.000	.003	.007	.004	.000	.001	.000	.009	.004	.000			.007	.016	.001		.001	.000	
		N	205	205	205	205	205	205	205	205	205	205	205	205			205	205	205		205	205	
	Spearman	Correlation Coefficient	.229**	.157*	.278**	.208**	.189**	.198**	.249**	.229**	.268**	.184**	.203**	.326**			.188**	.169*	.238**		.239**	.273**	
		Sig. (2-tailed)	.001	.025	.000	.003	.007	.004	.000	.001	.000	.008	.003	.000			.007	.016	.001		.001	.000	
		N	205	205	205	205	205	205	205	205	205	205	205	205			205	205	205		205	205	
Problem Solving Q3	Pearson	Correlation Coefficient	.153*			.192**	.185**	.151*	.159*		.198**	.138*	.213**	.212**	.147*	.264**	.157*	.137*	.236**	.078	.191**	.208**	
		Sig. (2-tailed)	.029			.006	.008	.030	.023		.004	.049	.002	.002	.035	.000	.025	.050	.001	.266	.006	.003	
		N	205			205	205	205	205		205	205	205	205	205	205	205	205	205	205	205	205	
	Kendall's Tau_b	Correlation Coefficient				.163*	.184**	.168**	.153*	.152*	.159*	.169**			.207**	.200**	.127*	.224**	.139*	.215**		.188**	.159*
		Sig. (2-tailed)				.010	.004	.006	.015	.016	.011	.007			.001	.001	.039	.000	.028	.039	.001	.002	.010
		N				205	205	205	205	205	205	205			205	205	205	205	205	205	205	205	205
	Spearman	Correlation Coefficient				.179*	.198**	.190**	.169*	.169*	.174*	.186**			.229**	.216**	.143*	.249**	.152*	.143*	.239**	.214**	.176*
		Sig. (2-tailed)				.010	.004	.006	.016	.015	.012	.008			.001	.002	.041	.000	.030	.041	.001	.002	.012
		N				205	205	205	205	205	205	205			205	205	205	205	205	205	205	205	205
Problem Solving Q4	Pearson	Correlation Coefficient						.234**	.143*	.139*	.224**	.203**	.232**	.278**		.193**		.158*	.212**		.250**	.230**	
		Sig. (2-tailed)						.001	.041	.046	.001	.004	.001	.000		.006		.023	.002		.000	.001	
		N						205	205	205	205	205	205	205		205		205	205		205	205	
	Kendall's Tau_b	Correlation Coefficient	.127*		.143*	.148*		.204**	.147*	.167**	.189**	.172**	.222**	.206**		.190**		.124*	.182**		.226**	.183**	
		Sig. (2-tailed)	.040		.024	.019		.001	.020	.007	.002	.006	.000	.001		.002		.048	.003		.000	.003	
		N	205		205	205		205	205	205	205	205	205	205		205		205	205		205	205	
	Spearman	Correlation Coefficient	.145*		.158*	.164*		.228**	.163*	.187**	.210**	.192**	.245**	.230**	.070274	.214**		.138*	.200**		.258**	.207**	
		Sig. (2-tailed)	0.038678		0.023769	0.019147		0.001031	0.019191	0.007295	0.002504	0.0005802	0.000402	0.000925	0.316703	0.002035		0.047737	0.00398		0.000189	0.002964	
		N	205		205	205		205	205	205	205	205	205	205	205	205		205	205		205	205	
Problem Solving Q5	Pearson	Correlation Coefficient				.155*	.160*		.152*	.176*	.141*	.223**	.183**	.204**	.276**	.207**	.161*		.236**		.227**	.169*	
		Sig. (2-tailed)				.027	.022		.029	.012	.043	.001	.008	.003	.000	.003	.021		.001		.001	.015	
		N				205	205		205	205	205	205	205	205	205	205	205		205		205	205	
	Kendall's Tau_b	Correlation Coefficient		.156*	.185**	.165**	.124*	.146*	.182**	.174**	.177**	.143*	.211**	.243**	.185**	.148*		.244**	.148*		.227**	.158*	
		Sig. (2-tailed)		.012	.003	.009	.042	.020	.004	.005	.005	.023	.001	.000	.003	.017		.000	.016		.000	.011	
		N		205	205	205	205	205	205	205	205	205	205	205	205	205		205	205		205	205	
	Spearman	Correlation Coefficient		.175*	.205**	.182**	.144*	.162*	.201**	.198**	.198**	.161*	.236**	.271**	.209**	.168*		.270**	.164*		.261**	.177*	
		Sig. (2-tailed)		.012	.003	.009	.039	.021	.004	.004	.004	.021	.001	.000	.003	.016		.000	.019		.000	.011	
		N		205	205	205	205	205	205	205	205	205	205	205	205	205		205	205		205	205	
Problem Solving Q6	Pearson	Correlation Coefficient	.161*		.203**	.158*	.149*	.211**	.198**	.200**	.239**	.214**	.256**	.391**	.166*	.216**	.248**	.258**	.253**		.323**	.219**	
		Sig. (2-tailed)	.021		.004	.023	.032	.002	.004	.004	.001	.002	.000	.000	.017	.002	.000	.000	.000		.000	.002	
		N	205		205	205	205	205	205	205	205	205	205	205	205	205	205	205	205		205	205	
	Kendall's Tau_b	Correlation Coefficient	.139*	.149*	.250**	.156*	.157*	.163*	.217**	.244**	.212**	.168**	.282**	.318**	.189**	.170**	.208**	.217**	.211**		.293**	.223**	
		Sig. (2-tailed)	.027	.018	.000	.015	.011	.011	.001	.000	.001	.008	.000	.000	.002	.007	.001	.001	.001		.000	.000	
		N	205	205	205	205	205	205	205	205	205	205	205	205	205	205	205	205	205		205	205	
	Spearman	Correlation Coefficient	.155*	.162*	.273**	.169*	.178*	.179*	.238**	.273**	.235**	.185**	.309**	.348**	.208**	.227**	.238**	.233**		.331**	.248**		
		Sig. (2-tailed)	.026	.020	.000	.015	.011	.010	.001	.000	.001	.008	.000	.000	.003	.006	.001	.001	.001		.000	.000	
		N	205	205	205	205	205	205	205	205	205	205	205	205	205	205	205	205	205		205	205	

Table 42: Correlation Analysis for H3 Between Transformational Leadership and Degree of Adoption, Time Consumption of Perception of Being Able to Apply TRIZ

Questions	Correlation Type	Coefficient	Idealized influence Q10	Idealized influence Q18	Idealized influence Q21	Idealized influence Q25	Idealized influence Q6	Idealized influence Q14	Idealized influence Q23	Idealized influence Q34	Inspirational Motivation Q9	Inspirational Motivation Q13	Inspirational Motivation Q26	Inspirational Motivation Q36	Intellectual Stimulation Q2	Intellectual Stimulation Q8	Intellectual Stimulation Q30	Intellectual Stimulation Q32	Individual Consideration Q15	Individual Consideration Q19	Individual Consideration Q29	Individual Consideration Q31
Degree of Adoption Q7	Pearson	Correlation Coefficient	.172*		.168*	.157*	.145*	.156*	.176*		.195**	.263**	.127	.272**					.163*	.194**		.140*
		Sig. (2-tailed)	.014		.016	.024	.038	.025	.012		.005	.000	.071	.000					.020	.005		.045
		N	205		205	205	205	205	205		205	205	205	205					205	205		205
	Kendall's Tau_b	Correlation Coefficient	.153*		.186**	.179**	.170**	.155*	.171**	.139*	.212**	.260**	.157*	.210**					.166**	.178**		
		Sig. (2-tailed)	.015		.004	.005	.006	.016	.008	.027	.001	.000	.014	.001					.009	.004		
		N	205		205	205	205	205	205	205	205	205	205	205					205	205		
	Spearman	Correlation Coefficient	.168*		.201**	.194**	.194**	.169*	.188**	.153*	.233**	.283**	.172*	.229**					.183**	.198**		
		Sig. (2-tailed)	.016		.004	.005	.005	.015	.007	.028	.001	.000	.014	.001					.009	.004		
		N	205		205	205	205	205	205	205	205	205	205	205					205	205		
Degree of Adoption Q8	Pearson	Correlation Coefficient		.226**	.169*	.223**	.149*	.138*		.150*		.233**	.155*	.220**					.157*		.157*	
		Sig. (2-tailed)		.001	.015	.001	.033	.049		.032		.001	.026	.002					.025		.024	
		N		205	205	205	205	205		205		205	205	205					205		205	
	Kendall's Tau_b	Correlation Coefficient		.227**	.128*	.169**	.164**	.151*		.190**	.131*	.233**	.152*	.210**					.158*	.139*		
		Sig. (2-tailed)		.000	.045	.008	.008	.017		.002	.037	.000	.016	.001					.012	.025		
		N		205	205	205	205	205		205	205	205	205	205					205	205		
	Spearman	Correlation Coefficient		.255**	.140*	.185**	.188**	.166*		.213**	.146*	.259**	.168*	.233**					.176*	.159*		
		Sig. (2-tailed)		.000	.045	.008	.007	.017		.002	.037	.000	.016	.001					.012	.023		
		N		205	205	205	205	205		205	205	205	205	205					205	205		
Degree of Adoption Q9	Pearson	Correlation Coefficient	.178*	.198**					.148*					.143*					.194**			
		Sig. (2-tailed)	.011	.004					.034					.041					.005			
		N	205	205					205					205					205			
	Kendall's Tau_b	Correlation Coefficient	.201**	.196**		.145*	.173**	.188**		.171**	.136*	.171**		.198**					.171**			
		Sig. (2-tailed)	.001	.002		.023	.005	.003		.006	.030	.007		.002					.006			
		N	205	205		205	205	205		205	205	205		205					205			
	Spearman	Correlation Coefficient	.224**	.219**		.160*	.199**	.207**		.192**	.154*	.192**		.218**					.193**			
		Sig. (2-tailed)	.001	.002		.022	.004	.003		.006	.028	.006		.002					.006			
		N	205	205		205	205	205		205	205	205		205					205			
Time Consumption Q10	Pearson	Correlation Coefficient																				
		Sig. (2-tailed)																				
	Kendall's Tau_b	Correlation Coefficient																				
		Sig. (2-tailed)																				
	Spearman	Correlation Coefficient																				
		Sig. (2-tailed)																				
Time Consumption Q11	Pearson	Correlation Coefficient																	.146*			
		Sig. (2-tailed)																	.036			
	Kendall's Tau_b	Correlation Coefficient																	.205			
		Sig. (2-tailed)																	.119*			
	Spearman	Correlation Coefficient																	.050			
		Sig. (2-tailed)																	.205			
Time Consumption Q12	Pearson	Correlation Coefficient			.154*	.217**			.220**	.214**		.230**	.225**	.181**	.242**	.164*	.177*	.148*		.210**		
		Sig. (2-tailed)			.027	.002			.002	.002		.001	.001	.010	.000	.019	.011	.034		.002		
		N			205	205			205	205		205	205	205	205	205	205	205		205		
	Kendall's Tau_b	Correlation Coefficient			.201**	.237**	.167**	.262**	.239**	.141*	.268**	.253**	.214**	.256**	.147*	.222**	.166**	.175**	.210**			.191**
		Sig. (2-tailed)			.002	.000	.007	.000	.000	.024	.000	.000	.001	.000	.018	.000	.009	.006	.001			.002
		N			205	205	205	205	205	205	205	205	205	205	205	205	205	205	205			.002
	Spearman	Correlation Coefficient			.221**	.256**	.191**	.291**	.261**	.154*	.295**	.277**	.235**	.281**	.166*	.246**	.182**	.193**	.234**			.213**
		Sig. (2-tailed)			.001	.000	.006	.000	.000	.027	.000	.000	.001	.000	.017	.000	.009	.006	.001			.002
		N			205	205	205	205	205	205	205	205	205	205	205	205	205	205	205			.002

Table 43: Correlation Analysis for H3 Between Transformational Leadership and Systematic Guidance, Degree of Acceptance of Perception of Being Able to Apply TRIZ

Questions	Correlation Type	Coefficient	Identified Influence Q10	Identified Influence Q18	Identified Influence Q21	Identified Influence Q25	Identified Influence Q6	Identified Influence Q14	Identified Influence Q25	Identified Influence Q34	Inspiration and Motivation Q9	Inspiration and Motivation Q13	Inspiration and Motivation Q26	Inspiration and Motivation Q36	Intellectual Stimulation Q12	Intellectual Stimulation Q8	Intellectual Stimulation Q39	Intellectual Stimulation Q32	Individual Consideration Q15	Individual Consideration Q19	Individual Consideration Q29	Individual Consideration Q31	
Systematic Guidance Q13	Pearson	Correlation Coefficient			205**	208**		273**	233**		255**	241**	264**	296**	183**	243**	165*	267**	177*		232**	179*	
		Sig. (2-sided)			.003	.003		.000	.001		.000	.000	.000	.000	.009	.000	.018	.000	.011		.001	.010	
		N			205	205		205	205		205	205	205	205	205	205	205	205	205		205	205	
	Kendall's Tau_b	Correlation Coefficient		156*	255**	264**	134*	278**	235**	173**	302**	257**	316**	357**	185**	250**	156*	285**	175**		238**	208**	
		Sig. (2-sided)		.013	.000	.000	.030	.000	.000	.006	.000	.000	.000	.000	.003	.000	.015	.000	.005		.000	.001	
		N		205	205	205	205	205	205	205	205	205	205	205	205	205	205	205	205		205	205	
	Spearman	Correlation Coefficient			172**	271**	236**	135*	301**	257**	311**	333**	381**	446**	385**	207**	277**	170*	311**	195**		262**	220**
		Sig. (2-sided)			.014	.000	.000	.027	.000	.006	.000	.000	.000	.000	.003	.000	.015	.000	.005		.000	.001	
		N			205	205	205	205	205	205	205	205	205	205	205	205	205	205	205		205	205	
Systematic Guidance Q14	Pearson	Correlation Coefficient	276**	151*	318**	207**	161*	315**	349**	188**	240**	287**	235**	405**	303**	305**	225**	270**	234**		264**	208**	
		Sig. (2-sided)	.000	.030	.000	.003	.021	.000	.000	.007	.001	.000	.001	.000	.000	.000	.001	.000	.001		.000	.003	
		N	205	205	205	205	205	205	205	205	205	205	205	205	205	205	205	205	205		205	205	
	Kendall's Tau_b	Correlation Coefficient	305**	299**	375**	276**	239**	348**	346**	280**	298**	318**	374**	393**	284**	320**	250**	293**	286**		279**	287**	
		Sig. (2-sided)	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000		.000	.000	
		N	205	205	205	205	205	205	205	205	205	205	205	205	205	205	205	205	205		205	205	
	Spearman	Correlation Coefficient	337**	325**	403**	295**	270**	376**	376**	308**	328**	342**	350**	423**	310**	352**	270**	317**	313**		308**	313**	
		Sig. (2-sided)	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000		.000	.000	
		N	205	205	205	205	205	205	205	205	205	205	205	205	205	205	205	205	205		205	205	
Systematic Guidance Q15	Pearson	Correlation Coefficient	153*		150*	202**		248**	176*	176*	198**		187**	199**	228**	149**	141*	147*		174*			
		Sig. (2-sided)	.028		.031	.004		.000	.012	.012	.004		.009	.004	.001	.023	.044	.026		.012			
		N	205		205	205		205	205	205	205		205	205	205	205	205	205		205			
	Kendall's Tau_b	Correlation Coefficient	150*	170**	147*	183**	162**	154*	269**	213**	187**	259**	163**	195**	165**	247**	140*	159*	148*		178**	135*	
		Sig. (2-sided)	.014	.005	.018	.003	.007	.013	.000	.000	.002	.000	.000	.002	.008	.000	.024	.010	.015		.003	.027	
		N	205	205	205	205	205	205	205	205	205	205	205	205	205	205	205	205	205		205	205	
	Spearman	Correlation Coefficient	169*	193**	162*	199**	190**	173*	300**	246**	212**	259**	180**	221**	185**	281**	156*	180**	169*		201**	151*	
		Sig. (2-sided)	.016	.006	.020	.004	.006	.013	.000	.000	.002	.000	.010	.001	.008	.000	.026	.010	.015		.004	.030	
		N	205	205	205	205	205	205	205	205	205	205	205	205	205	205	205	205	205		205	205	
Degree of Acceptance Q16	Pearson	Correlation Coefficient	272**		221**	145*	176*	156*	336**		237**	186**		271**		197*	161*		188**				
		Sig. (2-sided)	.001		.001	.038	.012	.026	.000		.001	.010		.000		.025	.021	.017	.002				
		N	205		205	205	205	205	205		205	205		205		205	205	205	205				
	Kendall's Tau_b	Correlation Coefficient	234**	188**	279**	213**	233**	187**	319**	163*	306**	205**	175**	337**		173**	211**	202**	270**		194**	135*	
		Sig. (2-sided)	.000	.003	.000	.001	.000	.004	.000	.011	.000	.002	.007	.000		.007	.001	.002	.000		.002	.035	
		N	205	205	205	205	205	205	205	205	205	205	205	205		205	205	205	205		205	205	
	Spearman	Correlation Coefficient	253**	206**	296**	236**	261**	200**	343**	176*	331**	219**	187**	361**		187**	225**	216**	295**		212**	147*	
		Sig. (2-sided)	.000	.003	.000	.001	.000	.004	.000	.012	.000	.002	.007	.000		.007	.001	.002	.000		.002	.036	
		N	205	205	205	205	205	205	205	205	205	205	205	205		205	205	205	205		205	205	
Degree of Acceptance Q17	Pearson	Correlation Coefficient		345**	200**	212**								288**			191**	146*	182**				
		Sig. (2-sided)		.000	.004	.002								.000			.006	.037	.009				
		N		205	205	205								205			205	205	205				
	Kendall's Tau_b	Correlation Coefficient		139*	267**	188**	216**		164*	177**	145*	153*	146*	256**			267**	173**					
		Sig. (2-sided)		.027	.000	.003	.001		.010	.005	.021	.016	.021	.000			.001	.006					
		N		205	205	205	205		205	205	205	205	205	205			205	205					
	Spearman	Correlation Coefficient		135*	296**	204**	238**		181**	192**	160*	168*	161*	286**			227**	192**					
		Sig. (2-sided)		.027	.000	.003	.001		.010	.006	.022	.016	.021	.000			.001	.006					
		N		205	205	205	205		205	205	205	205	205	205			205	205					
Degree of Acceptance Q18	Pearson	Correlation Coefficient			171*		155*							317**			184**						
		Sig. (2-sided)			.014		.026							.000			.008						
		N			205		205							205			205						
	Kendall's Tau_b	Correlation Coefficient		222**	134*	191**		136*	185**	150*	177**			281**			192**	158*					
		Sig. (2-sided)		.000	.037	.003		.034	.003	.018	.006			.000			.003	.012					
		N		205	205	205		205	205	205	205			205			205	205					
	Spearman	Correlation Coefficient		245**	146*	209**		148*	203**	164*	193**			306**			209**	175*					
		Sig. (2-sided)		.000	.037	.003		.034	.004	.019	.006			.000			.003	.012					
		N		205	205	205		205	205	205	205			205			205	205					
Degree of Acceptance Q19	Pearson	Correlation Coefficient	168*		230**	249**	142*	148*	191**	201**	197**	195**	197**	383**		172*	157*	220**		165**			
		Sig. (2-sided)	.016		.001	.000	.042	.034	.006	.004	.005	.005	.005	.000		.014	.025	.002		.018			
		N	205		205	205	205	205	205	205	205	205	205	205		205	205	205		205			
	Kendall's Tau_b	Correlation Coefficient	132*	165**	226**	243**	196**	151*	220**	248**	222**	216**	211**	327**		133*	163*	199**	241**		125*	134*	
		Sig. (2-sided)	.027	.009	.000	.000	.002	.019	.001	.000	.001	.001	.001	.000		.037	.012	.000	.000		.013	.034	
		N	205	205	205	205	205	205	205	205	205	205	205	205		205	205	205	205		205	205	
	Spearman	Correlation Coefficient	145*	180**	242**	262**	217**	162*	238**	270**	240**	234**	227**	352**		145*	175**	217**	264**		169*	146*	
		Sig. (2-sided)	.038	.010	.000	.000	.002	.021	.001	.000	.001	.001	.001	.000		.038	.012	.002	.000		.015	.037	
		N	205	205	205	205	205	205	205	205	205	205	205	205		205	205	205	205		205	205	
Degree of Acceptance Q20	Pearson	Correlation Coefficient	136**	176*	139*	191**		139*	183**	203**				148**			144**						
		Sig. (2-sided)	.048	.012	.046	.006		.047	.008	.004				.006			.034						
		N	205	205	205	205		205	205	205				205			205						
	Kendall's Tau_b	Correlation Coefficient	129*	188**	128*	178**		146*	215**	243**				161*			170**						
		Sig. (2-sided)	.043	.003	.046	.005		.022	.001	.000				.012			.008	.013					

Table 44: Correlation Analysis for H3 Between Transactional Leadership, Laissez Faire and Problem Solving of Perception of Being Able to Apply TRIZ

Questions	Correlation Type	Coefficient	Contenge ncy Reward Q1	Contenge ncy Reward Q11	Contenge ncy Reward Q16	Contenge ncy Reward Q35	Manage ment By Exceptio n Passive Q3	Manage ment By Exceptio n Passive Q12	Manage ment By Exceptio n Passive Q17	Manage ment By Exceptio n Passive Q20	Manage ment By Exceptio n Active Q4	Manage ment By Exceptio n Active Q22	Manage ment By Exceptio n Active Q24	Manage ment By Exceptio n Active 27	Laissez Faire Leadershi p Q3	Laissez Faire Leadershi p Q5	Laissez Faire Leadershi p Q28	Laissez Faire Leadershi p Q33
Problem Solving Q1	Pearson	Correlation Coefficient	.150*	.186**	.158*	.162*												
		Sig. (2-tailed)	.032	.008	.024	.020												
		N	205	205	205	205												
	Kendall's Tau_b	Correlation Coefficient	.165**	.195**	.167**	.156*												
		Sig. (2-tailed)	.009	.002	.008	.013												
		N	205	205	205	205												
	Spearman	Correlation Coefficient	.180**	.216**	.185**	.172*												
		Sig. (2-tailed)	.010	.002	.008	.014												
		N	205	205	205	205												
Problem Solving Q2	Pearson	Correlation Coefficient	.163*	.187**	.184**	.240**												
		Sig. (2-tailed)	.019	.007	.008	.001												
		N	205	205	205	205												
	Kendall's Tau_b	Correlation Coefficient	.167**	.230**	.208**	.211**	-.124*	-.155*										
		Sig. (2-tailed)	.010	.000	.001	.001	.048	.012										
		N	205	205	205	205	205	205										
	Spearman	Correlation Coefficient	.177*	.249**	.227**	.230**	-.139*	-.174*										
		Sig. (2-tailed)	.011	.000	.001	.001	.047	.013										
		N	205	205	205	205	205	205										
Problem Solving Q3	Pearson	Correlation Coefficient		.202**	.114	.154*												
		Sig. (2-tailed)		.004	.105	.027												
		N		205	205	205												
	Kendall's Tau_b	Correlation Coefficient		.183**	.132*	.157*												
		Sig. (2-tailed)		.003	.031	.011												
		N		205	205	205												
	Spearman	Correlation Coefficient		.203**	.149*	.176*												
		Sig. (2-tailed)		.003	.033	.012												
		N		205	205	205												
Problem Solving Q4	Pearson	Correlation Coefficient	.159*	.218**	.155*	.222**												
		Sig. (2-tailed)	.023	.002	.027	.001												
		N	205	205	205	205												
	Kendall's Tau_b	Correlation Coefficient	.151*	.204**	.176**	.214**												
		Sig. (2-tailed)	.014	.001	.004	.000												
		N	205	205	205	205												
	Spearman	Correlation Coefficient	.170*	.229**	.200**	.242**												
		Sig. (2-tailed)	0.014973	0.000941	0.004059	0.000471												
		N	205	205	205	205												
Problem Solving Q5	Pearson	Correlation Coefficient	.164*	.208**		.218**												
		Sig. (2-tailed)	.019	.003		.002												
		N	205	205		205												
	Kendall's Tau_b	Correlation Coefficient	.179**	.201**	.131*	.209**												
		Sig. (2-tailed)	.004	.001	.031	.001												
		N	205	205	205	205												
	Spearman	Correlation Coefficient	.199**	.229**	.149*	.233**												
		Sig. (2-tailed)	.004	.001	.033	.001												
		N	205	205	205	205												
Problem Solving Q6	Pearson	Correlation Coefficient	.207**	.228**	.208**	.258**												
		Sig. (2-tailed)	.003	.001	.003	.000												
		N	205	205	205	205												
	Kendall's Tau_b	Correlation Coefficient	.223**	.228**	.230**	.258**												
		Sig. (2-tailed)	.000	.000	.000	.000												
		N	205	205	205	205												
	Spearman	Correlation Coefficient	.249**	.252**	.257**	.286**												
		Sig. (2-tailed)	.000	.000	.000	.000												
		N	205	205	205	205												

Table 45: Correlation Analysis for H3 Between Transactional and Laissez Faire Leadership and Degree of Adoption, Time Consumption of Perception of Being Able to Apply TRIZ

Questions	Correlation Type	Coefficient	Confen- ncy Reward Q1	Confen- ncy Reward Q11	Confen- ncy Reward Q16	Confen- ncy Reward Q35	Manage- ment By Exceptio n Passive Q3	Manage- ment By Exceptio n Passive Q12	Manage- ment By Exceptio n Passive Q17	Manage- ment By Exceptio n Passive Q20	Manage- ment By Exceptio n Active Q4	Manage- ment By Exceptio n Active Q22	Manage- ment By Exceptio n Active Q24	Manage- ment By Exceptio n Active Q27	Laissez Faire Leadershl p Q3	Laissez Faire Leadershl p Q5	Laissez Faire Leadershl p Q28	Laissez Faire Leadershl p Q33
Degree of Adoption Q7	Pearson	Correlation Coefficient		.227**		.224**								.143*				
		Sig. (2-tailed)		.001		.001								.041				
		N		205		205								205				
	Kendall's Tau_b	Correlation Coefficient	.176**	.242**		.233**	-.140*							.157**				
		Sig. (2-tailed)	.005	.000		.000	.021							.008				
		N	205	205		205	205							205				
	Spearman	Correlation Coefficient	.193**	.269**	.152*	.260**	-.161*							.187**				
		Sig. (2-tailed)	.005	.000	.029	.000	.021							.007				
		N	205	205	205	205	205							205				
Degree of Adoption Q8	Pearson	Correlation Coefficient																
		Sig. (2-tailed)																
		N																
	Kendall's Tau_b	Correlation Coefficient	.142*				-.125*											
		Sig. (2-tailed)	.022				.037											
		N	205				205											
	Spearman	Correlation Coefficient	.161*				-.143*											
		Sig. (2-tailed)	.021				.041											
		N	205				205											
Degree of Adoption Q9	Pearson	Correlation Coefficient																
		Sig. (2-tailed)																
		N																
	Kendall's Tau_b	Correlation Coefficient																
		Sig. (2-tailed)																
		N																
	Spearman	Correlation Coefficient																
		Sig. (2-tailed)																
		N																
Time Consumption Q10	Pearson	Correlation Coefficient																
		Sig. (2-tailed)																
		N																
	Kendall's Tau_b	Correlation Coefficient																
		Sig. (2-tailed)																
		N																
	Spearman	Correlation Coefficient																
		Sig. (2-tailed)																
		N																
Time Consumption Q11	Pearson	Correlation Coefficient																
		Sig. (2-tailed)																
		N																
	Kendall's Tau_b	Correlation Coefficient																
		Sig. (2-tailed)																
		N																
	Spearman	Correlation Coefficient																
		Sig. (2-tailed)																
		N																
Time Consumption Q12	Pearson	Correlation Coefficient		.251**		.226**												
		Sig. (2-tailed)		.000		.001												
		N		205		205												
	Kendall's Tau_b	Correlation Coefficient		.246**		.199**												
		Sig. (2-tailed)		.000		.001												
		N		205		205												
	Spearman	Correlation Coefficient		.272**		.225**												
		Sig. (2-tailed)		.000		.001												
		N		205		205												

Table 46: Correlation Analysis for H3 Between Transactional and Laissez Faire Leadership and Systematic Guidance, Degree of Acceptance of Perception of Being Able to Apply TRIZ

Questions	Correlation Type	Coefficient	Confen- ce by Reward Q1	Confen- ce by Reward Q11	Confen- ce by Reward Q16	Confen- ce by Reward Q35	Manage- ment By Exception Positive Q12	Manage- ment By Exception Positive Q17	Manage- ment By Exception Positive Q17	Manage- ment By Exception Positive Q20	Manage- ment By Exception Active Q4	Manage- ment By Exception Active Q22	Manage- ment By Exception Active Q24	Manage- ment By Exception Active Q27	Laissez Faire Leadersh ip Q3	Laissez Faire Leadersh ip Q5	Laissez Faire Leadersh ip Q28	Laissez Faire Leadersh ip Q33
Systematic Guidance Q13	Pearson	Correlation Coefficient	.195**	.216**	.181**	.262**						.157*	.146*				-.236**	
		Sig. (2-tailed)	.005	.002	.009	.000						.024	.032				.001	
		N	205	205	205	205						205	205				205	
	Kendall's Tau_b	Correlation Coefficient	.231**	.228**	.187**	.263**	-.154*					.178**	.158**				-.217**	
		Sig. (2-tailed)	.000	.000	.003	.000	.011					.003	.007				.000	
		N	205	205	205	205	205					205	205				205	
Systematic Guidance Q14	Pearson	Correlation Coefficient	.255**	.254**	.206**	.292**	-.178*					.214**	.189**				-.241**	
		Sig. (2-tailed)	.000	.000	.003	.000	.011					.002	.007				.000	
		N	205	205	205	205	205					205	205				205	
	Kendall's Tau_b	Correlation Coefficient	.225**	.249**	.213**	.264**					-.194**		.170*				-.184**	
		Sig. (2-tailed)	.001	.000	.002	.000					.005		.015				.008	
		N	205	205	205	205					205		205				205	
Systematic Guidance Q15	Pearson	Correlation Coefficient	.303**	.313**	.265**	.315**	-.151*					-.155**	.194**				-.146*	
		Sig. (2-tailed)	.000	.000	.000	.000	.01					.010	.001				.020	
		N	205	205	205	205	205					205	205				205	
	Kendall's Tau_b	Correlation Coefficient	.331**	.341**	.292**	.345**	-.173*					-.181**	.236**				-.163*	
		Sig. (2-tailed)	.000	.000	.000	.000	.013					.000	.001				.019	
		N	205	205	205	205	205					205	205				205	
Systematic Guidance Q16	Pearson	Correlation Coefficient	.143*	.138*	.148*	.162*					.195**							
		Sig. (2-tailed)	.040	.048	.034	.020					.005							
		N	205	205	205	205					205							
	Kendall's Tau_b	Correlation Coefficient		.129*	.159**	.163**					.131*							
		Sig. (2-tailed)		.033	.008	.007					.023							
		N		205	205	205					205							
Degree of Acceptance Q17	Pearson	Correlation Coefficient		.144*	.182**	.181**					.160*							
		Sig. (2-tailed)		.039	.000	.010					.022							
		N		205	205	205					205							
	Kendall's Tau_b	Correlation Coefficient		.207**	.255**	.252**	-.152*				.158*							
		Sig. (2-tailed)		.003	.000	.029	.023				.006							
		N		205	205	205	205				205							
Degree of Acceptance Q18	Pearson	Correlation Coefficient	.148*	.253**	.139*	.188**	-.174**	-.157*			-.151**	-.160*					-.236**	
		Sig. (2-tailed)	.021	.000	.028	.003	.005	.011			.035	.006	.035				.001	
		N	205	205	205	205	205	205			205	205	205				205	
	Kendall's Tau_b	Correlation Coefficient	.161*	.279**	.153*	.207**	-.198**	-.178*			-.146*	-.154**	-.147*				-.269**	
		Sig. (2-tailed)	.021	.000	.028	.003	.004	.011			.037	.005	.035				.000	
		N	205	205	205	205	205	205			205	205	205				205	
Degree of Acceptance Q19	Pearson	Correlation Coefficient	.165*		.165*		-.189**										-.142*	
		Sig. (2-tailed)	.018		.018		.007										.042	
		N	205		205		205										.205	
	Kendall's Tau_b	Correlation Coefficient	.170**	.149*	.130*		-.182**										-.120*	
		Sig. (2-tailed)	.007	.017	.036		.003										.048	
		N	205	205	205		205										.026	
Degree of Acceptance Q20	Pearson	Correlation Coefficient	.187**	.166*	.146*		-.212**										.205	
		Sig. (2-tailed)	.007	.017	.037		.002										.050	
		N	205	205	205		205										.027	
	Kendall's Tau_b	Correlation Coefficient			.137*		-.217**										-.142*	
		Sig. (2-tailed)			.040		.002										.043	
		N			205		205										.029	
Degree of Acceptance Q21	Pearson	Correlation Coefficient	.148*		.133*		-.203**										-.145*	
		Sig. (2-tailed)	.018		.032		.001										.042	
		N	205		205		205										.205	
	Kendall's Tau_b	Correlation Coefficient	.164*		.140*		-.233**										-.161*	
		Sig. (2-tailed)	.019		.034		.001										.021	
		N	205		205		205										.039	
Degree of Acceptance Q22	Pearson	Correlation Coefficient	.289**	.159*	.189**	.157*											-.220**	
		Sig. (2-tailed)	.000	.023	.007	.025											.002	
		N	205	205	205	205											205	
	Kendall's Tau_b	Correlation Coefficient	.310**	.203**	.206**	.256**	-.151*										-.203**	
		Sig. (2-tailed)	.000	.001	.002	.013	.013										.001	
		N	205	205	205	205	205										205	
Degree of Acceptance Q23	Pearson	Correlation Coefficient	.337**	.224**	.219**	.171*	-.176*										-.225**	
		Sig. (2-tailed)	.000	.001	.002	.014	.012										.001	
		N	205	205	205	205	205										.205	
	Kendall's Tau_b	Correlation Coefficient	.144*		.161*												-.154*	
		Sig. (2-tailed)	.040		.021												.031	
		N	205		205												.205	
Degree of Acceptance Q24	Pearson	Correlation Coefficient		.126*			-.132*										-.156*	
		Sig. (2-tailed)		.043			.031										.013	
		N		205			205										.205	
	Kendall's Tau_b	Correlation Coefficient		.142*			-.153*										-.172*	
		Sig. (2-tailed)		.043			.028										.033	
		N		205			205										.205	

Table 47: Correlation Analysis for H4 Between Individual, Group, Organizational Diversity Climate and Problem Solving of Perception of Being Able to Apply TRIZ

Questions	Correlation Type	Coefficient	Individual Respect Q1	Individual Equality Q2	Individual Conflict Q3	Individual Discrimination Q4	Individual Feeling about diversity Q5	Group Respect Q6	Group Equality Q7	Group Conflict Q8	Group Discrimination Q9	Group Feeling about diversity Q10	Organizational Respect Q11	Organizational Equality Q12	Organizational Conflict Q13	Organizational Discrimination Q14	Organizational Feeling about diversity Q15
Problem Solving Q1	Pearson	Correlation Coefficient	.350**	.204**			.189**	.247**	.258**		.294**	.331**	.313**	.314**	.238**		.272**
		Sig. (2-tailed)	.000	.003			.007	.000	.000		.000	.000	.000	.000	.001		.000
		N	205	205			205	205	205		205	205	205	205	205		205
	Kendall's Tau_b	Correlation Coefficient	.243**	.191**			.204**	.223**	.221**		.237**	.264**	.273**	.283**	.204**		.250**
		Sig. (2-tailed)	.000	.002			.001	.000	.000		.000	.000	.000	.000	.001		.000
		N	205	205			205	205	205		205	205	205	205	205		205
	Spearman	Correlation Coefficient	.263**	.209**			.229**	.245**	.243**		.264**	.288**	.298**	.310**	.230**		.282**
		Sig. (2-tailed)	.000	.003			.001	.000	.000		.000	.000	.000	.000	.001		.000
		N	205	205			205	205	205		205	205	205	205	205		205
Problem Solving Q2	Pearson	Correlation Coefficient	.417**				.255**	.199**	.335**		.295**	.337**	.279**	.270**	.184**		.240**
		Sig. (2-tailed)	.000				.000	.004	.000		.000	.000	.000	.000	.008		.001
		N	205				205	205	205		205	205	205	205	205		205
	Kendall's Tau_b	Correlation Coefficient	.266**				.214**	.157*	.307**		.266**	.269**	.187**	.265**	.198**	.158*	.184**
		Sig. (2-tailed)	.000				.001	.012	.000		.000	.000	.004	.000	.002	.010	.003
		N	205				205	205	205		205	205	205	205	205	205	205
	Spearman	Correlation Coefficient	.282**				.233**	.172*	.336**		.286**	.287**	.201**	.289**	.217**	.177*	.201**
		Sig. (2-tailed)	.000				.001	.013	.000		.000	.000	.004	.000	.002	.011	.004
		N	205				205	205	205		205	205	205	205	205	205	205
Problem Solving Q3	Pearson	Correlation Coefficient	.350**				.211**	.168*			.179**	.261**					.318**
		Sig. (2-tailed)	.000				.002	.016			.010	.000					.000
		N	205				205	205			205	205					205
	Kendall's Tau_b	Correlation Coefficient	.313**				.208**	.193**			.144*	.151*	.247**	.121*	.141*	.139*	.271**
		Sig. (2-tailed)	.000				.001	.002			.018	.014	.000	.046	.019	.019	.000
		N	205				205	205			205	205	205	205	205	205	205
	Spearman	Correlation Coefficient	.343**				.237**	.221**			.163*	.169**	.278**		.158*	.154*	.303**
		Sig. (2-tailed)	.000				.001	.001			.019	.015	.000		.024	.027	.000
		N	205				205	205			205	205	205		205	205	205
Problem Solving Q4	Pearson	Correlation Coefficient	.300**	.203**			.140*	.245**	.312**		.213**	.307**	.285**	.276**	.185**		.319**
		Sig. (2-tailed)	.000	.003			.045	.000	.000		.002	.000	.000	.000	.008		.000
		N	205	205			205	205	205		205	205	205	205	205		205
	Kendall's Tau_b	Correlation Coefficient	.210**	.204**			.139*	.235**	.295**		.201**	.259**	.215**	.285**	.197**	.119*	.270**
		Sig. (2-tailed)	.001	.001			.022	.000	.000		.001	.000	.000	.000	.001	.043	.000
		N	205	205			205	205	205		205	205	205	205	205	205	205
	Spearman	Correlation Coefficient	.234**	.236**			.161*	.268**	.335**		.230**	.290**	.242**	.326**	.225**	.139*	.310**
		Sig. (2-tailed)	.001	.001			.021	.000	.000		.001	.000	.000	.000	.001	.047	.000
		N	205	205			205	205	205		205	205	205	205	205	205	205
Problem Solving Q5	Pearson	Correlation Coefficient	.346**	.185**			.208**	.214**			.319**	.329**	.299**	.330**	.268**		.346**
		Sig. (2-tailed)	.000	.008			.003	.002			.000	.000	.000	.000	.000		.000
		N	205	205			205	205			205	205	205	205	205		205
	Kendall's Tau_b	Correlation Coefficient	.261**	.174**			.181**	.182**			.252**	.257**	.250**	.286**	.270**	.117*	.304**
		Sig. (2-tailed)	.000	.004			.003	.003			.000	.000	.000	.000	.000	.046	.000
		N	205	205			205	205			205	205	205	205	205	205	205
	Spearman	Correlation Coefficient	.290**	.195**			.205**	.207**			.287**	.287**	.283**	.324**	.311**	.144*	.353**
		Sig. (2-tailed)	.000	.005			.003	.003			.000	.000	.000	.000	.000	.039	.000
		N	205	205			205	205			205	205	205	205	205	205	205
Problem Solving Q6	Pearson	Correlation Coefficient	.434**	.202**			.222**	.215**	.274**		.317**	.307**	.350**	.283**	.164*		.337**
		Sig. (2-tailed)	.000	.004			.000	.002	.000		.000	.000	.000	.000	.019		.000
		N	205	205			205	205	205		205	205	205	205	205		205
	Kendall's Tau_b	Correlation Coefficient	.328**	.204**			.161**	.171**	.219**		.279**	.251**	.284**	.236**	.170**	.119*	.285**
		Sig. (2-tailed)	.000	.001			.009	.005	.000		.000	.000	.000	.000	.005	.047	.000
		N	205	205			205	205	205		205	205	205	205	205	205	205
	Spearman	Correlation Coefficient	.357**	.234**			.183**	.193**	.242**		.310**	.276**	.316**	.266**	.190**	.141*	.324**
		Sig. (2-tailed)	.000	.001			.009	.005	.000		.000	.000	.000	.000	.006	.044	.000
		N	205	205			205	205	205		205	205	205	205	205	205	205

Table 48: Correlation Analysis for H4 Between Individual, Group, Organizational Diversity Climate and Degree of Adoption, Time Consumption of Perception of Being Able to Apply TRIZ

Questions	Correlation Type	Coefficient	Individual Respect Q1	Individual Equality Q2	Individual Conflict Q3	Individual Discrimination Q4	Individual Feeling about diversity Q5	Group Respect Q6	Group Equality Q7	Group Conflict Q8	Group Discrimination Q9	Group Feeling about diversity Q10	Organizational Respect Q11	Organizational Equality Q12	Organizational Conflict Q13	Organizational Discrimination Q14	Organizational Feeling about diversity Q15
Degree of Adoption Q7	Pearson	Correlation Coefficient	.355**	.156*			.229**	.183**	.246**		.294**	.367**	.266**	.217**	.160*		.237**
		Sig. (2-tailed)	.000	.026			.001	.009	.000		.000	.000	.000	.002	.022		.001
		N	205	205			205	205	205		205	205	205	205	205		205
	Kendall's Tau_b	Correlation Coefficient	.248**	.146*			.223**	.171**	.207**		.232**	.320**	.231**	.172**	.132*		.179**
		Sig. (2-tailed)	.000	.017			.000	.005	.001		.000	.000	.000	.005	.030		.003
		N	205	205			205	205	205		205	205	205	205	205		205
	Spearman	Correlation Coefficient	.271**	.164*			.250**	.190**	.227**		.258**	.346**	.257**	.192**	.149*		.205**
		Sig. (2-tailed)	.000	.018			.000	.006	.001		.000	.000	.000	.006	.033		.003
		N	205	205			205	205	205		205	205	205	205	205		205
Degree of Adoption Q8	Pearson	Correlation Coefficient	.160*	.250**		-.189**	.243**	.239**	.197**		.265**	.190**	.155*	.203**	.242**	.171*	.214**
		Sig. (2-tailed)	.022	.000		.007	.000	.001	.005		.000	.006	.026	.004	.000	.014	.002
		N	205	205		205	205	205	205		205	205	205	205	205	205	205
	Kendall's Tau_b	Correlation Coefficient	.141*	.247**		-.165**	.258**	.195**	.167**		.217**	.219**	.168**	.188**	.203**	.157**	.213**
		Sig. (2-tailed)	.023	.000		.006	.000	.001	.006		.000	.000	.007	.002	.001	.008	.000
		N	205	205		205	205	205	205		205	205	205	205	205	205	205
	Spearman	Correlation Coefficient	.159*	.285**		-.190**	.290**	.217**	.188**		.246**	.244**	.186**	.213**	.232**	.178*	.243**
		Sig. (2-tailed)	.023	.000		.006	.000	.002	.007		.000	.000	.008	.002	.001	.011	.000
		N	205	205		205	205	205	205		205	205	205	205	205	205	205
Degree of Adoption Q9	Pearson	Correlation Coefficient	.155*	.203**		-.160*	.207**		.178*		.220**	.171*	.144*	.173*			.189**
		Sig. (2-tailed)	.026	.004		.022	.003		.011		.002	.014	.039	.013			.007
		N	205	205		205	205		205		205	205	205	205			205
	Kendall's Tau_b	Correlation Coefficient	.160**	.241**		-.138*	.200**		.126*		.185**	.195**	.142*	.164**			.171**
		Sig. (2-tailed)	.010	.000		.022	.001		.039		.002	.002	.022	.007			.004
		N	205	205		205	205		205		205	205	205	205			205
	Spearman	Correlation Coefficient	.176*	.275**		-.157*	.224**		.140*		.210**	.217**	.155*	.185**			.196**
		Sig. (2-tailed)	.011	.000		.025	.001		.045		.003	.002	.027	.008			.005
		N	205	205		205	205		205		205	205	205	205			205
Time Consumption Q10	Pearson	Correlation Coefficient			.221**	.314**				.260**				.142*		.165*	
		Sig. (2-tailed)			.001	.000				.000				.042		.018	
		N			205	205				205				205		205	
	Kendall's Tau_b	Correlation Coefficient			.176**	.260**				.234**						.145*	
		Sig. (2-tailed)			.003	.000				.000						.012	
		N			205	205				205						205	
	Spearman	Correlation Coefficient			.207**	.305**				.271**						.172*	
		Sig. (2-tailed)			.003	.000				.000						.014	
		N			205	205				205						205	
Time Consumption Q11	Pearson	Correlation Coefficient			.180**	.201**				.186**							
		Sig. (2-tailed)			.010	.004				.008							
		N			205	205				205							
	Kendall's Tau_b	Correlation Coefficient			.150*	.164**				.179**							
		Sig. (2-tailed)			.011	.005				.002							
		N			205	205				205							
	Spearman	Correlation Coefficient			.175*	.192**				.211**							
		Sig. (2-tailed)			.012	.006				.002							
		N			205	205				205							
Time Consumption Q12	Pearson	Correlation Coefficient	.188**				.138*					.204**					.244**
		Sig. (2-tailed)	.007				.049					.003					.000
		N	205				205					205					205
	Kendall's Tau_b	Correlation Coefficient	.178**				.170**	.163**	.153*		.121*	.221**	.149*			.190**	.215**
		Sig. (2-tailed)	.004				.006	.007	.012		.048	.000	.017			.001	.000
		N	205				205	205	205		205	205	205			205	205
	Spearman	Correlation Coefficient	.195**				.192**	.185**	.173*		.138*	.244**	.167*			.214**	.244**
		Sig. (2-tailed)	.005				.006	.008	.013		.049	.000	.017			.002	.000
		N	205				205	205	205		205	205	205			205	205

Table 49: Correlation Analysis for H4 Between Individual, Group, Organizational Diversity Climate and Systematic Guidance, Degree of Acceptance of Perception of Being Able to Apply TRIZ

Questions	Correlation Type	Coefficient	Individual 1 Respect Q1	Individual 1 Equality Q2	Individual 1 Conflict Q3	Individual 1 Discrimination Q4	Individual 1 Feeling about diversity Q5	Group Respect Q6	Group Equality Q7	Group Conflict Q8	Group Discrimination Q9	Group Feeling about diversity Q10	Organizational Respect Q11	Organizational Equality Q12	Organizational Conflict Q13	Organizational Discrimination Q14	Organizational Feeling about diversity Q15
Systematic Guidance Q13	Pearson	Correlation Coefficient	.508**	.253**		-.153*	.244**	.257**	.350**		.341**	.402**	.373**	.289**	.145*	.149*	.249**
		Sig. (2-tailed)	.000	.000		.028	.000	.000	.000		.000	.000	.000	.000	.038	.033	.000
		N	205	205		205	205	205	205		205	205	205	205	205	205	205
	Kendall's Tau_b	Correlation Coefficient	.405**	.234**		-.170**	.256**	.244**	.305**		.267**	.336**	.338**	.258**		.188**	.212**
		Sig. (2-tailed)	.000	.000		.005	.000	.000	.000		.000	.000	.000	.000		.002	.001
		N	205	205		205	205	205	205		205	205	205	205		205	205
Systematic Guidance Q14	Spearman	Correlation Coefficient	.430**	.264**		-.191**	.287**	.274**	.339**		.298**	.370**	.373**	.287**		.210**	.240**
		Sig. (2-tailed)	.000	.000		.006	.000	.000	.000		.000	.000	.000	.000		.002	.001
		N	205	205		205	205	205	205		205	205	205	205		205	205
	Pearson	Correlation Coefficient	.421**	.277**	-.147*	-.221**	.268**	.335**	.305**	-.141*	.373**	.449**	.425**	.381**	.205**	.189**	.267**
		Sig. (2-tailed)	.000	.000	.036	.001	.000	.000	.000	.043	.000	.000	.000	.000	.004	.007	.000
		N	205	205	205	205	205	205	205	205	205	205	205	205	205	205	205
Systematic Guidance Q15	Kendall's Tau_b	Correlation Coefficient	.348**	.249**	-.150*	-.204**	.258**	.306**	.262**	-.133*	.321**	.446**	.375**	.304**	.155*	.231**	.294**
		Sig. (2-tailed)	.000	.000	.014	.001	.000	.000	.000	.026	.000	.000	.000	.000	.011	.000	.000
		N	205	205	205	205	205	205	205	205	205	205	205	205	205	205	205
	Spearman	Correlation Coefficient	.378**	.280**	-.168*	-.228**	.287**	.340**	.288**	-.159*	.353**	.490**	.411**	.337**	.172*	.258**	.331**
		Sig. (2-tailed)	.000	.000	.016	.001	.000	.000	.000	.023	.000	.000	.000	.000	.014	.000	.000
		N	205	205	205	205	205	205	205	205	205	205	205	205	205	205	205
Degree of Acceptance Q16	Pearson	Correlation Coefficient	.189**	.142*							.152*	.234**		.144*		.297**	.285**
		Sig. (2-tailed)	.007	.042							.029	.001		.039		.000	.000
		N	205	205							205	205		205		205	205
	Kendall's Tau_b	Correlation Coefficient	.192**	.139*							.140**	.214**	.155*	.142*	.135*	.310**	.274**
		Sig. (2-tailed)	.002	.045							.008	.000	.010	.014	.022	.000	.000
		N	205	205							205	205	205	205	205	205	205
Degree of Acceptance Q17	Spearman	Correlation Coefficient	.222**	.138*							.184**	.241**	.178*	.170*	.161*	.358**	.319**
		Sig. (2-tailed)	.001	.048							.008	.000	.011	.015	.021	.000	.000
		N	205	205							205	205	205	205	205	205	205
	Pearson	Correlation Coefficient	.331**	.211**	-.149**		.246**	.281**	.351**		.316**	.342**	.308**	.193**	.256**	.172*	
		Sig. (2-tailed)	.000	.002	.033		.000	.000	.000		.000	.000	.000	.005	.000	.014	
		N	205	205	205		205	205	205		205	205	205	205	205	205	
Degree of Acceptance Q18	Kendall's Tau_b	Correlation Coefficient	.250**	.199*	-.160**		.236**	.226**	.287**		.269**	.340**	.236**		.209**	.186**	.145*
		Sig. (2-tailed)	.000	.011	.010		.000	.000	.000		.000	.000	.000		.001	.002	.020
		N	205	205	205		205	205	205		205	205	205		205	205	205
	Spearman	Correlation Coefficient	.269**	.175*	-.181**		.258**	.249**	.315**		.295**	.367**	.256**		.229**	.206**	.159*
		Sig. (2-tailed)	.000	.012	.009		.000	.000	.000		.000	.000	.000		.001	.003	.023
		N	205	205	205		205	205	205		205	205	205		205	205	205
Degree of Acceptance Q19	Pearson	Correlation Coefficient	.294**	.176*			.235**	.276**	.306**		.223**	.211**	.256**	.253**	.219**	.163*	.209**
		Sig. (2-tailed)	.000	.011			.001	.000	.000		.000	.002	.000	.000	.002	.015	.003
		N	205	205			205	205	205		205	205	205	205	205	205	205
	Kendall's Tau_b	Correlation Coefficient	.212**	.185**	-.144*	-.124*	.207**	.201**	.259**		.260**	.210**	.191**	.255**	.196**	.146**	.197**
		Sig. (2-tailed)	.001	.002	.018	.041	.001	.001	.000		.000	.001	.002	.000	.002	.014	.001
		N	205	205	205	205	205	205	205		205	205	205	205	205	205	205
Degree of Acceptance Q20	Spearman	Correlation Coefficient	.234**	.211**	-.165*	-.143*	.235**	.228**	.295**		.302**	.234**	.210**	.253**	.216**	.169*	.223**
		Sig. (2-tailed)	.001	.002	.018	.041	.001	.001	.000		.000	.001	.003	.000	.002	.015	.001
		N	205	205	205	205	205	205	205		205	205	205	205	205	205	205
	Pearson	Correlation Coefficient	.335**	.155*			.232**	.249**	.332**		.381**	.297**	.281**	.242**	.202**	.151*	.218**
		Sig. (2-tailed)	.000	.026			.001	.000	.000		.000	.000	.000	.000	.004	.031	.002
		N	205	205			205	205	205		205	205	205	205	205	205	205
Degree of Acceptance Q21	Kendall's Tau_b	Correlation Coefficient	.243**	.143*			-.123*	.203**	.190**	.276**	.327**	.280**	.217**	.219**	.175**	.156**	.223**
		Sig. (2-tailed)	.000	.019			.043	.001	.002	.000	.000	.000	.001	.001	.004	.009	.000
		N	205	205			205	205	205	205	205	205	205	205	205	205	205
	Spearman	Correlation Coefficient	.268**	.163**			-.139**	.229**	.216**	.311**	.374**	.310**	.239**	.235**	.197**	.177*	.252**
		Sig. (2-tailed)	.000	.019			.046	.001	.002	.000	.000	.000	.001	.001	.005	.011	.000
		N	205	205			205	205	205	205	205	205	205	205	205	205	205
Degree of Acceptance Q22	Pearson	Correlation Coefficient	.384**				.266**	.274**	.275**		.311**	.295**	.287**	.228**	.196**	.248**	.225**
		Sig. (2-tailed)	.000				.000	.000	.000		.000	.000	.000	.001	.005	.000	.001
		N	205				205	205	205		205	205	205	205	205	205	205
	Kendall's Tau_b	Correlation Coefficient	.269**				.206**	.208**	.209**		.262**	.269**	.235**	.192**	.176**	.251**	.201**
		Sig. (2-tailed)	.000				.001	.001	.001		.000	.000	.000	.002	.004	.000	.001
		N	205				205	205	205		205	205	205	205	205	205	205
Degree of Acceptance Q23	Spearman	Correlation Coefficient	.294**				.225**	.231**	.235**		.294**	.290**	.258**	.215**	.197**	.287**	.222**
		Sig. (2-tailed)	.000				.001	.001	.001		.000	.000	.000	.002	.005	.000	.001
		N	205				205	205	205		205	205	205	205	205	205	205
	Pearson	Correlation Coefficient	.267**				.207**	.213**			.306**	.238**	.266**	.242**	.238**	.234**	.203**
		Sig. (2-tailed)	.000				.003	.001			.000	.001	.000	.000	.001	.003	
		N	205				205	205			205	205	205	205	205	205	205
Degree of Acceptance Q24	Kendall's Tau_b	Correlation Coefficient	.167**				.130*	.172**			.234**	.195**	.188**	.192**	.184**	.185**	.193**
		Sig. (2-tailed)	.008				.033	.005			.000	.002	.003	.002	.002	.002	.002
		N	205				205	205			205	205	205	205	205	205	205
	Spearman	Correlation Coefficient	.182**				.147*	.193**			.261**	.213**	.205**	.214**	.204**	.213**	.215**
		Sig. (2-tailed)	.009				.036	.006			.000	.002	.003	.002	.003	.002	.002
		N	205				205	205			205	205	205	205	205	205	205

Table 50: Correlation Analysis for H5 Between Knowledge Management Practices and of Perception of Being Able to Apply TRIZ

Questions	Correlation Type	Coefficient	Problem Solving Q1	Problem Solving Q2	Problem Solving Q3	Problem Solving Q4	Problem Solving Q5	Problem Solving Q6	Degree of Adoption Q7	Degree of Adoption Q8	Degree of Adoption Q9	Time consumption Q10	Time consumption Q11	Time consumption Q12	Systematic Guidance Q13	Systematic Guidance Q14	Systematic Guidance Q15	Degree of acceptance Q16	Degree of acceptance Q17	Degree of acceptance Q18	Degree of acceptance Q19	Degree of acceptance Q20
Knowledge Q1	Pearson	Correlation Coefficient	.190**	.165*		.239**	.184**	.244**	.197**	.175*	.265**			.155*	.322**	.309**		.156*	.261**	.295**	.241**	.201**
		Sig. (2-tailed)	.006	.018		.001	.008	.000	.005	.012	.000			.027	.000	.000		.025	.000	.000	.000	.004
		N	205	205		205	205	205	205	205	205			205	205	205		205	205	205	205	205
	Kendall's Tau_b	Correlation Coefficient	.189**	.156*		.217**	.191**	.237**	.193**	.189**	.230**			.214**	.337**	.345**	.181**	.179**	.264**	.288**	.260**	.253**
		Sig. (2-tailed)	.002	.014		.000	.002	.000	.002	.002	.000			.000	.000	.000	.002	.004	.000	.000	.000	.000
		N	205	205		205	205	205	205	205	205			205	205	205	205	205	205	205	205	205
	Spearman	Correlation Coefficient	.214**	.170*		.250**	.219**	.269**	.214**	.215**	.259**			.245**	.382**	.382**	.209**	.195**	.299**	.323**	.286**	.282**
		Sig. (2-tailed)	.002	.015		.000	.002	.000	.002	.002	.000			.000	.000	.000	.003	.005	.000	.000	.000	.000
		N	205	205		205	205	205	205	205	205			205	205	205	205	205	205	205	205	205
People Q2	Pearson	Correlation Coefficient	.200**		.228**	.167*		.204**	.213**	.256**	.299**			.237**	.206**	.161*		.190**	.266**	.299**	.207**	.218**
		Sig. (2-tailed)	.004		.001	.017		.003	.002	.000	.000			.001	.003	.021		.006	.000	.000	.003	.002
		N	205		205	205		205	205	205	205			205	205	205		205	205	205	205	205
	Kendall's Tau_b	Correlation Coefficient	.140*		.202**	.145*	.131*	.179**	.184**	.207**	.258**			.208**	.148*	.140*	.145*	.236**	.241**	.159**	.187**	
		Sig. (2-tailed)	.022		.001	.015	.028	.003	.002	.001	.000			.001	.015	.018	.019	.000	.000	.009	.002	
		N	205		205	205	205	205	205	205	205			205	205	205	205	205	205	205	205	
	Spearman	Correlation Coefficient	.158*		.233**	.172*	.151*	.203**	.205**	.236**	.292**			.237**	.164*	.164*	.160*	.272**	.274**	.180**	.209**	
		Sig. (2-tailed)	.024		.001	.014	.031	.004	.003	.001	.000			.001	.019	.019	.022	.000	.000	.010	.003	
		N	205		205	205	205	205	205	205	205			205	205	205	205	205	205	205	205	
People Q3	Pearson	Correlation Coefficient	.263**		.234**	.240**	.186**	.165*	.244**	.257**	.363**			.260**	.208**	.197**	.158*	.208**	.270**		.222**	
		Sig. (2-tailed)	.000		.001	.001	.007	.018	.000	.000	.000			.000	.003	.005	.024	.003	.000		.001	
		N	205		205	205	205	205	205	205	205			205	205	205	205	205	205		205	
	Kendall's Tau_b	Correlation Coefficient	.228**		.198**	.237**	.164**	.174**	.225**	.219**	.329**			.134*	.228**	.181**	.167**		.181**	.224**		.180**
		Sig. (2-tailed)	.000		.001	.000	.006	.004	.000	.000	.000			.027	.000	.003	.005		.003	.000		.003
		N	205		205	205	205	205	205	205	205			205	205	205	205		205	205		205
	Spearman	Correlation Coefficient	.254**		.228**	.273**	.189**	.196**	.251**	.247**	.369**			.151*	.258**	.200**	.189**		.206**	.254**		.200**
		Sig. (2-tailed)	.000		.001	.000	.007	.005	.000	.000	.000			.031	.000	.004	.007		.003	.000		.004
		N	205		205	205	205	205	205	205	205			205	205	205	205		205	205		205
Process Q4	Pearson	Correlation Coefficient	.305**		.228**	.231**	.219**	.192**			.307**			.236**	.353**	.301**	.172*	.218**	.323**	.324**	.215**	.243**
		Sig. (2-tailed)	.000		.001	.001	.002	.006			.000			.001	.000	.000	.014	.002	.000	.000	.002	.000
		N	205		205	205	205	205			205			205	205	205	205	205	205	205	205	205
	Kendall's Tau_b	Correlation Coefficient	.270**		.211**	.190**	.202**	.163**	.132*		.259**			.255**	.311**	.258**	.177**	.168**	.331**	.289**	.192**	.219**
		Sig. (2-tailed)	.000		.000	.001	.001	.007	.029		.000			.000	.000	.000	.003	.007	.000	.000	.002	.000
		N	205		205	205	205	205	205		205			205	205	205	205	205	205	205	205	205
	Spearman	Correlation Coefficient	.300**		.247**	.219**	.230**	.180**	.146*		.295**			.288**	.351**	.292**	.208**	.184**	.376**	.327**	.215**	.246**
		Sig. (2-tailed)	.000		.000	.002	.001	.010	.037		.000			.000	.000	.000	.003	.008	.000	.000	.002	.000
		N	205		205	205	205	205	205		205			205	205	205	205	205	205	205	205	205
Technology Q5	Pearson	Correlation Coefficient	.230**		.261**	.177*	.232**	.225**	.197**		.290**			.152*	.256**	.243**			.231**	.232**	.178*	.167*
		Sig. (2-tailed)	.001		.000	.011	.001	.001	.005		.000			.030	.000	.000			.001	.001	.011	.017
		N	205		205	205	205	205	205		205			205	205	205			205	205	205	205
	Kendall's Tau_b	Correlation Coefficient	.244**		.243**	.202**	.230**	.201**	.186**		.227**			.194**	.275**	.278**	.148*	.125*	.228**	.215**	.166**	.187**
		Sig. (2-tailed)	.000		.000	.001	.000	.001	.002		.000			.001	.000	.000	.012	.046	.000	.000	.007	.002
		N	205		205	205	205	205	205		205			205	205	205	205	205	205	205	205	205
	Spearman	Correlation Coefficient	.273**		.281**	.226**	.257**	.223**	.206**		.256**			.219**	.307**	.306**	.172*		.259**	.242**	.181**	.209**
		Sig. (2-tailed)	.000		.000	.001	.000	.001	.003		.000			.002	.000	.000	.014		.000	.000	.009	.003
		N	205		205	205	205	205	205		205			205	205	205	205		205	205	205	205

Table 51: Correlation Analysis for H6 Between Organizational Change and of Perception of Being Able to Apply TRIZ

Questions	Correlation Type	Problem Solving Q1	Problem Solving Q2	Problem Solving Q3	Problem Solving Q4	Problem Solving Q5	Problem Solving Q6	Degree of Adoption Q7	Degree of Adoption Q8	Degree of Adoption Q9	Time consumption Q10	Time consumption Q11	Time consumption Q12	Systematic Guidance Q13	Systematic Guidance Q14	Systematic Guidance Q15	Degree of acceptance Q16	Degree of acceptance Q17	Degree of acceptance Q18	Degree of acceptance Q19	Degree of acceptance Q20
Knowledge Sharing System Q1	Pearson	.375**	.385**	.245**	.351**	.388**	.454**	.359**	.257**	.228**			.241**	.394**	.407**	.280**	.272**	.323**	.326**	.333**	.250**
		.000	.000	.000	.000	.000	.000	.000	.000	.001			.001	.000	.000	.000	.000	.000	.000	.000	.000
		.205	.205	.205	.205	.205	.205	.205	.205	.205			.205	.205	.205	.205	.205	.205	.205	.205	.205
	Kendall's Tau_b	.293**	.224**	.208**	.280**	.308**	.333**	.256**	.254**	.221**			.198**	.307**	.352**	.281**	.237**	.272**	.265**	.234**	.214**
		.000	.000	.001	.000	.000	.000	.000	.000	.000			.001	.000	.000	.000	.000	.000	.000	.000	.001
		.205	.205	.205	.205	.205	.205	.205	.205	.205			.205	.205	.205	.205	.205	.205	.205	.205	.205
	Spearman	.326**	.243**	.233**	.316**	.350**	.372**	.281**	.281**	.249**			.226**	.341**	.389**	.322**	.260**	.301**	.296**	.259**	.236**
		.000	.000	.001	.000	.000	.000	.000	.000	.000			.001	.000	.000	.000	.000	.000	.000	.000	.001
		.205	.205	.205	.205	.205	.205	.205	.205	.205			.205	.205	.205	.205	.205	.205	.205	.205	.205
Knowledge Sharing System Q2	Pearson	.328**	.276**	.339**	.327**	.397**	.357**	.331**		.153*	.189**	.174*	.243**	.356**	.384**	.301**	.248**	.202**	.271**	.231**	.207**
		.000	.000	.000	.000	.000	.000	.000		.028	.007	.012	.000	.000	.000	.000	.000	.004	.000	.001	.003
		.205	.205	.205	.205	.205	.205	.205		.205	.205	.205	.205	.205	.205	.205	.205	.205	.205	.205	.205
	Kendall's Tau_b	.246**	.211**	.298**	.289**	.319**	.314**	.263**	.133*	.165**	.163**	.160**	.222**	.274**	.326**	.291**	.205**	.184**	.232**	.185**	.188**
		.000	.001	.000	.000	.000	.000	.000	.029	.006	.007	.000	.000	.000	.000	.001	.003	.000	.003	.002	
		.205	.205	.205	.205	.205	.205	.205	.205	.205	.205	.205	.205	.205	.205	.205	.205	.205	.205	.205	.205
	Spearman	.274**	.231**	.338**	.325**	.358**	.352**	.291**	.148*	.186**	.188**	.188**	.251**	.304**	.365**	.337**	.225**	.205**	.260**	.204**	.205**
		.000	.001	.000	.000	.000	.000	.000	.035	.007	.007	.000	.000	.000	.000	.001	.003	.000	.003	.003	
		.205	.205	.205	.205	.205	.205	.205	.205	.205	.205	.205	.205	.205	.205	.205	.205	.205	.205	.205	.205
Decision Making Q3	Pearson	.294**	.284**	.224**	.284**	.239**	.372**	.264**	.129	.201**			.157*	.241**	.242**	.296**	.255**	.142*	.206**	.211**	.182**
		.000	.000	.001	.000	.001	.000	.000	.066	.004			.025	.000	.000	.000	.000	.042	.003	.002	.009
		.205	.205	.205	.205	.205	.205	.205	.205	.205			.205	.205	.205	.205	.205	.205	.205	.205	.205
	Kendall's Tau_b	.257**	.197**	.206**	.237**	.200**	.299**	.225**	.158**	.229**			.132*	.231**	.223**	.297**	.247**	.161**	.197**	.193**	.133*
		.000	.002	.001	.000	.001	.000	.000	.009	.000			.026	.000	.000	.000	.000	.010	.001	.002	.030
		.205	.205	.205	.205	.205	.205	.205	.205	.205			.205	.205	.205	.205	.205	.205	.205	.205	.205
	Spearman	.288**	.215**	.233**	.272**	.230**	.336**	.249**	.176*	.254**			.154*	.259**	.241**	.329**	.284**	.175*	.219**	.215**	.147*
		.000	.002	.001	.000	.001	.000	.000	.012	.000			.028	.000	.001	.000	.000	.012	.002	.002	.036
		.205	.205	.205	.205	.205	.205	.205	.205	.205			.205	.205	.205	.205	.205	.205	.205	.205	.205
Management Structure Q4	Pearson	.227**	.278**	.209**	.273**	.265**	.268**	.350**	.160*	.160*	.168*	.149*	.297**	.353**	.329**	.238**	.257**	.215**	.227**	.270**	.234**
		.001	.000	.003	.000	.000	.000	.000	.022	.022	.016	.033	.000	.000	.000	.001	.000	.002	.001	.000	.001
		.205	.205	.205	.205	.205	.205	.205	.205	.205	.205	.205	.205	.205	.205	.205	.205	.205	.205	.205	.205
	Kendall's Tau_b	.169**	.187**	.169**	.226**	.203**	.215**	.302**	.157**	.162**	.145*	.139*	.278**	.319**	.345**	.240**	.249**	.198**	.194**	.230**	.212**
		.006	.003	.005	.000	.001	.000	.000	.009	.007	.014	.019	.000	.000	.000	.000	.000	.001	.001	.000	.001
		.205	.205	.205	.205	.205	.205	.205	.205	.205	.205	.205	.205	.205	.205	.205	.205	.205	.205	.205	.205
	Spearman	.192**	.206**	.194**	.261**	.235**	.248**	.338**	.178*	.183**	.165*	.162*	.314**	.360**	.385**	.274**	.277**	.224**	.219**	.252**	.236**
		.006	.003	.005	.000	.001	.000	.000	.010	.009	.018	.020	.000	.000	.000	.000	.000	.001	.002	.000	.001
		.205	.205	.205	.205	.205	.205	.205	.205	.205	.205	.205	.205	.205	.205	.205	.205	.205	.205	.205	.205
Public Relations Q5	Pearson	.409**	.326**	.248**	.332**	.382**	.396**	.399**	.231**	.172*	.175*	.147*	.352**	.441**	.495**	.370**	.388**	.315**	.343**	.377**	.344**
		.000	.000	.000	.000	.000	.000	.000	.001	.014	.012	.035	.000	.000	.000	.000	.000	.000	.000	.000	.000
		.205	.205	.205	.205	.205	.205	.205	.205	.205	.205	.205	.205	.205	.205	.205	.205	.205	.205	.205	.205
	Kendall's Tau_b	.276**	.224**	.210**	.260**	.283**	.308**	.311**	.202**	.149*	.133*	.140*	.322**	.347**	.430**	.342**	.319**	.263**	.257**	.301**	.245**
		.000	.000	.000	.000	.000	.000	.000	.001	.014	.024	.018	.000	.000	.000	.000	.000	.000	.000	.000	.000
		.205	.205	.205	.205	.205	.205	.205	.205	.205	.205	.205	.205	.205	.205	.205	.205	.205	.205	.205	.205
	Spearman	.307**	.242**	.242**	.297**	.319**	.343**	.345**	.228**	.168*	.156*	.165*	.362**	.384**	.478**	.390**	.346**	.295**	.289**	.333**	.269**
		.000	.000	.000	.000	.000	.000	.000	.001	.016	.025	.018	.000	.000	.000	.000	.000	.000	.000	.000	.000
		.205	.205	.205	.205	.205	.205	.205	.205	.205	.205	.205	.205	.205	.205	.205	.205	.205	.205	.205	.205

APPENDIX D

DETAILED CASE STUDIES

ADAC Case: Improving Baggage Claim Process

Abu Dhabi Airport Companies (ADAC) is focusing on providing the easiest and most comfortable process for the travelers to reclaim their baggage. After hours spent in traveling, security checks, and the immigration process, travelers become tired, exhausted and frustrated in the baggage claim area. In this process, the company specified the following constraints that the solution should focus on:

- Process: where the solution is subjected to all the airport regulations
- Behavior: The solution will help in smoothing the passenger's experience in the baggage claim area.
- Time: The solution should take less time than required for the normal process
- Manpower: The solution should reduce the manpower needed in the process
- Guidance: The solution can enhance ideality (no need for power or cost).
- Implementation: The solution can be implemented as quickly as possible in the current airport process.

The hierarchal criteria's that the problem needs to achieve are:

❖ Uncontrollable

1. Number of baggage/carousels
2. Number of toilets
3. Number of Passengers
4. Carousels serving multiple airlines at the same time

❖ Controllable

5. Temperature
6. Number of trolleys
7. Number of carousels staff
8. Number of chairs

❖ Key Performance Index (KPI)

9. Maximum of 20 minutes

❖ Ideas for Innovation

1. Music / Beverage / Entertainment

Angel Wings Case: Reducing Ego and Improving Work Environment

Angel Wings is a medical center that has very high experienced workers; those act as a mediator by providing necessary documents between the patient and the medical staff. There was a situation where a worker was fired from his work due to the toxic environment created from his egocentric behavior. There is a need to improve the work environment between workers and reduce the bad influence on work by:

- Working genuinely: Working from the heart.
- Eliminating ego: Improve behavior at work.
- Time management: Efficiently using the time to not affect workers
- Eliminating hostilities: To ensure that work continues smoothly.

The hierarchal criteria's that the problem needs to achieve are:

❖ Uncontrollable

1. Number of workers
2. Quality of expertise
3. Number of positions

❖ Controllable

4. Salary
5. Bonus
6. Working hours

❖ Work Behavior

7. Hazard
8. Friendly
9. Mixed work environment

❖ Time taken to resolve the situation

10. Immediately (same day)
11. within one day / within two days

Urban Planning and Municipalities Case 1: Improving Documenting Contracts Process

Urban Planning and Municipalities (UPC) is using the most suitable technologies for providing comfort to customers while they are waiting for their contracts to be documented and approved. However, customers are delayed in their process of documenting contracts for many uncontrollable reasons like rejecting the paperwork due to differences between the UPC and Electricity Distribution Company, which forces the customer to redo the whole process again. It is required to find suitable solutions to this process; the company specified the following constraints that the solution should focus on:

- Process: where the solution follows all regulations
- Time: The solution should take less time than required from the normal process
- Manpower: The solution should reduce the manpower needed in the process
- Guidance: The solution can enhance ideality (no need for power or cost).
- Communication: The solution can enhance make communication between the two companies.

The hierarchal criteria's that the problem needs to achieve are:

- ❖ Customers currently documentation
 1. Exact timing
 2. Number of comfortable chairs
 3. Number of customers
 4. Missing required paperwork
- ❖ Customers finished documentation
 5. Auditing Paperwork
 6. Customers next destination
 7. missing paperwork for the next company
 8. Time of next meeting (KPI <30 Minutes)
- ❖ Ideas while waiting for service
 9. Beverage / Entertainment / Reading

Urban Planning and Municipalities Case 2: Improving Food Distribution Center

The food distribution center is designed for providing a wholesale price for the UAE citizens who own unique cards. The food distribution center has been available for a long time and there is no emphasis on how it helps UAE citizens save their money, especially for big families. It is required to improve the food distribution center through:

- Advertising: the wholesale prices should be advertised for UAE citizens.
- Behavior: UAE citizens should always come to the center.
- Competence: The center should not compete with familiar market sellers.
- Attraction: The ideas developed should attract UAE citizens into the center.

The hierarchal criteria's that the problem needs to achieve are:

❖ Uncontrollable

1. Number of shelves
2. Number of corners
3. Number of customers
4. Number of checkout machines

❖ Controllable

5. Number of baskets
6. Number of trolleys
7. Number of goods

❖ Advertisement

8. Sales Periods
9. Sales brochures
10. Board announcements

❖ Competition

11. Carrefour
12. Lulu Hypermarket
13. Coop Market

GDRFA Case: Detecting Fraud Promises

The General Directory of Residency and Foreigners Affairs are trying their best to eliminate fraud through legal laws. Some companies are promising foreigners better treatments in term of money and housing by forcing those workers to come to the country with visitor visas, where they are not obligated to spend more money on the workers. After the visiting duration is over, those people are forced to return and companies do not look into their cases anymore. In this process, the company specified the following constraints that the solution should focus on:

- Detection: The fraud should be immediately detected
- Expectation: The fraud should not reach the visitors by any mean
- Credibility: The solution should show the difference between reality and fraud to workers
- Justification: The solution should show valid justifications to the workers from companies
- Rights: The solution should give companies and workers their official rights.

The hierarchal criteria's that the problem needs to achieve are:

❖ Validation

1. Paperwork's
2. Official stamps
3. Committee members
4. UAE GDRF approval

❖ Time

5. One week / One Month / Two Months

❖ Process

6. Companies / Targeted Workers / GDRFA Staff

❖ Awareness

7. Awareness / Self Awareness
8. Broadcast advertisements

Etisalat Ajman Case: Improving the number changing process

Etisalat is focusing more on increasing security in changing services between users, where they use a highly technical tool to scan the national ID through fingerprints. One situation happened to one of the users where he wanted to change his phone number with another user, where they waited in line for 40 minutes due to a crowded period. After waiting, one of the users could not pass the national ID fingerprint test because that there was a problem with his card that was initially caused in the Federal Authority For Identity and Citizenship. In this process, the company specified the following constraints that the solution should focus on:

- Detection: The situation should be immediately detected by the company.
- Convenient: The process has to show an easier approach
- Reliability: The process should always be successful
- Security: The process should still be as secure as it was initially.
- Rights: The process should show the requirements before beginning

The hierarchical criteria's that the problem needs to achieve are:

- ❖ Before Entering the process
 1. Paperwork
 2. Credentials
 3. Valid ID
 4. User physical attendance
- ❖ During the Process
 5. Waiting time
 6. Duration of process
 7. Beverage
 8. Wireless internet
 9. Convenience and greetings
 10. Reminding of validating national ID
- ❖ At the end of the process
 11. Confirmation of change

Abu Dhabi Chamber Case: Authorizing License

Previous cases have shown that some UAE citizens authorize a business license under their names on behalf of foreign citizens. Therefore, they get an official authorization that allows them to use, manage the business account bank and also request different loans on behalf of the retail store or company. In case the foreign citizen could not repay the loan or if they smuggle the money outside the country, the legal owner of the business (UAE citizen) is legally accountable and all his assets are held by the bank until payment of debt. It is required to solve the problem through:

- Advertising: The solution should be known to the public
- Behavior: The solution should change the behavior of UAE citizens.
- Awareness: The solution should raise awareness of the legal consequence terms for having this situation.

The hierarchical criteria's that the problem needs to achieve are:

❖ UAE Citizens

1. Raise awareness
2. Detect the problem
3. Full control of legality

❖ Foreign Citizens

4. Detecting fraud
5. Monitoring
6. Local account (credit history)

❖ AD chamber

7. Improve Process
8. Detecting fraud
9. Raise awareness
10. Legal authorization

Monitor and Control Center Case: Developing Calling System

Monitoring and Control Centre cooperates with the Command and Control Centre of the Abu Dhabi Police in receiving emergency calls (999) from all around the emirates of Abudhabi, Alain and AlDhafra. The calls varied between traffic and criminal reports and inquiries from the public regarding travel directions; sometimes they also received calls from people asking for help after their vehicles had broken down. The center worked round-the-clock through a high-tech electronic system and an advanced database to receive urgent calls and deal with them according to the established work mechanisms. Some of the non-urgent calls would result in wastage of time and efforts which could be dedicated to those who needed help. In this process, the company specified the following constraints that the solution should focus on:

- Security: The system should monitor the calls
- Speed: The system should detect a time-wasting call faster
- Productivity: The system should raise police office productivity
- Filter: The system must differentiate between a time-wasting call and an important call
- Priority: The system should always give the critical condition priority

The hierarchal criteria's that the problem needs to achieve are:

❖ People calling Police

1. Awareness
2. Situation
3. Waiting time
4. Hazard
5. Reporting Calls

❖ Police Station System

6. Fast Response / Critical Situation / Filtration / Problem Detection

❖ Contacting Departments

7. Fast contact / Valid Information / Time of arrival

General Authority of Islamic Affairs & Endowments Case 1: Improving Cleanliness in Carpets of Crowded Mosques

Many people would rush to the mosque to pray and forget to clean up or take off their socks before entering the mosque. With time, this situation can lead to carpets inside the mosque to be unclean, messy and worn out which required changing the carpets to new ones. This situation also provides an unsatisfied and untraditional view to prayers of the mosque. There is a need inside the Authority of Islamic affairs to reduce this problem by providing improvements to show the mosque in the most cleaned situation. In this process, the company specified the following constraints that the solution should focus on:

- Comfort: The carpets should be friendly to the posture taken during praying. They should smell good look clean.
- Speed: The time taken to change the carpet
- Durability: The carpets should last for a long time
- Cost: The cost required to maintain the carpet should be minimal
- Quality: The carpet should be highly efficient

The hierarchal criteria that the problem needs to achieve are:

- ❖ For people coming to the mosque
 1. Awareness
 2. Cleanliness
- ❖ For mosque operators
 3. Getting the problem fixed fast
 4. Cleaning activities
- ❖ For carpets in Mosque
 5. Maintain a suitable temperature
 6. Maintain security
 7. Cleanliness
 8. Maintain durability

General Authority of Islamic Affairs & Endowments Case 2: System for Mosque Maintenance

GAIAE are providing periodic maintenance to the Mosques. The mosques are mostly located between 5-7 blocks of residential houses inside Abu Dhabi/ Alain. The problem is there is no system to either show or indicates that the mosque under maintenance. If the mosque is under maintenance, there is no substance mosque in the residential area and people will go far to pray. Furthermore, Prayers do not know if the mosque will be under maintenance or construction unless they arrive at the mosque. There is a need to improve/ provide solutions either in communication, awareness or alternative of having a mosque in the residential houses if the only mosque will be under maintenance. In this process, the company specified the following constraints that the solution should focus on:

- Time: the system should show if the mosque is under maintenance immediately
- Symbolism: The system can show the prayer if the mosque is under maintenance.
- Alternative: The system should show the prayer for the nearest alternative mosque
- Alert: The system should show an alert of any kind about the maintenance.

The hierarchal criteria's and lists that the problem needs to achieve are:

- ❖ For people coming to the mosque
 1. Quick awareness and locating an alternative mosque
 2. Alternative mosques nearby
 3. Availability beverages or clean places for pray
- ❖ For mosque
 4. An alternative place to pray in/out the mosque
 5. Time of maintenance
- ❖ For mosque moderators
 6. Awareness regarding mosque regulations when people come to pray.
 7. Announcement

APPENDIX E

STRUCTURE EQUATION MODEL

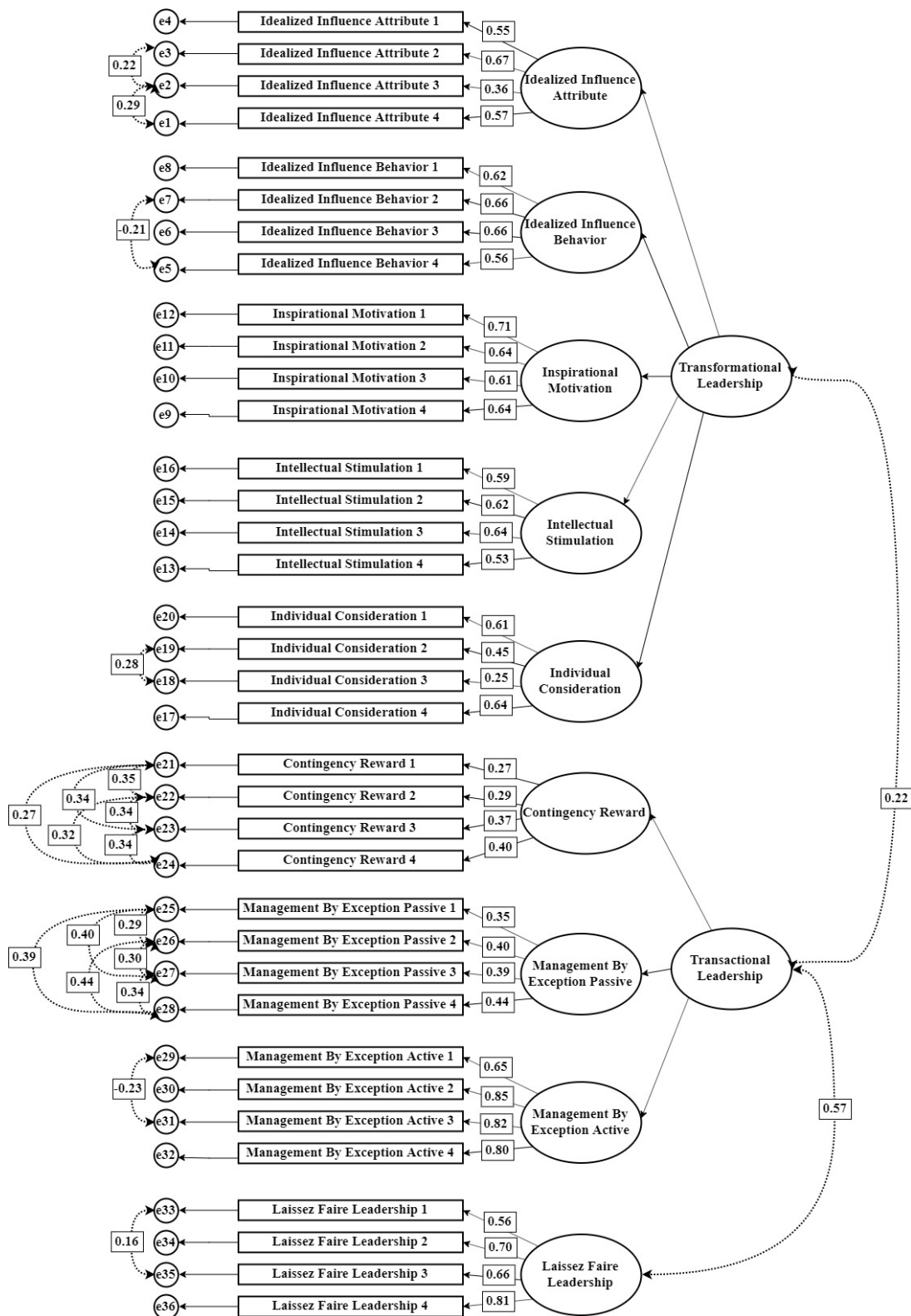


Figure 56: SEM for Transformational, Transactional and Laissez-Faire Leadership

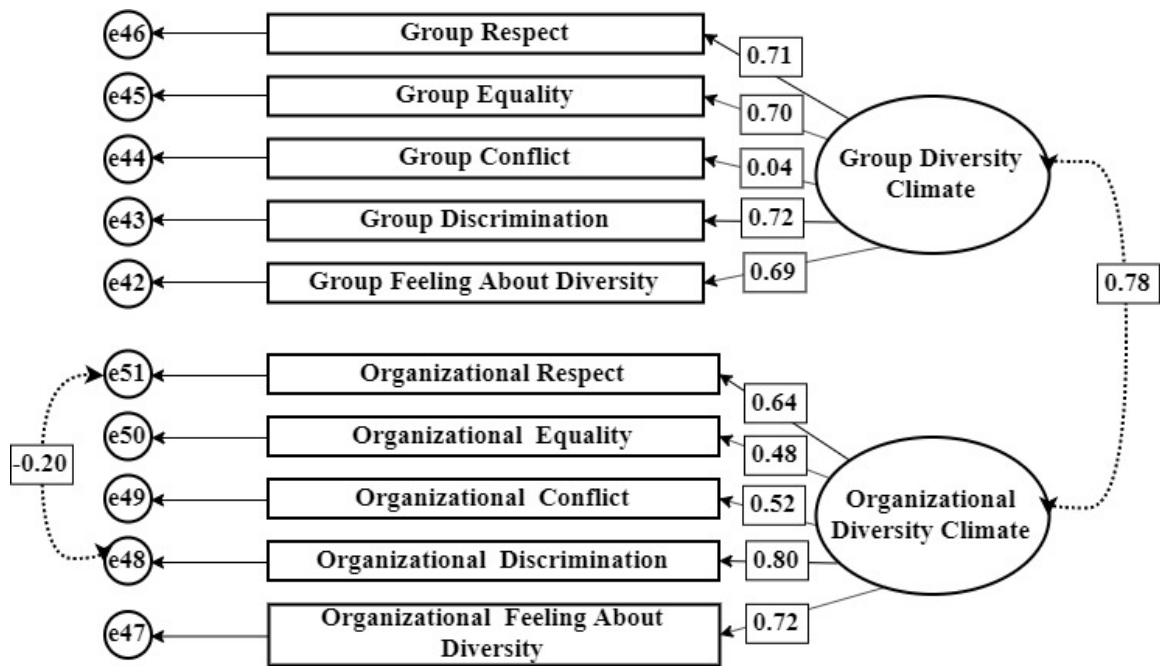


Figure 57: SEM for Group and Organizational Diversity Climate

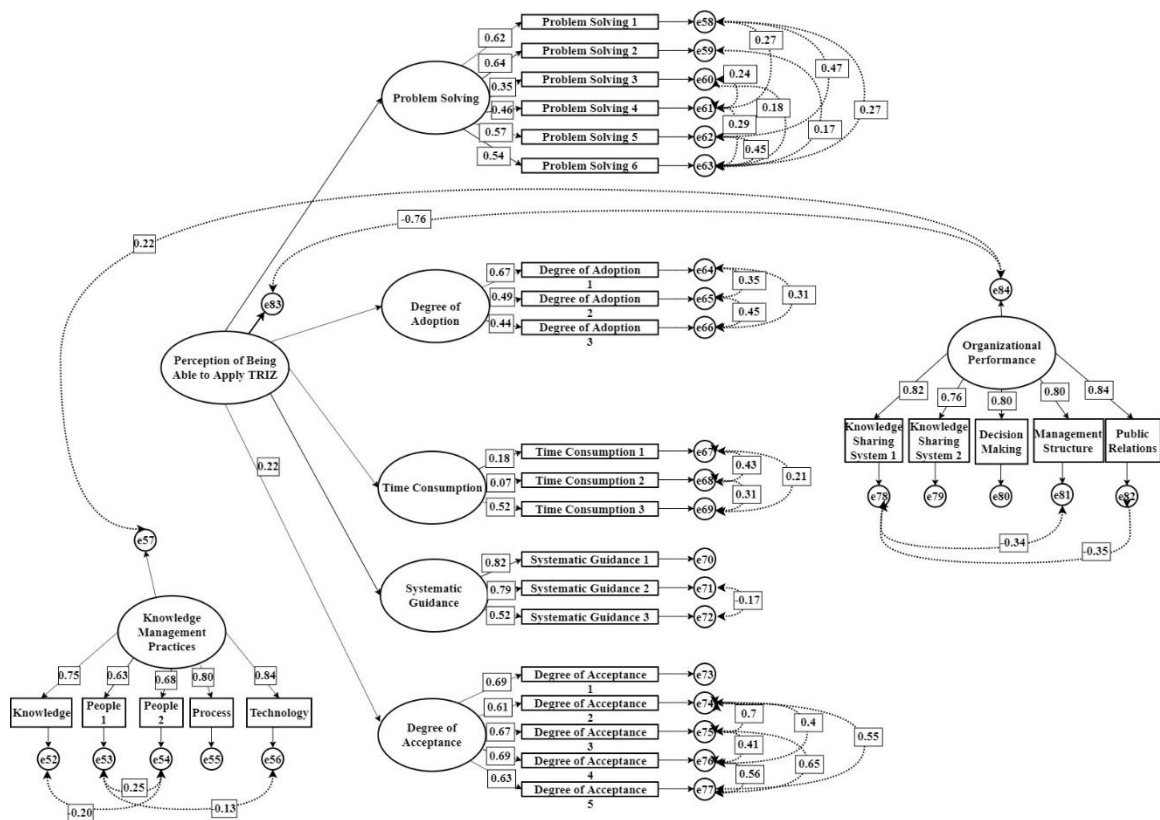


Figure 58: SEM for Knowledge Management Practices, Organizational Change and Perception of Being Able to Apply TRIZ

APPENDIX F

IDEA GENERATION METRICS

Idea Generation Results

Novelty scores:

Table 52: Group Novelty and Weight Scores

Weight	Function	Novelty Sub Score " Value from 1-10"			
		4	5	7	9
0.292	Uncontrollable	# of baggage	# of passengers	Carousels on multiple flights	Others
0.246	Controllable	# of trolleys	# of carousels stuff	# of chairs	Others
0.3	Service	Music	Beverage	Entertainment	Others
0.162	Time (min)	25	20	10	Others

Table 53: Novelty Occurrence for Functions (Uncontrollable and Controllable)

Uncontrollable	Cj	S11	Controllable	Cj	S11
# of baggage	4	8.52	# of trolleys	2	9.26
# of passengers	9	6.67	# of carousels stuff	7	7.41
Carousels on multiple flights	4	8.52	# of chairs	6	7.78
Construction work time	4	8.52	# of view corners	3	8.89
Exhaustion	2	9.26	available fixed TV	2	9.26
Identifying Bags	4	8.52	available gifts	1	9.63
			safety static belt	1	9.63
			home baggage delivery	5	8.15
Σ	27		Σ	27	

Table 54: Novelty Occurrence for Functions (Service and Time)

Service	Cj	S13	Time(min)	Cj	S14
Music	1	9.63	10	4	8.52
Beverage	1	9.63	20	5	8.15
Entertainment	5	8.15	25	10	6.30
Relaxing View	2	9.26	Full time	7	7.41
Greeting	1	9.63	When delayed flight	1	9.63
Quick Service	7	7.41			
Relieve Stress	5	8.15			
Advertisement	4	8.52			
Complement	1	9.63			
Σ	27		Σ	27	

Novelty for Brainstorming Session

Table 55: Novelty Scores Brainstorming

Brainstorming Novelty							
		Novelty Attributes				Novelty Scores	
Group	Idea	Uncontrollable	Controllable	Service	Time (min)	M1 Priori	M1 Post
G1	Idea# 1	Others	Others	Others	Others	9	8.65
	Idea# 2	Others	# of carousels stuff	Others	25	7.206	8.43
	Idea# 3	# of baggage	# of chairs	Entertainment	25	5.638	7.32
	Idea# 4	# of passengers	# of chairs	Others	10	7.016	7.68
	Idea# 5	# of baggage	# of carousels stuff	Others	25	5.746	7.55
G2	Idea# 1	Carousels on multiple flights	Others	Others	20	7.768	8.31
	Idea# 2	Others	# of trolleys	Others	20	7.122	8.31
	Idea# 3	# of passengers	Others	Others	25	7.022	7.71
	Idea# 4	Others	Others	Others	25	8.19	8.34
	Idea# 5	# of passengers	# of chairs	Beverage	25	5.33	7.77
	Idea# 6	Others	Others	Others	Others	9	7.91
G3	Idea# 1	Carousels on multiple flights	# of carousels stuff	Others	Others	7.432	7.73
	Idea# 2	Others	# of chairs	Entertainment	25	7.098	7.87
	Idea# 3	# of passengers	# of trolleys	Music	Others	5.102	8.67

Brainstorming Novelty							
		Novelty Attributes				Novelty Scores	
Group	Idea	Uncontrollable	Controllable	Service	Time (min)	M1 Priori	M1 Post
	Idea# 4	Others	# of carousels stuff	Others	20	7.368	7.85
	Idea# 5	# of passengers	Others	Others	25	6.73	7.07
	Idea# 6	Carousels on multiple flights	Others	Entertainment	25	7.606	8.43
G4	Idea# 1	Others	# of carousels stuff	Others	20	7.368	8.19
	Idea# 2	# of passengers	# of chairs	Entertainment	25	5.93	7.32
	Idea# 3	Carousels on multiple flights	Others	Others	Others	8.416	7.91
	Idea# 4	# of passengers	# of chairs	Others	10	7.016	7.68
	Idea# 5	Others	Others	Others	25	8.19	7.77
G5	Idea# 1	Others	# of carousels stuff	Others	Others	8.016	7.73
	Idea# 2	# of passengers	Others	Entertainment	20	6.584	7.9
	Idea# 3	# of baggage	# of carousels stuff	Others	10	6.232	9.01
	Idea# 4	# of baggage	# of trolleys	Others	10	5.986	8.37
	Idea# 5	Others	Others	Others	Others	9	7.91

Variety for Brainstorming Session

Table 56: Variety Separation – Brainstorming

Variety		
Set(1)	M3	2.325230769
Set(2)	M3	1.892571429

Grou p	Idea	Description	M1 Prior i	M1 Post	Set(1)	Set(2)
G1	Idea# 1	Installation of water fountains spinners	9	8.65	G1#1	
	Idea# 2	Staff Awareness	7.206	8.43	G1#2	
	Idea# 3	Sponsoring Entertaining Facilities	5.638	7.32		G1#3
	Idea# 4	Installation of massaging seats	7.016	7.68		G1#4
	Idea# 5	Deployment of airside operation	5.746	7.55		G1#5
G2	Idea# 1	Timer to display waiting time for the passenger	7.768	8.31	G2#1	
	Idea# 2	Airport Mobile Application	7.122	8.31	G2#2	
	Idea# 3	Booking office	7.022	7.71		G2#3
	Idea# 4	Screen to show attractions in UAE	8.19	8.34	G2#4	
	Idea# 5	Hospitality	5.33	7.77		G2#5
	Idea# 6	Automated Baggage Reclaim	9	7.91	G2#6	
G3	Idea# 1	Ground Handling Agents	7.432	7.73		G3#1
	Idea# 2	Entertainment facility	7.098	7.87		G3#2
	Idea# 3	Import bags before opening the door for passengers	5.102	8.67		G3#3

Group	Idea	Description	M1 Prior i	M1 Post	Set(1)	Set(2)
	Idea# 4	Bag Tracking System	7.368	7.85	G3#4	
	Idea# 5	Gifts	6.73	7.07		G3#5
	Idea# 6	Art of the belt	7.606	8.43	G3#6	
G4	Idea# 1	Provide promotion stands	7.368	8.19	G4#1	
	Idea# 2	Entertainment facilities	5.93	7.32		G4#2
	Idea# 3	Luggage home delivery	8.416	7.91	G4#3	
	Idea# 4	Introduce massage chairs	7.016	7.68		G4#4
	Idea# 5	Tourism authority	8.19	7.77	G4#5	
G5	Idea# 1	Service for baggage claim	8.016	7.73	G5#1	
	Idea# 2	Passenger entertainment	6.584	7.9		G5#2
	Idea# 3	Baggage roller coaster	6.232	9.01		G5#3
	Idea# 4	Trolley around carrousel	5.986	8.37		G5#4
	Idea# 5	Passenger automatic home delivery system	9	7.91	G5#5	
				Σ	13	14

Quality for Brainstorming Session

Table 57: Constrain Table - Brainstorming

Constrain Table	Rating
Process	3
Behavior	2
Time	3
Manpower	3
Guidance	2
Implementation	3

Group	Idea	Description	Total Scores (from graph)	Selected Best Ideas	Idea Baseline	Score (1-10)	M2
G1	Idea#1	Installation of water fountains spinners	-1				
	Idea#2	Staff Awareness	4				
G2	Idea#1	Timer to display waiting time for the passenger	7	√	1	6	
	Idea#2	Airport Mobile Application	7				
	Idea#4	Screen to show attractions in UAE	3				
	Idea#6	Automated Baggage Reclaim	5	√	3	7.2	
G3	Idea#4	Bag tracking system	5				
	Idea#6	Art of the belt	-4				
G4	Idea#1	Provide promotion stands	5				
	Idea#3	Luggage home delivery	8	√	8	8	
	Idea#5	Tourism authority	0				
G5	Idea#1	Service for baggage claim	8	√	5	7.7	
	Idea#5	Automatic delivery system	13	√	10	8.9	6.84

Novelty for TRIZ Session

Table 58: Novelty Scores - TRIZ

TRIZ Novelty							
		Novelty Attributes				Novelty Scores	
Group	Idea	Uncontrollable	Controllable	Service	Time (min)	M1 Prior	M1 Post
G1	Idea# 1	Others	Others	Others	Others	9	8.388148
	Idea# 2	Others	Others	Others	10	8.676	8.623704
	Idea# 3	# of passengers	Others	Others	10	7.508	8.1
	Idea# 4	Others	Others	Others	10	8.676	8.532593
	Idea# 5	# of baggage	Others	Others	Others	7.54	7.573333
G2	Idea# 1	Carousels on multiple flights	Others	Others	20	7.768	9.168148
	Idea# 2	# of passengers	Others	Others	20	7.768	8.411111
	Idea# 3	Others	Others	Others	Others	9	7.607407
	Idea# 4	Others	Others	Others	Others	9	8.678519
	Idea# 5	# of passengers	Others	Beverage	20	5.984	7.702222
	Idea# 6	Others	Others	Others	Others	9	7.482222
G3	Idea# 1	Others	# of carousels stuff	Others	Others	8.016	7.482222
	Idea# 2	# of passengers	Others	Entertainment	Others	7.232	8.442222
	Idea# 3	Others	Others	Beverage	Others	7.8	8.854815
	Idea# 4	# of baggage	# of carousels stuff	Others	Others	6.556	7.482222

TRIZ Novelty							
		Novelty Attributes				Novelty Scores	
Group	Idea	Uncontrollable	Controllable	Service	Time (min)	M1 Prior	M1 Post
	Idea# 5	# of passengers	Others	Others	Others	7.832	8.442222
	Idea# 6	Carousels on multiple flights	Others	Others	Others	8.416	8.57037
G4	Idea# 1	# of passengers	Others	Beverage	25	5.822	8.482222
	Idea# 2	# of passengers	Others	Entertainment	Others	7.232	7.631111
	Idea# 3	Others	Others	Others	Others	9	7.482222
	Idea# 4	Others	Others	Others	10	8.676	8.532593
	Idea# 5	Others	Others	Entertainment	10	8.076	8.663704
G5	Idea# 1	# of passengers	Others	Others	Others	7.832	6.924444
	Idea# 2	Others	Others	Entertainment	20	7.59	9.35037
	Idea# 3	# of baggage	Others	Others	Others	7.54	7.573333
	Idea# 4	Others	# of trolleys	Others	Others	7.77	7.78963
	Idea# 5	# of passengers	Others	Others	Others	7.832	6.742222

Variety for TRIZ Session

Table 59: Variety Separation - TRIZ

Variety						
Set(1)		M3	2.049789474			
Set(2)		M3	3.744			
Group	Idea	Description	M1 Priori	M1 Post	Set(1)	Set(2)
G1	Idea#1	Install a wall water palm	9	8.3881481	G1#1	
	Idea#2	Active staff	8.676	8.6237037	G1#2	
	Idea#3	Video game entertainment	7.508	8.1	G1#3	
	Idea#4	Massage Jacket	8.676	8.5325926	G1#4	
	Idea#5	Baggage priority	7.54	7.5733333		G1#5
G2	Idea#1	Timer clocks to display the waiting time	7.768	9.1681481	G2#1	
	Idea#2	Alarm Tracker	7.768	8.4111111	G2#2	
	Idea#3	Booking machines	9	7.6074074	G2#3	
	Idea#4	Millage advertisement	9	8.6785185	G2#4	
	Idea#5	Hospitality tags	5.984	7.7022222		G2#5
	Idea#6	Automated Baggage Reclaim #2	9	7.4822222	G2#6	
G3	Idea#1	Region flight companies	8.016	7.4822222	G3#1	
	Idea#2	Entertainment Vouchers	7.232	8.4422222	G3#2	
	Idea#3	Choosing to wait for your bag to be imported	7.8	8.8548148	G3#3	
	Idea#4	Customizing baggage claim	6.556	7.4822222		G3#4
	Idea#5	Flying Gifts& Coupons	7.832	8.4422222	G3#5	
	Idea#6	Sticker Belt	8.416	8.5703704	G3#6	
G4	Idea#1	Promotion Coffee pots	5.822	8.4822222		G4#1
	Idea#2	Activity Tent	7.232	7.6311111		G4#2
	Idea#3	Automated Luggage Delivery	9	7.4822222	G4#3	
	Idea#4	Introduce massage balls	8.676	8.5325926	G4#4	
	Idea#5	Air laser show	8.076	8.6637037	G4#5	
G5	Idea#1	Baggage claim booking	7.832	6.9244444		G5#1
	Idea#2	Passenger selection of entertainment	7.59	9.3503704	G5#2	
	Idea#3	Baggage web carrousel	7.54	7.5733333		G5#3
	Idea#4	Pre-Booked trolleys	7.77	7.7896296	G5#4	
	Idea#5	Security check confirming delivery system	7.832	6.7422222		G5#5
				Σ	19	8

Quality for TRIZ Session

Table 60: Constrain Table - TRIZ

Constrain Table	Rating
Process	3
Behavior	2
Time	3
Manpower	3
Guidance	2
Implementation	3

Group	Idea	M1 Priori	M1 Post	Total Scores (from graph)	Selected Best Ideas	Idea Baseline	Score (1- 10)	M2
G1	Idea#1	9	8.38815	1				7.01333
	Idea#2	8.676	8.6237	2				
	Idea#3	7.508	8.1	5				
	Idea#4	8.676	8.53259	5	√	1	6.4	
G2	Idea#1	7.768	9.16815	9	√	5	7.8	
	Idea#2	7.768	8.41111	9	√	8	8.4	
	Idea#3	9	7.60741	3				
	Idea#4	9	8.67852	4				
	Idea#6	9	7.48222	5				
G3	Idea#1	8.016	7.48222	0				
	Idea#2	7.232	8.44222	5				
	Idea#3	7.8	8.85482	2				
	Idea#5	7.832	8.44222	2				
	Idea#6	8.416	8.57037	2				
G4	Idea#3	9	7.48222	10	√	10	9.3	
	Idea#4	8.676	8.53259	5				
	Idea#5	8.076	8.6637	-5				
G5	Idea#2	7.59	9.35037	-2				
	Idea#4	7.77	7.78963	8	√	3	7.2	

APPENDIX G

COMMON LATENT FACTOR ANALYSIS

Table 61: Full CLF Analysis

					Standardize Regression Weight		
Factor Loading			Unstandardized Regression Weight (<0.5)	Common Variance	With CLF	Without CLF	Difference (<0.3)
Diversity Climate Survey							
Group Diversity Climate							
GroupDiverQ5	<---	Group Diversity Climate	0.44	0.1936	0.578	0.702	0.124
GroupDiverQ4	<---	Group Diversity Climate	0.44	0.1936	0.567	0.686	0.119
GroupDiverQ3	<---	Group Diversity Climate	0.44	0.1936	-0.256	0.029	0.285
GroupDiverQ2	<---	Group Diversity Climate	0.44	0.1936	0.476	0.727	0.251
GroupDiverQ1	<---	Group Diversity Climate	0.44	0.1936	0.447	0.7	0.253
Organizational Diversity Climate							
OrganizationDiverQ5	<---	Organizational Diversity Climate	0.44	0.1936	0.463	0.632	0.169
OrganizationDiverQ4	<---	Organizational Diversity Climate	0.44	0.1936	0.249	0.356	0.107
OrganizationDiverQ3	<---	Organizational Diversity Climate	0.44	0.1936	0.342	0.496	0.154
OrganizationDiverQ2	<---	Organizational Diversity Climate	0.44	0.1936	0.604	0.776	0.172
OrganizationDiverQ1	<---	Organizational Diversity Climate	0.44	0.1936	0.602	0.74	0.138

					Standardize Regression Weight		
Factor Loading			Unstandardized Regression Weight (<0.5)	Common Variance	With CLF	Without CLF	Difference (<0.3)
Multi Factor Leadership Questionnaire							
Transformational Leadership							
TransformIIBQ34	<---	IdealizedInfluenceBehavior	0.45	0.2025	0.58	0.592	0.012
TransformIIBQ23	<---	IdealizedInfluenceBehavior	0.45	0.2025	0.617	0.627	0.01
TransformIIBQ14	<---	IdealizedInfluenceBehavior	0.45	0.2025	0.615	0.622	0.007
TransformIIBQ6	<---	IdealizedInfluenceBehavior	0.45	0.2025	0.484	0.554	0.07
TransformISQ32	<---	IntellectualStimulation	0.45	0.2025	0.64	0.703	0.063
TransformISQ30	<---	IntellectualStimulation	0.45	0.2025	0.644	0.653	0.009
TransformISQ8	<---	IntellectualStimulation	0.45	0.2025	0.617	0.627	0.01
TransformISQ2	<---	IntellectualStimulation	0.45	0.2025	0.56	0.648	0.088
TransformIIAQ18	<---	IdealizedInfluenceAttribute	0.45	0.2025	0.44	0.627	0.187
TransformIIAQ10	<---	IdealizedInfluenceAttribute	0.45	0.2025	0.551	0.645	0.094
TransformICQ29	<---	IndividualConsideration	0.45	0.2025	0.462	0.667	0.205
TransformICQ19	<---	IndividualConsideration	0.45	0.2025	0.404	0.547	0.143

					Standardize Regression Weight		
Factor Loading			Unstandardized Regression Weight (<0.5)	Common Variance	With CLF	Without CLF	Difference (<0.3)
TransformICQ15	<---	IndividualConsideration	0.45	0.2025	0.442	0.457	0.015
TransformICQ31	<---	IndividualConsideration	0.45	0.2025	0.561	0.569	0.008
TransformIIAQ21	<---	IdealizedInfluenceAttribute	0.45	0.2025	0.439	0.49	0.051
TransformIIAQ25	<---	IdealizedInfluenceAttribute	0.45	0.2025	0.216	0.306	0.09
TransformIMQ9	<---	InspirtationalMotivation	0.45	0.2025	0.602	0.697	0.095
TransformIMQ13	<---	InspirtationalMotivation	0.45	0.2025	0.633	0.635	0.002
TransformIMQ26	<---	InspirtationalMotivation	0.45	0.2025	0.65	0.767	0.117
TransformIMQ36	<---	InspirtationalMotivation	0.45	0.2025	0.661	0.667	0.006
Transactional Leadership							
TranscationalCRQ35	<---	ContingentReward	0.48	0.2304	0.37	0.667	0.297
TranscationalCRQ16	<---	ContingentReward	0.48	0.2304	0.312	0.686	0.374
TranscationalCRQ11	<---	ContingentReward	0.48	0.2304	0.245	0.608	0.363
TranscationalCRQ1	<---	ContingentReward	0.48	0.2304	0.217	0.543	0.326
TranscationalMEPQ20	<---	ManagementByExceptionPassive	0.48	0.2304	0.698	0.801	0.103
TranscationalMEPQ17	<---	ManagementByExceptionPassive	0.48	0.2304	0.48	0.578	0.098
TranscationalMEPQ12	<---	ManagementByExceptionPassive	0.48	0.2304	0.569	0.677	0.108
TranscationalMEPQ3	<---	ManagementByExceptionPassive	0.48	0.2304	0.523	0.591	0.068

					Standardize Regression Weight		
Factor Loading			Unstandardized Regression Weight (<0.5)	Common Variance	With CLF	Without CLF	Difference (<0.3)
TranscationalMEAQ27	<---	ManagementByExceptionActive	0.48	0.2304	0.737	0.803	0.066
TranscationalMEAQ24	<---	ManagementByExceptionActive	0.48	0.2304	0.694	0.803	0.109
TranscationalMEAQ22	<---	ManagementByExceptionActive	0.48	0.2304	0.83	0.872	0.042
TranscationalMEAQ4	<---	ManagementByExceptionActive	0.48	0.2304	0.559	0.646	0.087
Laissez Faire Leadership							
LFLeadershipQ33	<---	LaissezFaireLeadership	0.88	0.7744	0.64	0.823	0.183
LFLeadershipQ28	<---	LaissezFaireLeadership	0.88	0.7744	0.798	0.644	0.154
LFLeadershipQ7	<---	LaissezFaireLeadership	0.88	0.7744	0.688	0.72	0.032
LFLeadershipQ5	<---	LaissezFaireLeadership	0.88	0.7744	0.667	0.525	0.142
TRIZ Feedback Survey							
Perception of Being Able to Apply TRIZ							
PersTRIZQ6	<---	ProblemSolving	0.5	0.25	0.58	0.749	0.169
PersTRIZQ5	<---	ProblemSolving	0.5	0.25	0.63	0.843	0.213
PersTRIZQ4	<---	ProblemSolving	0.5	0.25	0.484	0.632	0.148
PersTRIZQ3	<---	ProblemSolving	0.5	0.25	0.325	0.489	0.164
PersTRIZQ2	<---	ProblemSolving	0.5	0.25	0.589	0.643	0.054

					Standardize Regression Weight		
Factor Loading			Unstandardized Regression Weight (<0.5)	Common Variance	With CLF	Without CLF	Difference (<0.3)
PersTRIZQ1	<---	ProblemSolving	0.5	0.25	0.496	0.78	0.284
PersTRIZQ9	<---	DegreeofAdoption	0.5	0.25	0.586	0.603	0.017
PersTRIZQ8	<---	DegreeofAdoption	0.5	0.25	0.625	0.672	0.047
PersTRIZQ7	<---	DegreeofAdoption	0.5	0.25	0.404	0.845	0.441
PersTRIZQ13	<---	SystematicGuidance	0.5	0.25	0.478	0.856	0.378
PersTRIZQ14	<---	SystematicGuidance	0.5	0.25	0.319	0.777	0.458
PersTRIZQ15	<---	SystematicGuidance	0.5	0.25	-0.15	0.454	0.604
PersTRIZQ16	<---	Degreeofacceptance	0.5	0.25	0.328	0.699	0.371
PersTRIZQ17	<---	Degreeofacceptance	0.5	0.25	0.66	0.81	0.15
PersTRIZQ18	<---	Degreeofacceptance	0.5	0.25	0.708	0.9	0.192
PersTRIZQ19	<---	Degreeofacceptance	0.5	0.25	0.593	0.828	0.235
PersTRIZQ20	<---	Degreeofacceptance	0.5	0.25	0.641	0.876	0.235
PersTRIZQ12	<---	TimeConsumption	0.5	0.25	1.124	1.161	0.037
PersTRIZQ11	<---	TimeConsumption	0.5	0.25	0.202	0.259	0.057
PersTRIZQ10	<---	TimeConsumption	0.5	0.25	0.213	0.232	0.019

					Standardize Regression Weight		
Factor Loading			Unstandardized Regression Weight (<0.5)	Common Variance	With CLF	Without CLF	Difference (<0.3)
Community Innovation Survey							
Organizational Change							
OrganizationQ5	<---	OrganizationChange	0.72	0.5184	0.801	0.811	0.01
OrganizationQ4	<---	OrganizationChange	0.72	0.5184	0.781	0.833	0.052
OrganizationQ3	<---	OrganizationChange	0.72	0.5184	0.787	0.837	0.05
OrganizationQ2	<---	OrganizationChange	0.72	0.5184	0.73	0.787	0.057
OrganizationQ1	<---	OrganizationChange	0.72	0.5184	0.75	0.78	0.03
Knowledge Management Practices							
KnowldgeQ5	<---	KnowledgeManagement	0	0	0.828	0.828	0
KnowldgeQ4	<---	KnowledgeManagement	0	0	0.812	0.812	0
KnowldgeQ3	<---	KnowledgeManagement	0	0	0.681	0.681	0
KnowldgeQ2	<---	KnowledgeManagement	0	0	0.595	0.595	0
KnowldgeQ1	<---	KnowledgeManagement	0	0	0.761	0.761	0