Pepperdine University

Graduate School of Education and Psychology

AN EXAMINATION OF CULTURES OF INNOVATION WITHIN ESOTERIC TECHNOLOGY PROVIDER - A LOOK INTO COMPUTER-AIDED ENGINEERING (CAE)

A dissertation submitted in partial satisfaction

of the requirements for the degree of

Doctor of Education in Organizational Leadership

by

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December, 2017

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DEDICATION

I would to dedicate these works to my family, friends, and colleagues for without whom none of this would be possible. And to MSC Software and the Executive team, this is dedicated to the further progression of the organization and its future.

ACKNOWLEDGEMENT

I cannot thank my wife, Jaime, enough for the love and support she has given me throughout this journey. Truly, without her, I would be lost. To my parents, Ed and Ivy, who have been, and surely will always be, the foundation for a better future. Thank you both for putting up with me all these years. To my cohort, also as known as iGapsters, you all been the support I needed to keep pushing on; and for that I will always be grateful. You are all, in no particular order: Jane, Sartura, Will, John, Marco, Charlotte, Jasmine, Kris, Pam, and Deb, simply the best cohort anyone can ask for. Continue to do good.

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purpose. I hope that I have lived up to the expectations and legacy of those before me. Finally, I hope to continue to the mission in the spirit in which forbearers imbued in MSC Software.

A last note, to my future self, do not be so hard on yourself. You will do great (just watch your coffee intake).

VITA

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ABSTRACT

The 1960's space race in the United States gave rise to a unique culture of innovation embodied by an engineering class of professionals (Wisnioski, 2009). As knowledge workers, engineers were applying niche knowledge to solve big problems in the world (Kasdan, 1999). The result of their efforts in utilizing specific knowledge (i.e. esoteric knowledge) would become the basis for advanced development and production technology (Kasdan, 1999). One byproduct of this era is the advancement of engineering methods and computational mechanics (i.e. simulation) used to solve difficult, but semi-generalizable physics and engineering problems (Sinha, Paredis, Liang, & Khosla, 2001). However, sharing knowledge involved in engineering methods and esoteric knowledge (McMahon, Lowe, & Culley, 2004), as a whole, is difficult and a limiting factor in progressing similar large-scale, innovations (Alic, 1994). The response from organizations hoping to capitalize on developing esoteric technologies may turn to fostering a culture of innovation (Zairi and Al-Mashari, 2005). While research suggests innovation can be cultivated within an organization based on proposed frameworks and attributes (Crossan & Apaydin, 2010), an examination of lived-experiences of leaders, whose mission is to seek out the development of new esoteric technology, may provide rich insight into how cultures of innovation actually operate (Jucevičius, 2010). Therefore, this study proposes that a study of esoteric technology providers, beyond a contextual inquiry, may provide insights into how cultures of innovation may lead to new breakthroughs in technology and possibly an enabler to the next space race.

Keywords: esoteric technology, innovation, culture, leadership

Chapter 1: Introduction

Background

Today, technology continues to grow, mature, and evolve at an increasing rate. Like the Agricultural or Industrial Age earlier, key scholars are contributing to the identity of this Age of Information. Joseph Schumpeter (1961) once described economic conditions as a business cycle of highs and lows over a given period. Schumpeter acknowledged that entrepreneurism and innovations could act as a catalyst to alter a cycle. Peter Drucker (1969) popularly characterized the emergence of the *Knowledge Economy* and posited that organizations would be a focal point for continued research. In the Knowledge Economy, driving forces such as globalization and information technology tools may create an abundance of knowledge resources, such as data intelligence and insights. Organizational models developed, like the one proposed by Edgar Schein in 1985 (2010), offered a way to understand the uniqueness of an organization's culture. Continued studies in organization development topics—like the ones performed by John Kotter and James Heskett (1992), Peter Senge (1990, 2006), and James Heskett (2011)—illuminated how corporate cultures might impact performance within an organization. Furthermore, contemporary authors (e.g., Collins & Hansen, 2011) conduct ethnographic research to generalize culture and performance research.

The Knowledge Economy also highlights the notion of the democratization of technology. Thomas Friedman (1999) argues that the increased abundance of knowledge-based resources contributes to accelerating change and an increase in specialized knowledge and tools. Futurists speculate that the Knowledge Economy will usher change in how people receive and utilize information. As an example, Kevin Kelly (1999) postulated that innovation is a function of change and that accepting technology is a critical step in transforming knowledge to change initiatives. Kelly (2010) would later go on to say technology itself is an artifact of any culture.

Malcolm Gladwell (2000) once observed that abundance enables small changes to have a big impact on societies. In 2008, Seth Godin reinforced this idea by examining the ability of tribes and affinity groups to leverage information to enact change. In this sense, Godin (2008) argues that leadership of these tribes galvanizes a change from status quo to the discovery of affinity personalization. Contemporary commentary like these attempts to provide a better explanatory framework for the current Knowledge Era paradigm of accessible information and democratization of technology.

Observing technology can provide insight into the innovation process and its influence on people and culture. The importance of innovation is not restricted to the technologist. The famous economist Michael Porter (1998) once asserted that the Information Age is less about comparative advantage than it is about competitive advantage and that competition necessitates continual innovation. However, while Porter's theories contextualize the formulation of innovations today, the study of innovation goes back much further. Typically, the development of technology grows in a function similar to a logistic function (i.e., S-curve) as once proposed as early as 1890 by Gabriel Tarde (Djellal & Gallouj, 2014). The rate of technology adoption as it relates to innovation is thus an area of study worth discussing.

A specific area of innovation involves the dissemination or diffusion of knowledge—in other words, how new ideas reach people and how those ideas may affect a target audience. In 1962, Roger Everett, a communication studies expert, who is not a technologist or futurist, published a book that examined the findings of other researchers studying diffusion. Everett found that diffusion was a function of social groups (communities of people with similar interests), time, the transmission speed of communication, innovation (not adhering to a status quo), and individuals' willingness to adopt the new idea. He synthesized his findings into a model called *diffusion of innovation*. This model demonstrates that acceptance of innovation by a community occurs as a rate versus time on a two-dimensional axis adhering to a normal distribution curve. This curve expresses a population of undetermined size and unknown time. It

may be possible then to assume that the diffusion of innovation model has application across a variety of standards. The impact of innovation may thus prove difficult to evade.

Some models of corporate may rely on hierarchies and fixed processes. As an example, Mintzberg's model (1979) of organizational structure with its five key elements, namely, operating core, technostructure, support staff, middle line, and strategic apex, applied to the notion of machine bureaucracy (Mintzberg, 1979) promotes few chances for variances. Another schema Mintzberg proposed, however, called divisional form, does account for more responsiveness to consumer demand. In these types of organizations, each division houses the five elements and when the divisions are aggregated, they fall within the operating core of the whole organization. In some cases, the structure can facilitate or hinder the organization's ability to promote team performance (Katzenbach & Smith, 1993) and self-managing groups (Cohen & Ledford, 1994; Emery & Frendendall, 2002). According to David Noble (1979), technology in general greatly impacts the corporate capitalism model. Noble goes on to explain that the impact of technology reframes the perspective of the organization and how organizational structures respond to continual innovation. Noble believes technology is a fundamental element of a corporate capitalist organization and that the impact on features of an organization can lead to structural support for innovation. Other concepts, such as Luis Suarez-Villa's (2009) technocapitalism, further Noble's notion of the interconnection between organizations and technology. In this regard, technology has an impact on business and vice versa to the extent that group and individual values and beliefs are affected.

The understanding of the social interplay of system level factors aides in understanding what innovation is and facilitates its further study. In a paradigm shift, the consideration of consumer participation is known to be the democratization of technology (Feenberg, 1999).Democratizing technology differs from traditional views of technology, whereby the formation of technology is derived from discovery rather than application. This constructivist view of technology supports the notion that technology is a socially derived construct (Schot &

Rip, 1997). Friedman (1999) argues that the expansion of knowledge creates a social demand for accessibility to new technology and a relationship that is more intimate with consumers. However, as Tyler Veak (1999) noted, Feenberg's view of technology leaves an open question as to how innovation may positively or negatively contribute to macro systems over time.

The American scholar Clay Christensen (1997) postulated that innovation is not simply linear progression in an area of technology, but that in fact, activities can be directed to change the entire perspective of the technology. Christensen (1997) argues that innovation can be either sustaining or disruptive. He views disruptive innovation as the outcome of new processes or products that target underserved and undervalued markets. This view underscores further segmentation of innovation suggesting that by categorizing the type of innovative activities in the organization, the consumer feels as though a more intimate solution is provided and possibly interprets it as more valued. Scholars of innovation management sometimes parallel this experience to design (Norman & Verganti, 2014). Furthering this sentiment, these scholars contend that intentional design facilitates the democratization of technology, making way for more nuanced solutions and granular information to fit within these systems. Invariably, emerging technologies (i.e., advancements to the current state of technology to a yet-to-be defined future state; Rotolo, Hicks & Martin, 2015), address the need to develop specialized information and domain knowledge. Applied research creates a small niche of aggregated knowledge, and esoteric knowledge. It is in these areas of unexploited domains where the application of esoteric knowledge to innovate new technologies generates a focal area of esoteric technologies.

An example of esoteric knowledge transfer to technology is the use of engineering methods. In mechanical engineering, the use of engineering methods allows the application of baseline physics to a variety of situations (Sinha, Paredis, Liang, & Khosla, 2001). Should these situations not be related to the importance of leveraging an engineering method to solve a mechanical problem is important. Technology is introduced to scale the engineering method to

account for the complexity of the problem. Engineering methods software focus on addressing design issues, tool use, and proper techniques to solve or support specific engineering problems. This technology translates into a software application known as computer-aided engineering (CAE). The subsequent empirical background information is derived from standard industry practice(s).

CAE applications develop into simulation software. Simulation technology is specific to domain usage. In other words, calculating the stress and fatigue of an airplane wing is much different than measuring the impact of sound on the environment for a noise-free headphone. Both are important to the consumer—one ensures surviving air travel without falling from the sky while the other ensures a crying baby does not disturb the important phone call. Again, the basis to make products starts with mechanical engineering, but the use of esoteric technologies ensures an outcome that engineers struggled to deal with in the past (Milburn, 2004). Thinking about the kind of training and education required for a mechanical engineer to create systems that account for these types of scenarios is not common. CAE software providers fit the model of esoteric technology innovators—constantly innovate to produce new applications relating to esoteric knowledge and based on an unclear future state.

This type of technology is so difficult to learn; mechanical engineers are a captive audience. Mechanical engineers do not usually change their CAE tool, and if they do, it occurs maybe one or two times in their careers, that spans several decades. The reason for this is again due to the esoteric nature of the specific engineering method the mechanical engineer is familiar with (Lemon, Tolani, & Klosterman, 1980). For many CAE software providers, innovation continues, but the knowledge to create products that may have societal impact continues to be trapped. Democratization of technology and the diffusion of innovative processes remains restricted to the ability to transfer knowledge (McMahon, Lowe, & Culley, 2004). To transfer knowledge that might enable engineers to create more innovative solutions would require a CAE software provider to first embrace democratization of technology. It would

mean a different operating model (e.g., technocapitalism) and an intentional culture to support and facilitate the innovation process.

Assuming a CAE software provider subscribes to the diminishing role of highly structured organizations and behaviors for a more flexible organization, the focus on developing the organization and culture may become vital to the innovation process (Denison & Mishra, 1995). Therefore, any organization with a focus on cultivating esoteric knowledge—an organization that develops technology not yet imagined—is an organization that relies on a pragmatic lens to examine group values, beliefs, and artifacts. A unique feature of the Information Age is the ability to build organizations through virtual procedures and norms (e.g., emails, internet) anywhere in the world (Rodan & Galunic, 2004). As such, creating connections and relationships away from physical artifacts limits the communication of values and beliefs of the group. This feature means that network theories play a prominent role in the development of an organization's culture. The conditions for relationships can be built on social networks and the management of conflicts through contact hypothesis methods. In organizations that seek to create constant innovations, there may exist a different need for conflict. Organizations attempting to adopt innovative processes may look to conflict theory to help explain the culture (Cropley, 1997). However, when an organization is the producer of iterative innovations, the discussion on deciding how to innovate and what to innovate goes back to the diffusion of innovation model and postulates who is deciding—a collective, or an authority.

These decision structures in the organization can differ widely; however, for a CAE software provider, the easiest model to study is a for-profit, business organization. For a CAE software provider, the governance model dictates the framework for delivering innovative goods and services. Most common for business organizations (i.e., a firm) is the use of an Agent governance model (Uhlaner, Wright, & Huse, 2007). This model contends that a governance board provides the vision and shapes the directives for the administration. In this model, executive compensation is highly tied to the performance against objectives set by the board.

The argument is based on the assumed relationship that executives have to money and on the direct correlation between performance and increasing financial incentives. Another model, while less popular with corporate capitalism, is more favorable for firms seeking to innovate—and that is the Steward Governance model (Uhlaner et al., 2007). In this model, one person is the head of the board and administration, which is usually the Chief Executive Officer (CEO). In this case, the CEO has a stake in delivering upon a vision that he/she championed with the board. The thought behind this model for a CAE software firm is that the constant innovation required to evolve technology would rely on a single authority to make the vision come to fruition. However, most technology companies—let alone a CAE software firm—have this option. The governance model then is something of a hybrid and not yet well defined.

Given the lack of distinction of a governance model, the decision theory of a CAE software firm may also be under scrutiny. A possible starting point is to clearly understand the guidelines for how innovative goods and services are produced at the executive level. The executive level represents the closest level of strategic actors within the firm to interact with the board. As such, the interactions between decision makers create the initial frame of reference for all other organizational decisions (Schilit, 1997). As a reference point, the decisions made reflect an authoritarian approach to the diffusion of innovation. From a vision, strategy, set of initiatives, and action plan, this type of organizational model can provide the impetus to more innovation. However, executives also have functional and operational responsibilities that align more with traditional business operations. In this situation, executives and their managers face a balance of output expectations and resource management. Often this sort of cognitive dissonance forces the executive and his/her managers to evaluate a decision based on intertemporal choices. What can further exasperate management—and at times present an infuriating roadblock to innovation—is an operational restraint that creates a bounded rationality issue. That is, managers may be forced to make a decision they may not be comfortable making but which may be, at that time, the best decision given the information available. These types of

scenarios can very well describe the organizational complexities surrounding a privately held business. Moreover, the balance between business performance and supporting innovation further complicates these business decisions for leaders (Howell & Avolio, 1993). While research around transformational leadership has provided some evidence to support the relationship between managing innovation and performance needs by leaders, further research is needed to ascertain the right application of balancing innovation and performance (Howell & Avolio, 1993). The frame of investigation will be CAE software provider as a privately held company.

Statement of the Problem

At present, few, if any, models address the application of esoteric technologies as part of a culture of innovations. While research has been conducted to explain cultures of innovation (Zairi & Al-Mashari, 2005), few are able to generalize a model that addresses the development of esoteric knowledge into technology with corresponding conditions. The democratization of technology is a complex problem for commercial CAE companies, especially those that are private equity owned. The difficulty that innovators face is taking into consideration the lack of change in tools by consumers, resources required to innovate, and talent available with the requisite knowledge base to make a truly universal engineering methods based technology. Similar challenges exist for nearly any highly technical and esoteric knowledge base technology, in the demand to continually address the unique and ever-changing problems that society faces.

Purpose Statement

The purpose of this study is to develop a culture of innovation model for esoteric technology companies, capable of replication and having the scalability to address the needs of the organization. At this stage in the research, a culture of innovation model will be generally defined as a funneling of dynamic leadership models, esoteric knowledge-based elements, and innovation. As such, this study is designed to determine:

- The best strategies and practices employed by executive leaders of esoteric technology companies that promote a culture of innovation.
- The challenges and obstacles faced by these executive leaders in implementing a culture of innovation.
- How executive leaders of esoteric technology companies measure the success in promoting a culture of innovation.
- What recommendations executive leaders have for promoting a culture of innovation and executive leaders of esoteric technology companies would make for future leaders in the field.

Research Questions

Accordingly, the following research questions inform the study:

1. What strategies and practices are employed by the executive leaders of esoteric technology companies to promote a culture of innovation?
2. What challenges are faced by the executive leaders in esoteric technology companies to prompt a culture of innovation?
3. How do the executive leaders of esoteric technology companies measure success in promoting a culture of innovation?
4. What recommendations for promoting a culture of innovation would executive leaders of esoteric technology companies make for future leaders in the field?

Significance of the Study

In order to understand how society can foster innovation, a study on extreme cases can offer insights into how cultures of innovation might exist. The study will attempt to develop a cogent representation of a culture of innovation that exists to address gaps in research involving esoteric technologies. By replicating the findings, organizations will be able to initiate and better support the innovation development of goods and services. A general acknowledgment of the validity of this model will provide practitioners authority in this domain. Furthermore, the findings

from this study may become the benchmark for future studies involving cultures of innovation and esoteric technologies. Also, discuss how and by whom your results will be used; e.g., consulting, preventing unforeseen mistakes, training, to modify curricula in colleges, etc.

Limitations and Assumptions

Esoterism is generally defined as a narrow body of knowledge constrained to a small group. The use of esoteric knowledge to describe technologies is a burgeoning topic with several authors attempting to define boundary conditions. Furthermore, identifying organizations that fit this profile will be unique. A single organization likely represents the population, wherein subjects of the study (sample size) will come from various company locations.

While access to subjects has not been identified as a limitation, the availability of subjects that meet the criteria for the study may be. Decision makers at multiple levels who have an impact on the innovation process will likely represent a minority group. The size of the sample may be compounded given the time allotted for the study. Should there be variations and unforeseen events within the organization, time may impose additional constraints on the research and write-up of this study.

A final limitation may be the validity of responses received. The likelihood of conflicting perspectives and outcomes may skew the findings; however, such responses should not be discounted. Comprehension of the esoteric technologies may also become an issue. However, based on the assumption that the subjects work and contribute to the development of esoteric technologies, these limitations are known and generally accepted and therefore represent a reduced risk.

This study assumes full access to an esoteric technology company and employees. Accessibility will not be an issue due to the nature of the relationship between the researcher and organization of study. This study has executive support, and its findings will be presented to

the executive team upon completion and publication. Any feedback provided from this study will serve as foundational research for further studies other researchers may carry out.

Definition of Terms

For the purposes of this study, the following definitions are used:

Leadership - an influential process that facilitates individuals and groups in attaining a goal (Northouse, 2012). Leadership will also be viewed as the ability and efficacy to achieve cascading organizational goals. Leadership theories and styles will be examined in an effort to match evaluate whether a single leadership theory or style might work for a multidivisional, organizational structure.

Esoteric technologies - application of esoteric knowledge central to the development and production of technology (Kasdan, 1999). Esoteric knowledge will be considered contained to the technical and functional knowledge of a specific domain, in this case, mechanical engineering, across a limited number of industries, aerospace, automotive, consumer goods, medical technologies, and heavy machinery. Such application of technologies should also aid in the development of mass audience size, if not have an impact on society as a whole (Alic, 1994).

Innovation - “an idea, practice, or object that is perceived as new" (Rogers, 2003, p. 12). Innovation will be examined in the context as a result of process and outcomes. The application of innovation can be in product goods, services, and process methodologies. Several popular terminologies may be found in the literature regarding innovation; however, each has a distinct meaning and usage.

Disruptive Innovation - rebalance of the market as it pertains to the value of a product—typically one that is not high performing (Christensen, 1997). Disruptive innovation applies to outputs of a firm in relation to competitors in the marketplace. This may take the form of new products and or services, or may be the repurposing of a fledgling product and or service to

meet demand in a lower quality and feature set. Products and or services are subsequently priced lower than other comparable products and or services in the same category.

Sustaining Innovation - improved performance of an established product (Christensen, 1997). Sustaining innovation also applies to outputs of a firm in relation to competition in the marketplace. These types of innovation are mostly applied to describe additions in features to established products.

Incremental Innovation - methods of improvements within a given frame of solutions (Norman & Verganti, 2014). Incremental innovation is a term that differs from sustaining innovation in that incremental innovation is typically applied to the internal activities of a firm, rather than as outputs. These incremental innovations relate mostly to technology rather than market impact.

Radical Innovation - methods to change a frame of solutions (Norman & Verganti, 2014). Like incremental innovation, radical innovation is applied to internal firm activities. However, it differs from incremental innovation in that the frame of solutions is much larger with an impact measured against a smaller time boundary. Again, these activities relate to the approach and formulation of activities that might impact the overall advancement in technology.

Design Thinking - a way to describe a set of principles that can be applied diversely to an array of problems (Brown & Katz, 2009). Design thinking is a popular term to address a broad array of mental acuity when addressing complex problems beyond normal constraints. Design thinking will be referenced as an overarching mental approach to bringing about innovation.

Democratization of Technology - an accessibility (cost, availability, meets requirements, etc.) of technology for personal use (Friedman, 1999). Democratization of technology refers to the desired end state. Innovation will be the change agent within cultures to galvanize worker output to meet consumer needs. Accessibility will be an important factor when considering knowledge transfer of esoteric knowledge. The democratization of technology will be considered

a success when there is a growing knowledge base of knowledge workers utilizing esoteric technologies.

Chapter Summary

Through the core themes highlighted in this chapter, an awareness of the peculiarities of this study should be more evident. The basis for esoteric technologies begins a contextual understanding of the purpose its underlying knowledge base fits within the innovation context (Alic, 1994). The study of innovation has progressed with several scholars and authors adding to its domain knowledge (Becker & Whisler, 1967). Not surprisingly, contributors to the field of study also (if not predominantly) contribute to other fields, such as business, economics, sociology, and others (Nieto, 2003). Innovation is an intersection of many aspects of culture to accelerate change in status quo.

Meanwhile, an examination of corporate cultures adds depth to the discussion. An introduction to several broad themes that comprise corporate cultures operating under a capitalist economic system frames the type of organization this study will focus on. Rather than employing a unified theoretical model of organizational structure, practical evidence suggests that many of these organizations utilize a mix and match of systems (Mumford & Licuanan, 2004). To study a firm with variations in its underpinning organizational design and development is a unique opportunity (Meyer & Goes, 1988). Therefore, this study will highlight issues from leadership to decision-making to fostering innovation.

Applying the combination of the aforementioned discussion themes to an esoteric knowledge base such as (mechanical) engineering methods within CAE systems should provide insights into the cultural norms, such as artifacts, espoused values, and observable assumptions and beliefs. These cultural norms, in turn, should identify areas for developmental opportunities (Meyer & Goes, 1988), and will thereby indicate touch points for innovation opportunities in the future (Zairi & Al-Mashari, 2005).

Other variables within an organization may contribute to the ability to innovate. Certainly, knowledge management is a key for knowledge transfer, however, the notion of absorptive capacity refers to the ability to acquire new knowledge and enhance current core competencies (Daghfous, 2004). Factors that might strengthen or hinder the absorptive capacity of an organization can be either cultivated internally or impacted by external forces (Daghfous, 2004). Of course, regardless of whether the organization has the ability or capacity to innovate, without leadership guiding key directives, organizational effort will be less effective (Carmeli, Gelbard, & Gefen, 2010).

In summary, this chapter represents an effort to describe how cultures are imbued with innovation. By examining the context by which many interactions have an impact on an organization's culture, this study will identify key characteristics that explain a culture of innovation. An exploration of cultures of innovation (Jucevičius, 2010) in relation to esoteric technology development creates the unique opportunity to examine a field of inquiry that continually evolves, making it difficult to be fully developed (Wisnioski, 2012). While the aim of this study is not to develop immutable laws about the culture of innovation in esoteric technology companies, it does aim to provide a platform for future studies. The following study will examine the complexities of an esoteric technology company (privately owned, CAE software company) in order to derive meaningful insights about how innovations are developed and fostered within the organization.

Chapter 2: Literature Review

A historical context of how innovation is related to popular culture may help to highlight prevailing themes affecting the role of innovation in organizational dynamics. Commentary from sociologists and economists alike attempts to conceptualize the events and artifacts involved with innovation to the point that the topic has become a focus for popular literature. Of these works, Richard Florida's commentary on the socio-economic history in America after World War II is an important contribution to the field (Pink, 2004). Florida states that the development of the American economy as an unrivaled power is in part due to the expanding role of creativity in the economy (Florida, 2002). Florida's thesis extends William Whyte's 1956 notion of a collectivist identity shaping everyday life. However, instead of addressing organizational structure (Nocera & Whyte, 2002), Florida addresses competencies like creativity as being a dominant factor in economic growth. Florida's commentary is not unique in that he addresses the intersection of economics and sociology, but in his claim that innovation is somehow inherent to creativity (Florida, 2002). By stating innovation as something of a desired state, Florida's commentary raises the question as to how best to frame the past, current, and future state of activities that might bring about innovation.

Robert Gordon (2016) examined the American economy through the latter parts of the Industrial Age as a way to frame the economic activities that have historically contributed to innovation. Gordon's thesis is that the American economy grew at a rate never before seen in history and that industry changed in large part due to the adoption of new technologies replacing less efficient methods of production. Gordon argues that this type of growth, attributed to innovation, is likely not to be seen again. In other words, linking technology to innovation will likely not have the same impact as it did over the past half-century. Gordon's argument against technological deterministic rationale underscores the sense of boundary conditions required for innovation to flourish. Boundary conditions such as culture, politics,

legislature, etc., form the basis for a social construction of technology perspective (MacKenzie & Wajcman, 1999). The complexity of social construction of technology makes pinpointing the generation and impact of innovation difficult to discern.

Furthermore, determining how esoteric technologies fit into this paradigm is also tricky. Taking into consideration Gordon's critique of technology, specific technologies are not singled out (Gordon, 2016). It may be that technologies based on niche knowledge contributing to the betterment of society are excluded (Wisnioski, 2012). If so, evaluating how esoteric technologies arise may give credence to future innovations, just as it did during the space race of the 1960s (Wisnioski, 2012). Further understanding of the complexities and challenges faced by esoteric technology producers will also can help better solidify concepts. Understanding how esoteric technologies are formulated and the conditions that substantiate them may begin with understanding the knowledge base that technology is built upon. The knowledge underwriting the technology is typically unique and rarely substantiated as a general practice and or process (Kasdan, 1999). While the public may not have a deep appreciation of esoteric technologies, nations (e.g., the United States) have found the benefits of esoteric technologies to be highly beneficial in efforts to progress their society (Alic, 1994). The impact of esoteric technologies is thus evident in areas of life beyond the direct application of the technology. Awareness of the impact of how these technologies matriculate may set the conditions for the broader pursuit of innovation.

To that end, the role that technology plays in shaping society beyond an organization may be worth mentioning. The notion that technology arises as a byproduct of innovation and ignoring how that impact might be meaningful in other contexts can narrow the discussion about technology and innovation (Winner, 1993). An analysis of macro factors that may affect esoteric technology organizations may provide a foundation for understanding the role and impact innovation can have on an esoteric technology producer. Organizational analysis tools help

practitioners to understand how and why innovation may represent a critical component to esoteric technology organizations.

Using an organizational analysis model like the Social, Political, Economic, Legal, Intercultural, and Technology Power Matrix (SPELIT) can help frame the start of the further investigation of factors that may influence innovation. Evaluating the impact of technologies begins with evaluating the complex social interactions that affect the organization (Winner, 1993). Here, according to Winner (1993), the opportunity to analyze influencing factors in an organization is a requirement rather than choice. While Winner (1993) does not recommend a specific organizational analysis tool or method, the conclusion is clear: analysis of social, economic, and political factors are at least required. The SPELIT model (Schmieder-Ramirez & Mallette, 2007) identifies three of the aforementioned areas of analysis and in fact, incorporates a total of six areas of organizational analysis to comprise a matrix for evaluating the effects of power upon an organization. This analysis model extends Winner's benchmark and may provide additional help to identify areas of concern for leaders to address and lead change initiatives directly. The broad nature of the SPELIT model allows for analysis at multiple levels including organizational, macro, and mega. Utilizing the scalar nature of the model may allow innovation to be examined top down.

In many ways, esoteric technologies are concentrated versions of innovations in a domain segment. Esoteric technologies are a representation of distilled knowledge bases wherein an innovative approach to some knowledge is transformed into technology. Starting from a broad sense, public policy regarding innovation has both domestic and international appeal (Roessner, 1988). The impact of government policies on industries drives performance as well as innovation (Roessner, 1988). Advocacy groups, in particular, have an interest in promoting topics in this area ("Innovation policies for inclusive growth," 2015). For instance, The Organisation for Economic Co-Operation and Development (OECD) (2015) is an international, non-governmental agency with a mission to promote policies that support the development of

economic and social well-being. As of 2016, the OECD is strategically committed to economic development, promoting innovation and the benefits, and workforce readiness initiatives. A project falling under the OECD innovation initiative is aimed at addressing innovation for inclusive growth. The OECD advocates for government involvement in areas—like innovation—that stimulate "opportunity for all segments of the population and distributes dividends of increased prosperity, both in monetary and non-monetary terms, fairly across society" ("Innovation policies for inclusive growth," 2015). While the impact of this project will continue to be measured, governments have already begun exploring domestic strategies for innovation that may have trickle-down effects ("Innovation policies for inclusive growth," 2015).

In the United States, for example, studies have been commissioned to explore comparative national innovation policies. In 2012, a report by the National Research Council published an analysis on how the United States compared to other countries and identified top initiatives (Wessner, Wolff & National Research Council of the National Academies, 2012). The report argued that the need for New Growth economies based on innovation-led development is already happening in other nations. These nations are increasing their innovation capacity. The move away from Neoclassical economics is a trend that allows nations to be more flexible with capital, labor costs, and industry positioning. Conventional development of innovation requires the ability to generate high levels of intellectual property, consistent funding, and time. The report goes on to contend that as countries compete more evenly, the response and support for innovation policies need to increase. In addition, while other countries such as Germany, Singapore, China, Finland, Taiwan, and even Canada have all established a comprehensive national innovation policy, the United States has not committed to doing the same. The authors go on to identify areas for development that would include a mix of finance and commitments by the United States.

The geopolitical landscape indicates a jockeying of power as it relates to economic might. The view Wessner et al. (2012) take in their report supported by other research. For

example, academic management journals have published findings on the linkages and impact of public research on industrial research and development (Cohen, Nelson, & Walsh, 2002). In one particular article, Cohen et al. (2002) identify how public research assists with new ideas and contributes to furthering existing technologies. These pathways have a large impact on small, middle, and large organizations, both public and private alike. While some research contends that the impact of innovation is based on the ability to spread the cost of development, the size and complexity of industries complicate the ability to generate innovation predictably (Cohen & Klepper, 1996). The size and complexity of industries is a consistent issue in order to innovate. While these factors seem to be a complicated constraint, there may not be many leaders of organizations can do to change these facts immediately.

In the United States, research organizations expend considerable energy on the economic impact of various topics. The ability to innovate is one of the topics of intense interest. At the National Bureau of Economic Research, where the organization has a deep history in research focused on aggregate economic topics directed at societal issues, researchers have been investigating innovation as an element for societal development. The study of clusters or spatial concentration of like-minded and of similar interest practitioners, of entrepreneurship and innovation was the subject of a 2014 paper published by the National Bureau of Economic Research. Chatterji, Glaeser, and Kerr (2013) reviewed potential policy recommendations that might support the growth of innovation within the United States. They concluded that more work in understanding how to qualify projects intended to be focal innovation initiatives is needed. Concerns over effective projects or profitability come into focus (Cohen & Levinthal, 1989).

Measuring the impact of innovation is difficult to evaluate. Unlike technical considerations for developing innovations, describing research investments is still difficult (Mervis, 2005). In 2009, the United States enacted the American Recovery and Reinvestment Act to qualify the investments paid for by its citizens. The program requires its voluntary research subjects to document federal investments. Once in the system, an evaluation protocol

is used to examine short and long- term impact of the research conducted (Largent & Lane, 2012). In contrast to this voluntary system, other methodologies include automated evaluation protocol by way of topic modeling, also known as Latent Dirichlet Allocation (Lane, Newman, & Rosen, 2013). Topic modeling uses computer algorithms to identify keywords within research proposals that might have alignment with topics for investment. In other words, the program intends to standardize elements relevant to particular innovations. This would possibly allow better allocation of resources, ensuring a higher rate of return or profit.

Again, referring back to the SPELIT model for analysis, the topic of profitability may be evaluated through social and cultural benefit. According to Phills, Deiglmeier, and Miller (2008), innovation can be broken down into four parts. First, how innovation comes to produce a product or service; second, the creation of a product; third, the adoption of a product or service by way of diffusion of innovation, and lastly, value creation by the innovation. Phills and colleagues (2008) question whether all innovations should primarily focus on delivering social benefits, and be labeled “social innovation.” This concept is derived from the notion that need and problems are a function of social paradigms rather than purely economic ones. Furthermore, the point is that innovations benefiting both public and private value distinguish social innovation from all other innovations. However, compliance with this notion is difficult to truly differentiate in a global economy, which includes markets, communities, and people (Freeman, 2015). Whether for economic or social gain, the appropriate effort required to innovate may require further investigation.

Innovation

Innovation is commonly associated with products and strategies associated with the development of those products. Anecdotally, innovation is mostly a business activity or something a creative genius cooked up in one’s imaginative brain. Concepts like Kim and Mauborgne’s (2005) blue ocean strategy have garnered much attention for demonstrating how business strategy can be applied to new markets, thereby innovating new markets and creating

value. This is not the type of innovation nor process best aligned here. Clay Christensen (1997), a renowned economist, framed other innovation models such as the disruptive versus sustaining innovation model (see Figure 1). While less focused on strategy, Christensen's model for innovation depicts market opportunities that new products can adjust. Even Don Norman, a renowned designer, suggested that innovation as radical or incremental in change applies mainly to product features that the user wants (Norman & Verganti, 2014; see Figure 2). While fitting contexts, these definitions and interpretations of innovation do not directly attribute their models to the cultures within their organization (Becker & Whisler, 1967). This is to be the focus. These concepts have a place and merit discussions later; however, a continuation of the literature review will occur without these models being central to the discovery of findings.

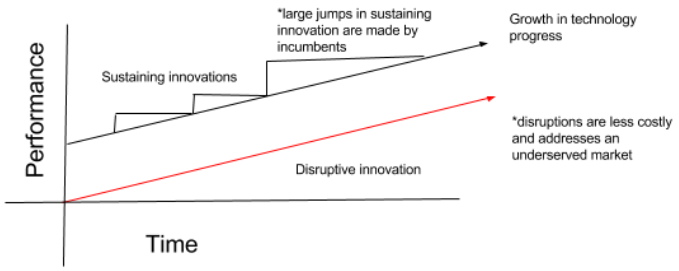

Figure 1. Adapted Disruptive Innovation model by Clay Christensen (1997). Adapted Disruptive Innovation model by Clay Christensen (1997). It is a depiction of Clay Christensen's Disruptive Innovation model shows the relationship of innovation and organizational efforts to create new products and services. The model depicts disruptive innovations take advantage of less direct competition. Thus organizations may look to niche approaches to creating innovative offerings to the market.

		MEANING	
		Incremental	*Radical*
TECHNOLOGY	*Radical*	Innovations providers push to market	New applications for technology
	Incremental	Innovations people want	Innovations markets want

Figure 2. Adpatation of Norman & Verganti Model of Innovation (2014). *Don Norman's product innovation model (Norman & Verganti, 2014). Matrix summarizes how an organization thinks about innovation in relation to the impact it has on consumers. A decision can be made how best to allocate resources for development.*

A culture of innovation is a complex system characterized by multiple facets and dimensions (Jucevičius, 2010). The following section provides an outline of components that may help better model the concept of innovation and how it plays a part in cultures as well as how culture may be predominantly defined as such. This distinction is the difference between "culture of innovation," which attempts to characterize attributes required in a culture to innovate, and "cultures of innovation," the investigation of how innovation might come about in cultures and subcultures (Jucevičius, 2010). Each subsection regarding innovation is intended to highlight aspects of well-known concepts and to draw together insights wherein cross-sections of knowledge help form a more concise definition and perspective of cultures of innovation. The major themes within the subsection include knowledge-based economy, creativity, and network effects (see Figure 3).

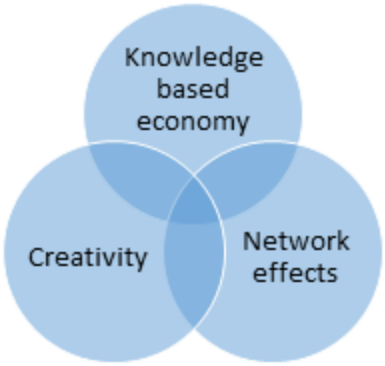

Figure 3. Innovation Topics. Innovation concepts for review in Chapter 2, including themes and sub-themes.

These themes were chosen as part of recurring themes within selected literature. In general, the literature mentioned above relates in some way to each theme, both directly and indirectly. An outline of how each theme is defined and how it relates to the innovation will be presented. Contemporary perspectives and criticisms to concepts may also be provided in relation to strategies and practices relevant to success factors in driving innovation, such as leadership and culture (Wong, 2005). The purpose of this section on innovation is to demonstrate the linkages that knowledge-based economy, creativity, and network effects have to esoteric technologies and the organizations that produce them.

Knowledge-based economy. Innovation as part of a larger system can be examined vis-à-vis macro structures focusing primarily on policy and programs (Wessner et al., 2012). The notion of how innovation might affect economies was an inevitable point to be made. People, it turns out, were the second prevalent topic. Perhaps it is unsurprising that public policy addresses the society, which it helps govern. However, the idea that innovation be directed to the increased well-being of society was surprising (Wessner et al., 2012). As it were, the application of innovation within a society may begin by more firmly defining the type of economy innovation that can be expected to flourish.

As it happens, knowledge-based economies fit the scope of discussion. Choosing which literature to review to address knowledge-based economies can pose a challenge due to the

vast nature of the topic, or any economic based topic for that matter. However, narrowing the focus to include dynamics helped focus the search. Adding a requirement to include conceptual models also helped. There is a knowledge-based economy model represented by what is known as a triple helix model (Dolfsma & Soete, 2006).

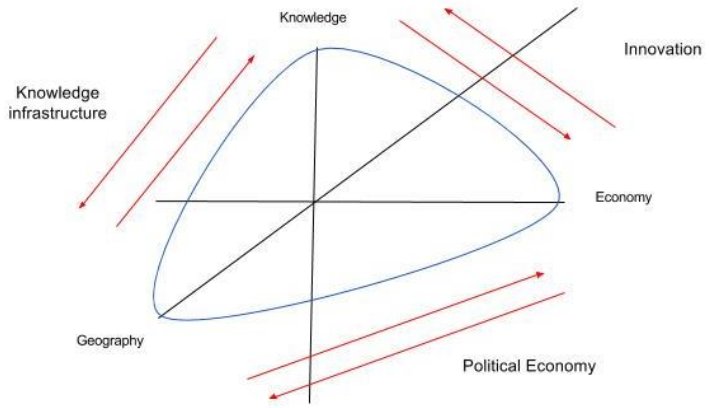

Figure 4. Adapted Dolfsma & Soete Triple Helix Model (2006). Triple Helix Axis representation of knowledge-based economy (Dolfsma & Soete, 2006). Model describes innovation as a construct between knowledge, economy, and geography as well as corresponding factors like knowledge infrastructure and political economy.

This representation models common problems and solutions surrounding innovation. The model takes into consideration that dynamics of innovation usually disrupt general market mechanisms (Dolfsma & Soete, 2006). The triple helix model for knowledge-based economies involves knowledge, economy, and geography all representing one axis (see Figure 4). Over time, activities on any axis can change the position, exchange of relations, and influence on the other axsis. These dynamics can evolve to generate next-order systems and sub-systems (see Figures 5 & 6).

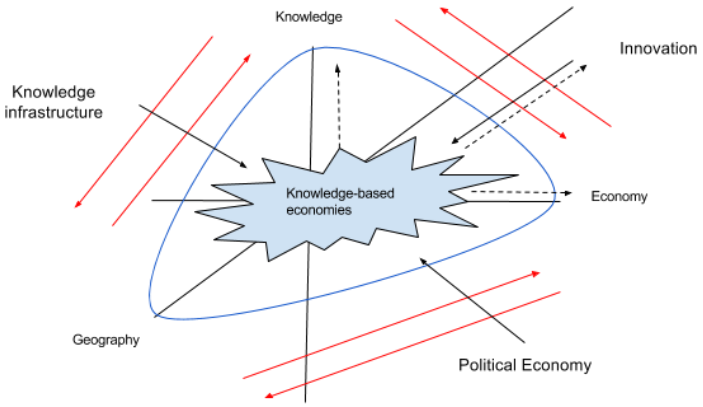

Figure 5. Adapted from 2006 Dolfsma & Soete's triple helix model with activity.

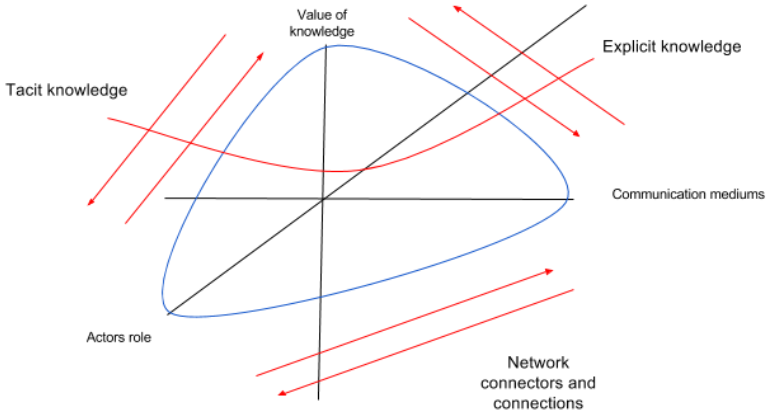

Figure 6. Adapted from 2006 Dolfsma & Soete's triple helix model sub-systems. The underlying sub-systems of the triple-helix model demonstrates the interactions within an organization that generate explicit and tacit knowledge. An interesting note is the inclusion of networks as a factor (Dolfsma & Soete, 2006). This highlights how the adapted Dolfsma & Soete's triple helix model sub-systems of knowledge-based economies can be described using the triple-helix model. Knowledge infrastructures and innovations generate new knowledge as well as more rewards in the economy.

The subsystems listed above in Figure 6 provide insight into the micro-orientation of this model. Here actors involved in the orientation of the sub-system are the drivers of innovation with the main transaction being knowledge (Dolfsma & Soete, 2006). As knowledge is transferred from one actor to another, knowledge is codified into discrete activities such as accumulating discursive or tacit knowledge. Each of the sub-system axes relates to the dynamics of the micro-model and the interactions involving knowledge transactions. Further discussion on network impact will be revisited further in the chapter.

A 2007 World Bank Institute report called “Building Knowledge Economies: Advanced Strategies for Development” contends that the desire to bring about innovation in society relies on frameworks that can easily be communicated to the public. The report released advanced strategies for development and highlighted key efforts (“World Bank Institute,” 2007). This document was targeted to help countries build knowledge economies, and it outlined ideal conditions and identified possible issues with a developmental program involving knowledge-based economies. Most importantly, the document provided a framework. The World Bank referred to it as a Four-Pillar Framework.

The World Bank Institute's Four-Pillar Framework highlights four key areas: education, innovation, information technology (IT) infrastructure, and public policy (see Figure 7). The World Bank identified these as areas for primary focus for countries seeking to develop a knowledge economy. Figure 9 shows the various details involved with each pillar (World Bank Institute, 2007). Each of the pillars derives from existing knowledge collected over the years. Intuitively, these pillars address common needs for development. A knowledge economy requires the skills and effective use of new knowledge by workers. In order to innovate, workers must have access and be able to leverage both local and global knowledge resources. Support for individual efforts requires both public policy in terms of local incentives as well as IT infrastructure to transmit and or trade knowledge.

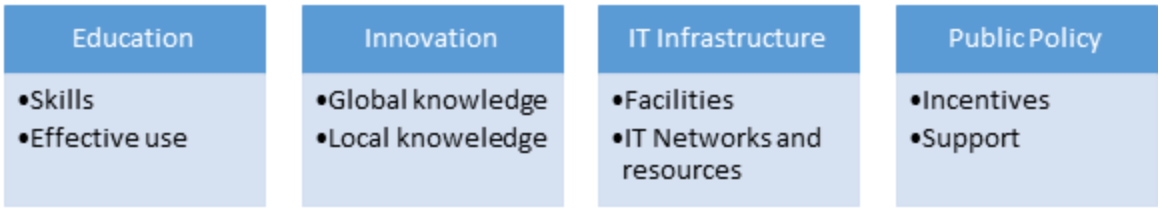

Figure 7. Adapted from The World Bank (2007) depiction of a Four-Pillar Framework for developing knowledge economies. Segmentation creates localize interests, but also demonstrates the other factors for consideration for innovation.

As mentioned earlier in the analysis, measuring innovation is often difficult. While conceptual models and other public efforts try to assert benchmarks for developing innovation, evaluating how such value may be created and measured furthers the discussion. Systems that evaluate innovation may consider them intangible assets (Teece, 1998). Intangible assets have no current inherent value (Lev, 2005) and are valued based on their future performance (Brockington, 1996). If there is only future value, the issue becomes how to evaluate and thus value activities within an organization that may or may not be considered innovations.

Teece (1998) argue the need to further the understanding of how intangible assets might be categorized, in order to evaluate possible value for innovations. First, consider the central driver in all innovations: intellectual capital. Lopes and Martins (2006) contend that intellectual capital drives four main areas of capital associated with creating value: structured capital, renewed capital, relational capital, and human capital. Organizational level intellectual capital-based activities are sorted within each of these categories of value creation (see Figure 8). Structured capital activities include financially structured capital, research and development (R&D), and realized innovations. Less direct, yet also commonly recognized, is renewed capital. The value created by renewal are activities such as intellectual property (IP), intellectual assets, and information technology (IT). In addition, while structured and renewed capital are connected to more traditional forms of financial recognition, human and relational capital are more difficult to capture as value creation activities. Unfortunately, Lopes and Martins (2006) do not further

the discussion in these areas; they simply state that there is more research required in these areas to clearly define how to connect metrics to intellectual capital, which is tied to human and or relational capital. The call for more measurements ties to the global, interlinked, and intangible (Kelly, 1999) arena of intellectual capital.

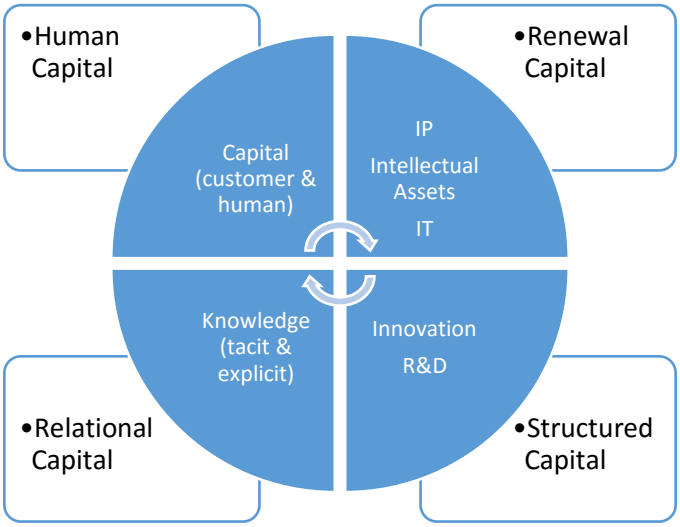

Figure 8. Adapted Innovation Capital Model describes the capital required for innovation: human, renewal, structured, and relational capital. The interconnectedness of the model demonstrates how embedded the notion of innovation must be in an organization for it to happen (adapted from Phillips & Philips, 2002).

Measuring intangible asset performance is a part of managing innovation. Innovation management principles adjust to take into consideration unique factors associated with the innovation process (Kelly, 1999). Taking into consideration the categorization component mentioned earlier, innovation management could examine competencies related to innovation; technologies applied to innovation, and the connection between knowledge management and innovation management (Dankbaar, 2003). Examining factors such as these helps frame future discussions around organizational structures and helps address the question of how innovation can be driven and managed effectively.

The topic of competencies as it relates to innovations is different from measuring individual competencies. Aggregating individual competencies from everyone in the

organization is not the idea either. Organizations as a whole are considering competencies for innovation (Dankbaar, 2003). Part of the reason organizations are focusing on competencies relates to the imbalance in competencies related to traditional economy competencies. Again, knowledge economy has an impact. Fewer individuals in an organization are asked to maintain traditional economy competencies. Moreover, competitive performance in a knowledge economy relies on human capital and talent. This shift in focus also impacts the way teams within an organization are organized, and indicate a shift in the internal locus of control (Cobbenhagen, 2003). Organizations are reorienting themselves to adapt better to the challenges of the knowledge economy. All levels of processes and therefore strategies need to align to better service activities that drive innovation. This includes examining competence in areas of technological and scientific knowledge creation, development, and management (Gerybadze, 2003). Notably, this type of knowledge creation tends to include the acquisition of additional resources to add to knowledge aggregation activities. However, Gerybadze (2003) warns that global teams, seemingly the logical progression to spread acquisition, may not always be equipped to handle the demands that generating innovation might require. Specifically, the notion of innovation must be a generally accepted practice in an organization's industry, and it requires direct consumers that specifically demand such an innovation. In other words, having a global workforce in order to fill organizational competency does not guarantee an organization's ability to innovate.

Innovation is also not solely a function of the technology produced, but also of the technology used to produce a good or service. Measuring the impact of these technologies on developing intangible assets is not easy. The thought is that measuring how these technologies impact an economy as a whole rather than examining the organizational level performance is a more direct indicator of how innovation technology is providing value (Dankbaar, 2003). This kind of value is important for a variety of reasons. Organizations utilizing innovation technology also have to adapt to the integration of these new technologies within their process (Debackere

& Van Looy, 2003). The impact of these innovation technologies helps transform the output as well. With new processes, new methodologies are adopted to fit the new technology. These methodologies also may dictate new organizational approaches to the development of innovative outputs. The result may reduce time, expense, R&D time, quality checks, etc. (Debackere & Van Looy, 2003). The example given by Debackere and Van Looy (2003) is that of applying 3D CAD technologies in rapid prototyping activities. By utilizing rapid sequence iteration between design-build-test coupled with improvements in organizational communication, innovation decisions can be made faster and products pushed to market before the competition. This example of how innovation technology impacts organizations, both internally and with customers, may be generalizable, and that is the aim of innovation management.

Generalizing the process of innovation management allows further discussion of the scalability of innovation management. In order to scale innovation management for greater operational use, a look at how innovation management is positioned within organizations can be beneficial. Innovation management has roots in the service economy (Dankbaar, 2003). This is because innovation management is derived from knowledge economy activities, which are mostly associated with service economies. However, that does not mean that all knowledge economy activities are service based, merely service related. This has a lot to do with the fact that in a global economy with global resources and global partners, the value chain that an organization defines for it is, at some point, service focused (Dougherty, 2003). To illustrate, if an organization is addressing a consumer issue within the value delivery chain, the organization utilizes what Dourgherty (2003) refers to as *practice-based knowledge* in order to provide an innovative solution. In other words, innovation is derived from key insights from those who know the consumer's problem, regardless of whether they have ever dealt with that consumer. Knowledge, therefore, is the innovation, and knowledge management is innovation management.

A concern for innovation management is the difficulty in coordinating communications. Often, organizing work to meet the unpredictable need of knowledge solutions is difficult to do (Dougherty, 2003). This is because it is not possible to standardize the development of a shared understanding. Typical organizational structures do not accommodate the type of strategy and development of innovations needed to respond to consumer demand, let alone address any kind of scaled efforts to increase innovations. Instead, an amalgamation of knowledge types and configurations occurs (Choi & Lee, 2002). Any strategy would involve directing knowledge either as a human or systems process balancing tacit and explicit knowledge (Choi & Lee, 2002). However, directing knowledge transformation can be complicated given the progression of innovation (Cropley, 1997). Understanding these parameters may help leaders develop innovation strategies and practices within their organizations, thereby allowing organizational practices, such as creativity, to seed activities supporting cultures of innovation. However, treating innovation and knowledge as activities to be linked to processes that may develop an innovation is the first step to building practices by which an organization's culture may continue to grow.

Creativity. Anecdotally, innovation is associated with creativity. Much of the literature in the following section will reflect this statement. This clearly isn't the entire story (Waples & Friedrich, 2011). Areas of study outside of creativity have also offered insights into innovation, as discussed in the section on the knowledge economy. Perhaps if more areas of the study claim dominance in the area of innovation, the attitude towards creativity being the cornerstone for innovation might change. Alternatively, perhaps not. While the debate on the importance and influence of creativity on innovation may be important to some, a broader investigation into how creativity might be integrated into other areas—such as culture—might prove interesting to those looking to generate and manage innovations. In this sense, the following section will focus on what creativity is, how it is applied both to individuals and to groups, and key formations of innovation. This highlights the practice of organizations utilizing creativity for innovation as an

operational function (Waples & Friedrich, 2011). Concepts will be discussed in detail in order to further illustrate the nuances and differences in models and descriptions. For example, it might be expected that in terms of organizations generating innovations, individual creativity has a greater impact than the organization; however, the literature might not agree (see Figure 9). Detangling and clarifying the role that creativity has in producing innovation is a key objective for this section.

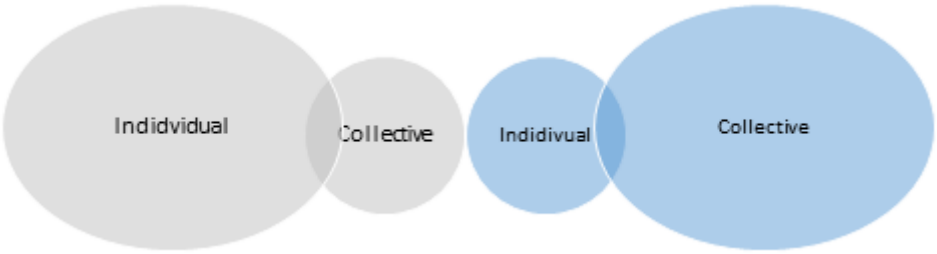

Figure 9. Differentiation of impact of collective creativity over individual creativity (Waples & Friedrich, 2011).

The basics. Creativity according to Arthur Koestler (1964) is a process of discovery. Koestler highlights the creative act as a process whereby two or more frames of thought, or mental models, differ yet are somehow combined to create a new thought (Koestler, 1964). This is known as *bisociation*. Bisociation applies any ability, habit, skill, or ordinary and regular pattern of behavior into sets of matrices to be organized and then recombined to generate variety. The various formations reconcile as a result of intense effort. By consciously focusing on multiple trains of thought to solve a single problem or reach a specific goal, the resulting by-product is considered a creative byproduct. In this process, after relinquishing focus after a period of intense determination, a person is most creative and apt to solving peculiar problems (Koestler, 1964).

An expansion of Koestler's process to define creativity as an immersion into the experience, activation of feelings and memories about the experience, dreaming about the future, bisociation and expression of new ideas relating to the future experience (see Figure 10)

is an example of attempts to operationalize creativity (Sanders, 2003). In this statement, multiple ideas are expressed without guidance as to order, magnitude, or relative importance. Figure 10 demonstrates that these characteristics defined are not immediately distinguishable and that some characteristics of creativity will disproportionately focus on certain aspects over others. In order to focus on strategies and practices regarding innovation within their organization, leaders may need to consider a holistic approach. An interactionist perspective applied towards organizations can address creativity across multiple levels (Woodman et al., 1993). Moreover, without specific investigation of practices within an organization, capturing the contextual factors involved with organizational creativity may be difficult to accomplish (Zhou & Hoever, 2014). This may mean that in order to understand the contextual factors of cultures of innovation, additional focus is required.

Figure 10. Adapted from Sanders (2003) to highlight a basic interconnected creativity model for delivering future results.

With that said, it may be useful to identify more target-specific frameworks that can increase awareness of the applicability of creativity. The expectation for a framework or model to describe creativity in terms of organizations is to identify concepts that may have corresponding linkages to organization based concepts and or theories. An example of such a framework might include a definition of the concepts for discussion relevant to both creativity

and organizations, attributes to further the conceptual discussion, as well as possibly extending certain concepts that might describe corresponding concepts. An example of this is the investment theory of creativity by Robert J. Sternberg of Cornell University. The investment theory of creativity considers creativity to be a decision, much like an investment. The key tenets of this theory involve redefining a problem in a novel way, then taking sensible risks to investing in the process. Follow-up actions include getting rid of ideas that are too risky for others, demonstrating grit and perseverance, and reflecting to remove preconceptions that could hold the process back (see Figure 11). These attitudes according to Sternberg are teachable.

Figure 11. Linear representation of Sternberg's Investment Theory of Creativity (1991), indicating the sequential steps needed to move forward.

Sternberg's theory conceptualizes creativity as an attitude rather than an end state. Furthermore, Sternberg recognizes attributes to be an important piece to his theory, which include abilities, knowledge, style of thinking, personality attributes, motivation (including intrinsic motivation), and environment (Sternberg & Lubart, 1991). These attributes (see Figure 12) are important because they frame competencies for individuals and establish a boundary for research. However, unlike innovation competencies, which relate to organizational core competencies to be built and referenced as espoused values, these attributes help depict an organization's operational ability to deliver creativity.

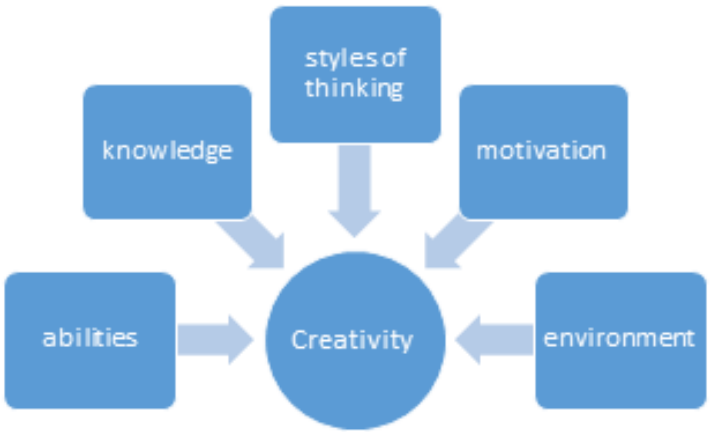

Figure 12. Representation of an individual's attributes in Sternberg's Investment Theory of Creativity (1991). The acknowledgement of influencing variables that might impact a person's ability to create.

The basis of the Investment Theory of Creativity highlights the variability inherent in the generating innovation within an organization. With multiple variables across a diverse set of backgrounds and locations, the issues of networks come up (Sternberg, 1991). However, Sternberg also thought about how contributions from a diverse population might occur. Sternberg (1999) called this the Propulsion Theory of Creative Contributions. Just as it sounds, it is a theoretical model for how contributions can be drawn from various sources to deliver creative solutions. The eight contributions include:

1. Conceptual replication
2. Redefining a solution for a different purpose
3. Forward incrementation to the next step in a long chain of ideas
4. Advance forward incrementation in a large leap past the last current idea
5. Redirection of an idea to a completely different focus
6. Regressive redirection of an old idea into a new direction
7. Re-initiation to start over
8. Synthesis of different ideas into something new

Of the eight types of creative contributions, Koestler's (1964) definition of creativity as a bisociation process most closely resembles Sternberg's synthesis. Perhaps the expansion of the definition has broadened to encapsulate larger complexities. Maybe individual creativity springs forth organizational options, or perhaps any variance is a function of the knowledge economy and its complexities.

In consideration of individual vs. organizational creativity. In discussing the role creativity plays in determining innovation within a culture, a review of concepts delineating individual from organization-level activities is helpful. First, it be helpful to acknowledge the broader theme, whereby creativity is differently viewed when examining individuals versus organizations. Much of the literature acknowledges that with regard to creativity within organizations, the focus of research has centered more on the individual (Hargadon & Bechky, 2006). This means that organizational dynamics are less studied. In fact, a common restriction in studying the creativity of an organization is the focus on the individual psychology of a creative individual (Nayak, 2008). With that said, there are still studies that assess creativity at the organizational level.

Research regarding creativity at the organizational level tends to diverge from studies on individual creativity. Studies where the characteristics of creative people within the organization bridge the individual level studies on creativity to the aforementioned individual psychology studies on creativity. The other type of studies focusing on organizations and creativity are directed toward the characteristics of the organization and its ability to facilitate and support an individual's creativity (Parjanen, 2012). The specific systems and behaviors used by these organizations to empower individual creativity can be generalized for study. Furthermore, the importance of organizational structure and culture can be identified as major contributors to the creativity process (Axtell et al., 2000). Certainly, organizations may desire to generate innovation through these structures and dynamics. An example is the use of flexible, transparent structures with decentralized decision-making functions (Parjanen, 2012). Other

examples include the use of ad hoc or informal networks to generate creative ideas in the absence of a creative-centric infrastructure (Parzefall, Seeck, & Leppänen, 2008).

While organization structure and culture have been mentioned, an organization's climate can also contribute to the organizational level creativity. For instance, Baer and Frese (2003) advance the notion that psychology safety is a top priority in order for individuals to feel that risks are permissible in order to innovate (Patterson et al., 2005). It is a shared belief that the organization has safeguards and espouses the values required to take initiatives. The desire to avoid negative consequences (Edmondson, 1999) and the motivation to press on (Morrison & Phelps, 1999) must be highly prioritized to ensure a climate conducive to innovation.

***Collective creativity*.** As the ability to innovate and organizational capacity grows, fostering greater development, group interactions foster greater collective creativity. Collective creativity is an example of a dynamic scenario wherein group members engage in social interactions in order to create new discoveries (Hill & Brandeau, Truelove, & Lineback, 2013). This model is based on the notion that leadership is a critical factor in establishing frameworks for group members to innovate (Hill et al., 2013). Leaders subscribe to the notion—termed "collective genius"—that small contributions of individual creativity combined as a group provide an effective means for generating innovation (Hill et al., 2013). This model works in addressing contribution effort as well as the role leadership plays in facilitating innovation. Group level interaction requires the cumulative effect of innovative activities as the record for growth. Collective creativity gauges the interactions and dynamics within a group. These dynamics are triggered by one of a few types of determinants. Thus, creative insights are delivered because of the established framework that fosters these triggers (see Figure 13).

Figure 13. Collective creativity model adopted from Hill et al. (2013). Showing the connectivity of each major theme.

In this framework, Hill and colleagues (2013) argue that as a conceptual model, the collective creativity model is limited. Should this model be practiced by a few, the results would likely not meet expected outcomes. Their argument is, in order to have enough scale and diversity available for the model to work; it would need to be formalized in the form of organizational capabilities (Hill et al., 2013). Hill et al. understand that the development of systems will require commitment. They define creative abrasion as the ability of the organization to generate new ideas and concepts through collaboration and, when debate ensues, to embrace it. Creative agility is defined as an organizational structure that engages the learning organization to seek discovery. The learning organizations thus attribute the ability to perform rapid prototyping, are fast to act, and make decisions based on the ability to reflect, digest, and consider divergent thoughts. Finally, the creative resolution is the ability to actually converge divergent thoughts and reconcile them for a positive, innovative result to occur.

Today, collective creativity can be found in a number of contexts. Examples include games, contest-based activities, and networks (Yu, Nickerson, & Sakamoto, 2012). Each of these activities requires subjects to make decisions based on unfamiliar resources. For instance, complex games require players to figure out new solutions to conquer the game. Contests represent the ability for people to seek resources beyond their control. A network requires group agreement before achieving goals. These activities represent just how an

organization might utilize collective creativity. It may not be abundantly clear that these activities have a semi-structured organization and flexible rule base.

A look at how an organization might determine the same conclusion can be derived by organizations attempting to implement collective creativity into their organization. Empirically driven scientific staff can find difficulty in changing their operating procedures (Neumann, 2007). The nature of their work might elucidate the need for rigid processes, both in research and development. Given this fact, case studies that highlight the use of collective creativity might be worth investigating. A study of a large research institute, European Molecular Biology Laboratory (EMBL), revealed that even seemingly a less creative organizations (i.e., a research institute) can have success in defining and implementing collective creativity within their organization (Neumann, 2007). The result after adoption resulted in in not only improved innovations but also the realization that developing a highly interactive organization with minimal hierarchies proved to be the key.

As a note, the advances in the area of creativity are quickly becoming popular and new solutions are being proposed to automate the process. Computational creativity algorithms are being designed to help facilitate this process (Maher, 2012). While the area is still developing, the option to scale the collective creativity to aid the development in this area is a possibility. Should this happen, the paradigm for collective creativity might again shift, adding new complexities to the domain.

Creative abrasion. More details regarding creative abrasion can help further distill the concept to core components. According to Hill et al. (2014), the key to creative abrasion is fostering both intellectual diversity and intellectual conflict. The idea here is that generating an increase in varied ideas and thoughts within an organization will increase the likelihood of the ideas and thoughts colliding to create intellectual conflict (Hill et al., 2014). This first step allows an organization to generate activity without the need of extensive resources or systems; it simply happens as a spark.

Creative abrasion was a term coined by Jerry Hirshberg of Nissan Design International (Leonard & Straus, 1997). Nissan Design International is a design arm for Nissan Motors. Based in California, Nissan Design International is a place where innovation is expected. The automotive design hub works on a number of designs at any one time. Hirshberg was managing a team that was unlike him. He would make recommendations to his team, and their reaction was always the same, general agreement. However, Hirshberg knew that this operation would not work. He realized the group needed more time to respond to his queries, and so he gave it to them. To his surprise the team began responding differently, coming up with ideas that were, in fact, innovative. Hirshberg realized that the way he was thinking and his reactions were actually the impediments to fostering creativity.

***Creative agility*.** Creative agility, according to Hill et al. (2013), involves organizational support. This is the organizational framework of the model. Creative agility provides an organizational model by which creative abrasion and creative resolution might take shape (Hill et al., 2013). The definition provided may draw similarities from typical agile organizations. Layering organizational characteristics may highlight the connection of creativity to innovation within an organization's culture.

Creativity and innovation may generally be attributed to organizations that foster diversity. Diversity can support creativity by facilitating fluency, flexibility, and novelty (Tadmor, Satterstrom, Jang, & Polzer, 2012). As Tadmor et al. (2012) note, these dimensions are standard characteristics referenced to creativity. These characteristics aid in developing organizational creativity due to the dynamics related to organizations with diverse thought. Corresponding structures need to accommodate diversity (Bassett-Jones, 2005). In other words, diversity helps align organizations toward embracing agile organizational practices.

Addressing innovations as a product of collective creativity is only a part of how creative agility might impact an organization. Examining how agile organizations are organized might help better define the structures by which creative agility succeeds. As such, the topic of how to

make agility come alive is a point of interest for scholars and practitioners alike (Worley, Williams, & Lawler, 2014). Worley et al. (2014) term their subject of study the agility factor. They are essentially focused on how to make agility work within an organization, what it's the drivers are, and how to transform an organization to this orientation. Worley et al. start the discussion by identifying key areas of performance.

Unlike businesses, not all organizations measure organizational performance in the same way. This was a challenge for Worley et al. (2014). They knew that any type of performance would need to be sustainable. These criteria allowed them to view the organization as a system rather than a transactional vehicle for production. They ended up borrowing from three broadly held views on performance, which are Darwinian selection, organization physics, and dynamic capabilities (see Figure 14). Darwinian selection as applied to their research refers to organizations competing to stay relevant (survive) and finding ways to avoid organizational inertia (Worley et al., 2014). The dynamics of an environment force organizations to make critical decisions to find ways to thrive (i.e., succeed) and evolve. Whether the change is internally or externally motivated, organizations focus on finding ways to be resilient (McCann, 2004). Managing the range of changes and balancing them becomes a priority. Such activities become a common protocol of sorts. When faced with decisions that might enable innovation within an organization, Worley et al. (2104) contend that managing these decisions is the basis for Clay Christensen's *Innovator's Dilemma* whereby leaders either do nothing or try something totally new at some unknown risk. This strategic decision is important to recognize as it frames one of the major problems that can occur (i.e., inertia) if organizations are not agile. Consequently, leaders rely on prescribed best practices to help bring ideas to fruition. Worley et al. refer to this action, as organizational physics, in other words, leaders who follow good creative practices are more or less assured of innovative outcomes. Good practices generally adhere to organizational competencies and in the case of supporting creativity are dynamic capabilities (Teece & Pisano, 1994). Each opportunity is represented by the fact that high-

performing organizational competencies allow an organization to dynamically adapt to conditions through iterations or large changes (Worley et al., 2014).

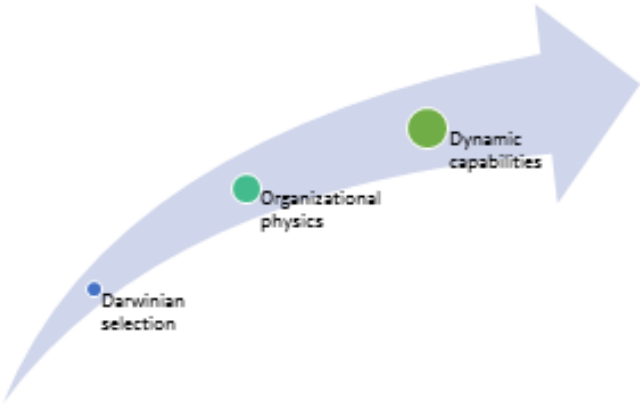

Figure 14. Three models of performance based on Worley et al. (2014), illustrating the progression of organizational agility through time.

Dynamic capabilities describe the driver for developing agility. Worley et al. (2014) describe the absence of dynamic capabilities as an inability to support continuous change (Worley et al., 2014). They argue that it is these types of continuous change activities—suggesting organizational change and performance—that maintain a correlated pattern. In order to mimic the pattern for success, organizations need to become agile organizations. Organizational agility can be defined as the ability and capacity to make timely, effective, and sustainable organizational changes (Worley et al., 2014). Organizations adopt a cycle or routine of agility involving strategy, perceptions, testing, and implementing (see Figure 15).

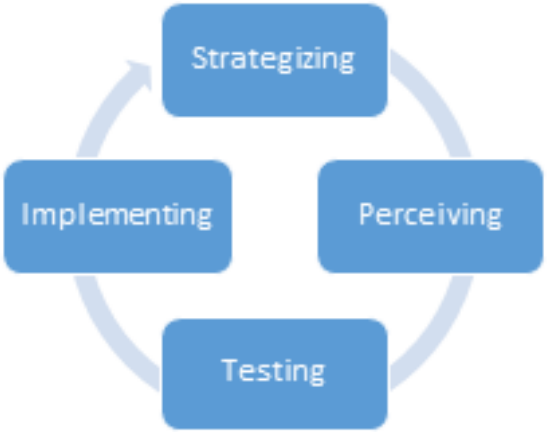

Figure 15. A model for routinizing agility as activities within an organization (Worley et al., 2014).

These routines are generalized observations of the types of activities that occur throughout an agile organization. It is important to keep in mind that the goal of this model is to change in order to innovate. Unlike Peter Senge's (1990) work on the learning organization, the concepts seem related (shared vision, team learning, and systems thinking) but are not the same. Worley et al. (2014) said: "Agility represents an institutionalized ability to do things differently when and where this creates a performance advantage" (Worley et al., 2014, p. 31).

Creative resolution. The section regarding creative resolution might inherently be the most ambiguously represented in this model. Collective creativity relies on creative abrasion for a spark, and on creative agility for a framework for organizing, but it leaves the final action to creative resolution (see Figure 16). As far as a logical statement is concerned, this makes sense. However, letting two actors with unidentified methods make decisions can be confusing to interpret. It's not explicitly clear which model(s) of decision theory should or could be applied (Hill et al., 2013). With that said, perhaps a later opportunity will emerge to discuss various decision theory models as it applies to creative resolution and cultures of innovation.

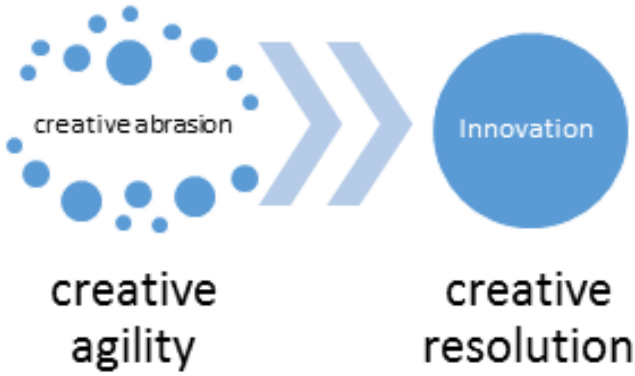

Figure 15. Model represents how innovations might occur as part of a Collective creativity model (Hill et al., 2014).

Design thinking. However, while creative resolution opens the door for questions, perhaps an indirect model for making decisions can be applied to the collective creativity system. Much like creative abrasion (i.e., the idea of attracting diverse thought and allowing contact to generate an idea), design thinking is a method for groups to evaluate various points of view to come to some conclusion (Brown & Katz, 2009). A key component of this is the idea of balancing convergent and divergent ideas. While convergent thought processes eliminate choices in order to make a decision, divergent thought processes seek to expand the choices available. Invariably the issue arises when a decision should be made by convergence.

It would seem that design thinking is not the direct mechanism for solving the conundrum that creative resolution has created. Moreover, it is noticeable that even the literature on design thinking leaves out the topics of agendas and outcomes (Brown & Katz, 2009). However, this perspective focuses on finding multiple answers before settling on one. The better approach to manage convergence versus divergence is to find as many varying questions as possible before searching for a solution (Wylant, 2008). This involves expanding the range of questions and then distilling them down to themes and repeating until only the right

questions remain, which can then be resolved (see Figure 17). While extremely circumspect, it seems to adhere to the criteria of creative resolution.

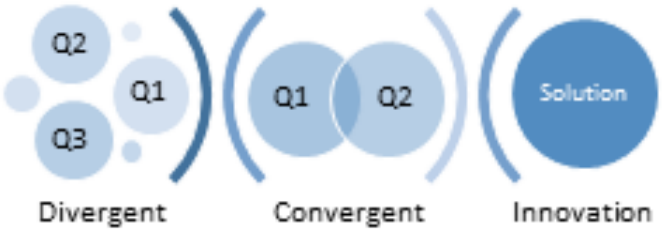

Figure 16. Represents the relationship between divergence and convergence of thoughts (Brown & Katz, 2009) that are balanced for innovation to occur.

Network effects. Thus far, the literature presented has framed innovation as a seed in the soil. Creativity has been described as the basis for innovation within complex environments. Such complex environments can be strategically conceptualized as organizational networks that can be segmented to better manage the innovation initiative (Rodan & Galunic, 2004). While innovation alone may not be sufficient for describing the culture related to innovations, a connection can be made to external factors, the innovation ecosystem, and the organization (Adner, 2006). Examining how the connections within an organization are facilitated and established may provide better insight into how to grow innovation strategies. Moreover, examining literature surrounding this area of the study suggests networks and network transmission as a possible answer.

Graph theory is a mapping of networks. This abstraction, which can represent physical connections, is a defined yet fluid structure—it is a collection of nodes representing elements of people, activities, or benchmarks. Grenier and Metes (1992) used this notion of a social network

to describe the orientation of an organization. Instead of an organization of hierarchies, Grenier and Metes (1992) described organizations as sets of networks.

Sets of networks can be oriented in different ways. Some of these orientations revolve around node formation. For example, clusters of nodes on a network can represent unique group characteristics (Aviv, Erlich, Ravid, & Geva, 2003). As a new entity, this group can exhibit different properties and agendas than if each node were evaluated independently. Moreover, the proximity of the nodes to one another acts to magnify influence that one node may have on another.

In terms of innovation, this could represent the orientation of team members collaborating. The collaboration of teams to generate something innovative would represent a cluster (Aviv et al., 2003). In addition, innovation as an output would represent the unique characteristics the group would require to be able to generate something new. However, proximity may be defined both in physical and virtual terms. Influence on one another, therefore, can be represented both ways.

This anecdote provides an example of how networks might behave. In the context of knowledge economies, organizations with global partnerships and distributed teams can take note. Effective team collaboration has been seen to be a function of close proximity (Barab, Makinster, & Scheckler, 2003). Close ties within the network create a familiarity that teams relate to. Leveling off disparities within the group creates what Barab et al. (2003) refer to as *homophily*.

Homophily describes a network composition as well as alludes to interaction behaviors. With the composition of a homophilily network, generally, even variations in characteristics and behaviors should be kept to a minimum (Lazarsfeld & Merton, 1954). These types of network configurations suit organizationally efficient producers. There is less uneven production to market. However, homophily does seem to deter innovation (Hannah & Lester, 2009). The lack of bisociation referred earlier may be the contributing factor.

By contrast, heterophily may contribute more directly to innovation. The issue with regard to innovation in heterophilic interactions involves the diffusion process (Rogers, 2003). Diffusion relates to how effectively the attributes for bringing about innovation are transmitted. In any case, the difference between technical acumen, education, knowledge, experience, etc., all contribute to the conditional state sought after for innovation. However, the degree to which networks should be heterophilic may depend on other factors. In which case, people become the focal node for analysis.

One of these factors may be identifying what information is transmitted within the network, and how. In a global heterophily-dominant organization, attributes vary between people within an organization. Both physical and virtual differences may exist. These differences can be examined through the information transmitted within the network. At times, this is represented as informal learning. Part of the global, interconnected phenomena is the rise of informal learning as part of a global workforce (Conlon, 2004). Informal learning may provide deeper insights into the impact of networks on innovation.

The literature about knowledge economies refers to information transferred through informal means, which may aid in the transfer of information and knowledge across networks. A point about informal information is that the definition established forms for transmission and protocol are not utilized (Conlon, 2004). The fluid nature of informal learning means that people continue to search, intentionally and unintentionally, for ways to enhance their own abilities and skills (Marsick & Volpe, 1999). Furthermore, Marsick and Volpe (1999) note that the need for informal learning may be derived, in part, from an organization's culture. In other words, the facilitation of informal learning may have something to do with an organization's structure and orientation.

In this case, informal learning can be conceptualized as an intentional activity. By addressing informal learning as something people intentionally engage in, informal learning becomes part of the organization's artifacts (Watkins & Marsick, 1993, 1996; Marsick & Watkins,

1999). Being intentional with informal learning acknowledges that the transmission of information over networks adds to both explicit and tacit knowledge. The aggregation of knowledge is a key asset in innovation. In order to generate more knowledge, mechanisms governing the regulation of skills related to knowledge acquisition become important. A learner's self-regulatory skills can be imparted directly, and organizations can support specific learning outcomes (Boekaerts & Minnaert, 1999).

However, the more involved an organization becomes with facilitating informal learning through defined mechanisms, the more trade-offs are needed. Differentiating environmental factors from individual factors related to informal learning may provide more insight into factors that can influence innovation within an organization, specifically, the differentiation between external conditions and those of the individual learner (Straka, 2004). External conditions to examine include formal, non-formal, and informal responses, while individual conditions for learning include how the learner approaches explicit, implicit, and incidental information.

Balancing between organizational and individual needs can distract from integrating informal learning to innovation-generating activities. A model suggested by Svensson, Ellström, & Åberg (2004; see Figure 18) bridges the gap in the process. Formal and informal learning becomes bi-directional and the transition between explicit and implicit knowledge increases. The aggregation of information into knowledge creates contextual factors that support innovation. This support extends to the organizational community to include peers and management (Macneil, 2001). Greater social support may indicate more focus to be placed on informal learning and its role in innovation. Frameworks to provide operational conditions within an organization to support informal learning (see Figure 21) may be provided added (Skule, 2004).

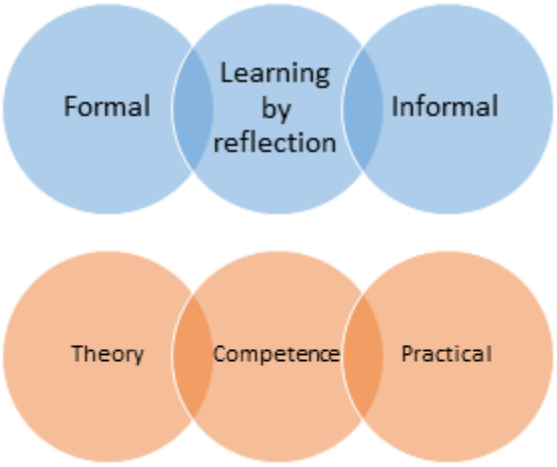

Figure 17. Adapted from Svensson et al.'s (2004)'s model of learning transfer. The model demonstrates the alignment, both vertically and horizontally, between learning styles.

Figure 18. Adapted from Skule's (2004) framework for learning conditions to meet proficiency benchmark.

Culture

Much of the discussion to this point has focused on innovation and the components that influence the creation of innovation. The focus on conditions required in order to innovate was intentionally described. Through these factors, innovation may seem like a discrete process with a foregone conclusion that resulting efforts will create something novel (Phillips, 2009). Though this notion may seem reasonable and even rationalized by the evidence in the literature, organizations may still require additional insights into processes and methods used to deliver innovation.

As stated, much of the literature revolves around generating the right factors that can generate innovation. For instance, an example of additional attributes may be related to leadership energy. As it turns out, leaders directing energy to appropriate outlets may contribute to fostering better performance and innovation within an organization (Cooper, 2001). Pinpointing any one attribute that contributes directly to innovation seems unlikely. The following section reviews common organizational factors that may contribute to incubation, such as culture. By examining standard culture formation, concepts and outlining a framework to evaluate innovation within cultures, this next section can provide further insights into how innovation may continue to grow after the inception of an idea.

An organizational culture model that has been a standard is Edgar Schein's culture model (2010). Schein described culture as the generalized tacit knowledge people within an organization have regarding how the organization is and should be (Schein, 2010). This view of an organization relates to how people feel, think, perceive, and behave overall (Schein, 2010). These behaviors make up the actions within an organization and bring a uniqueness to each organization. Schein proposed a model that included three layers, namely: artifacts, espoused values and beliefs, and basic assumptions (Schein, 2010). In this model, each level is a layer upon which the understanding of culture within in an organization is based (see Figure 20).

Figure 19. Adopted model of Schein's culture model (2010) demonstrating the level of organizational culture.

The layers are distinct in orientation within an organization (Schein, 2010). The top layer, artifacts, relates to the visible traits of an organization. Physical items that directly speak to culture may include physical spaces, design, and language (Schein, 2010). These items and corresponding related activities should be visible to new members of the organization as well as public. The middle level relates to the espoused values and beliefs (Schein, 2010). Here organizations promote a stated set of values and beliefs both internally and externally. There is an intentionality on the part of the organization at this level. Finally, the last level relates to the shared consciousness of basic assumptions (Schein, 2010). The activities at this level are less obvious and are not necessarily vocalized, but reinforced by expectations. These assumptions are core to the people in the organization. Further exploration of this model may provide deeper insights into the type of culture in which innovation may thrive.

Artifacts. Schein's model of organizational culture begins with a description of attributes that are common and present in an organization (Schein, 2010). Common artifacts are often items that can be readily found in and around an organization. These items should be present and represent something universally known throughout the organization. Such items become

symbols within the organization and are embedded as the way the organization prefers to operate.

The operation of the organization is a fluid set of actions. These actions are known as *cultural dynamics*. More specifically, cultural dynamics refer to how cultures exist and evolve (the enculturation process), and change through diffusion, innovation, apathy, and or resistance (Hatch, 1993). These dynamics, according to Hatch, are cyclical in nature (see Figure 21). For instance, the concept of symbolizing some behavior in the organization to be recognized throughout the organization will eventually be tied to values and then eventually become a basic assumption regarding how the organization works. However, Hatch's model does not take into consideration the impact of market forces external to the organization.

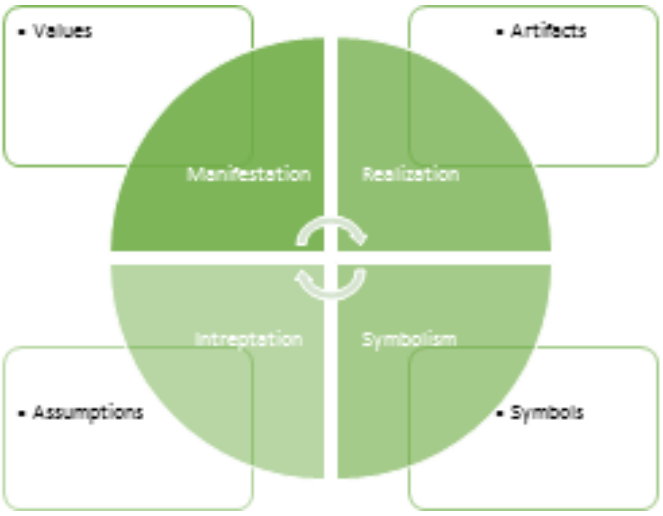

Figure 20. Adaptation of Hatch's Cultural Dynamics Model (1993) depicting the interplay of themes and corresponding associations.

External forces outside the organization are especially potent for knowledge economy organizations (Teece, 1998). As discussed earlier, knowledge economy organizations are defined and highly driven by the geographic dispersal of partners and customers. These market forces act almost as regulators (see Figure 22). In this way, the accumulation of artifacts contributes to defining the structure of the culture. As the dynamics of the organization continue

to matriculate over time, the connection between structure and behaviors is strengthened and creates a sub-cycle within the cultural framework (see Figure 23).

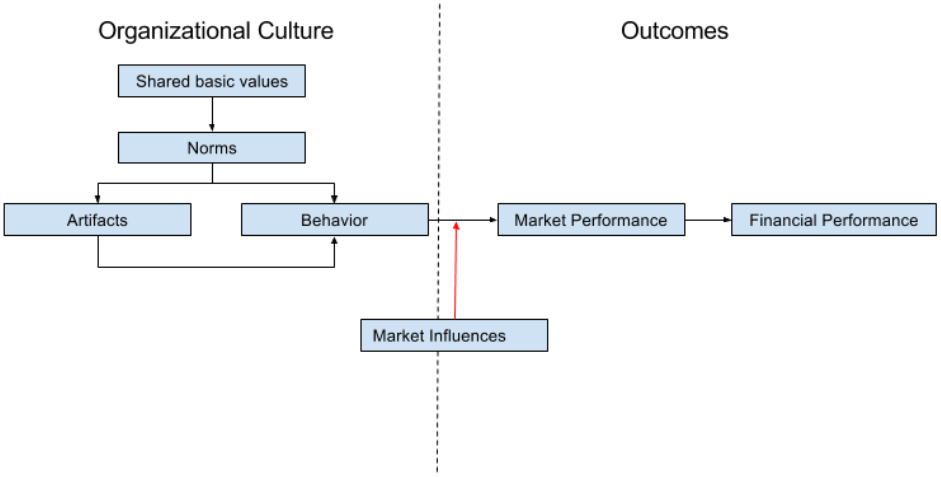

Figure 21. Illustration of organizational culture components in relation to outcomes, as well as where external influences may intervene when attempting to produce innovations (Homburg & Pflesser, 2000).

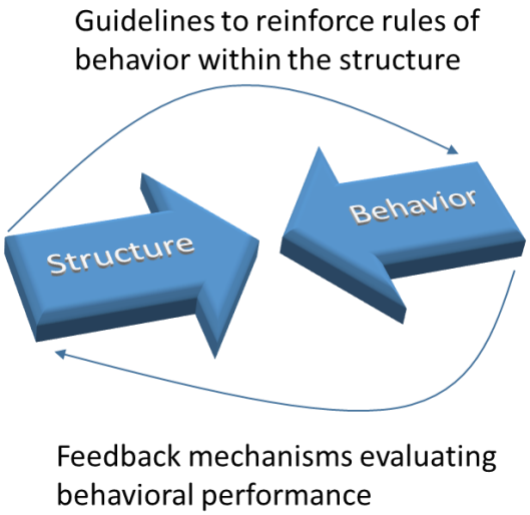

Figure 22. Dynamics of artifacts as represented as an interplay between standards (structure) and measurements of performance and behavior (Dauber, Fink, & Yolles, 2012).

Espoused beliefs and values. The next level within Schein's culture model addresses the espoused beliefs and values of an organization as they relate to prevailing norms. To begin with, a set standard of values may help guide the remainder of the discussion. By those criteria, the use or universal values to assess the typology of an organization can create a common platform to work from (Schwartz, 2012). The value theory concept identifies ten common values and categorizes them according to theme (see Figure 24). These values can be measured based on each individual's own priority with respect to the organizational values. An examination of which values are prioritized by innovation-based organizations will again help narrow the scope of inquiry.

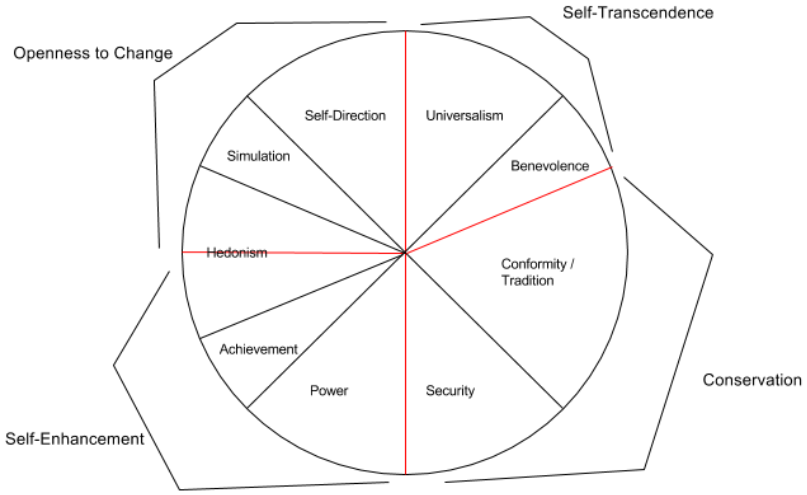

Figure 23. Adapted universal values model that can be directed as a model for support in innovation within an organization. However, to that point, further investigation into how it relates to esoteric innovations is warranted (Schwartz, 2012).

As it turns out, organizations that foster innovation tend to couple the universal values described above. In fact, these values can be grouped to include value profiles, value congruence, and value-practice interactions (Khazanchi, Lewis, & Boyer, 2007). Value profiles

relate to a cohesive set of organizational values (e.g., flexibility or control), while value congruence accounts for perceived coherence (Quinn & Rohrbaugh, 1983). Lastly, value-practice interactions is a way to assure support from the culture and reduce the risk of misalignment (Frohman, 1998; Higgins & McAllister, 2002). However, there is research to suggest that values orientation can be impacted by time, humanity, natural environment, relating to other people, and motive for behaving (Hills, 2002). In fact, following this notion of adjusting an individual's value orientation, another impact may be how a person views and accepts technology and consequently innovations. These values may be examined through the lenses of individualism versus collectivism, power distance, uncertainty avoidance, and masculinity or femininity (Srite & Karahanna, 2006).

Supporting the dynamics of an organization's espoused values are its attitudes and beliefs. The way a person feels about an artifact (i.e., attitude) or perception of truth (i.e., belief) over time can lead to ingrained values and thereafter norms (Schwartz, 2012). Keeping in mind mental models that demonstrate the captured thought process is also important to manage thoughts and abstractions of selected representations of the facts (Jones, Ross, Lynam, Perez, & Leitch, 2011).

Basic underlying assumptions. At the core of Schein's organizational culture model are the basic underlying assumptions of an organization. Some of these basic assumptions are well known; others are not. Self-awareness, in this case, amounts to the ability to recognize these basic underlying assumptions, also referred to as *theories-in-use* (Argyris & Schon, 1974). The notions about theories-in-use are that these are implicit assumptions used all the time. Assumptions are connected to those underlying assumptions related to behavior and relationships. They also tell a group how to perceive, think about, and feel something within an organization (Argyris & Schon, 1974).

Theories-in-use manifest in organizations and their interactions in two ways. The first is called *single loop learning*, which refers to the completion of goals, tasks, values, and plans as

part of an operationalized action. Single loop learning is the basis for what Chris Argyis calls Model I (Argyris, Putnam, & Smith, 1985). In Model I behavior, people act on their preconceived notions without thinking twice.

By contrast, *double loop learning* requires an individual to think about and evaluate the factors involved in a decision. What the individual questions are the processes involved in the prevailing theory-in-use (Argyris & Schon, 1974), which include things like governing variables (i.e., boundary elements), action strategies, and consequences (see Figure 25). In this type of Model II behavior, decisions are made only after questioning the status quo and reevaluating processes as they relate to the organization.

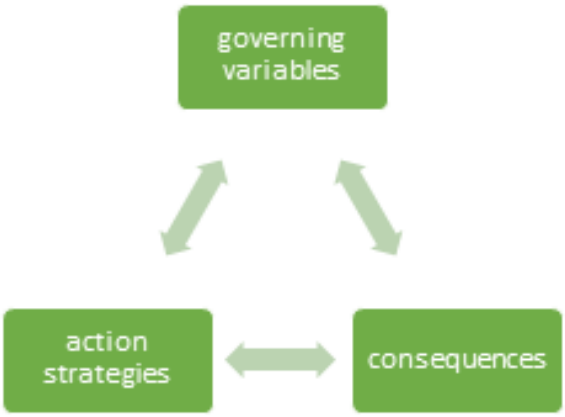

Figure 24. Adapted theory-in-use diagram (Argyris & Schon, 1974) demonstrates the reciprocating effect variables have on each other.

As a note: earlier, it was discussed that knowledge-based economies have different organizational configurations than traditional economies, which are built on fixed assets and physical products (Chang & Lee, 2008). This has been a relevant detail throughout this literature review. It is relevant in order to compare and contrast normally considered literature. A topic normally considered an extension of culture might be organizational effectiveness. Studies involving organizational effectiveness may highlight organizational performance and culture whereby performance is based on an established set of criteria. Literature around criteria-based

performance standards may thus be directed at attempting to normalize behavioral variances. This basic assumption on organizational effectiveness literature may then be at odds with literature involving innovation. The literature reviewed so far has intimated that innovation is best cultivated when there is organizational flexibility, and there are variances in behavior (i.e., bisociation). However, this may not necessarily be true. Should organizational effectiveness be evaluated as a framework rather than a specific guide to achieving an ideal end state; perhaps the literature might reveal a connection with delivering a culture of innovation.

Organizational effectiveness. Paradoxically, examining organizational effectiveness as it relates to innovation involves a discussion both of fundamentally opposing ideas and of framework compatibility. As discussed, there is some doubt whether innovation can be examined as part of the organizational effectiveness model. Generally, core problems of a social system can be identified by reducing variances in behavior pattern and implementing systems to smooth out the variances (Katz & Kahn, 1978). This approach mirrors a certain assumption that organizational effectiveness may not be a consideration for innovation based on the literature above. Speculatively, this definition could not account for the knowledge economy at the time, and traditional economy organization might still refer to organizational effectiveness this way.

From the perspective of organizational effectiveness as a framework to help organizations achieve their goal, innovation seems to be more congruent with this understanding. This is useful as the earlier discussion regarding agility as an organizational factor to support creativity can be used as a starting point for this topic. In other words, achieving organizational effectiveness is inherently a function of change and adaptability (Lawler, Worley, & Porras 2006). As discussed previously, change and adaptability are keys for innovation. Thus, examining organizational effectiveness through this perspective can promote a deeper discussion regarding the application of organizational effectiveness to innovation.

Basic organizational effectiveness is, firstly, a set of attributes. Common attributes for an organization to achieve goals include involvement, consistency, adaptability, and mission (Denison & Mishra, 1995). This framework (see Figure 26) guides the discussion of how organizational effectiveness is really a trade-off between internal versus external forces, as well as agility compared to stability. The decision to make trade-offs does not result in a net-zero effect. In fact, the decisions made addressing these trade-offs are cumulative and can build momentum. These become activities within the organization and eventually become part of the culture cycle (Schein, 1990). Embedding these behaviors occurs over time to support the overall evolution of an organization's culture.

	Flexibility/Change	Stability/Guidance and Direction
External factors	Adaptability	Mission
Internal efforts	Involvement	Consistency

Figure 25. Denison and Mishra's Theoretical Model of Culture traits . Matrix highlights the traits that an organization needs be able to balance in order to achieve objectives related to innovation.

While this framework examines organizational effectiveness as a part of the organization's overall conscious attempt to regulate itself, other models examine organizational effectiveness as a sub-section of Schein's (1990) culture model. Examples of this relate would include the impact of value systems on organizational effectiveness. Values are defined as

explicit norms that consolidate to make up a system (Wiener, 1988). These systems are defined by organizational variables such as how decisions are made, the makeup of the organizational structure; leadership styles, and rewards (Deal & Kennedy, 1982). The evaluation could be based on analyzing impacts to the matrix (see Figure 27). Each axis of the matrix represents how values might be translated within an organization. The x-axis is focused on the content representing organizational values, while the y-axis represents the source and core beliefs behind these values (i.e., basic assumptions).

Figure 26. Adapted from Deal and Kennedy's value system model (1982) . Highlights the directionality of values (y-axis) and beliefs (x-axis) in an organization.

In this model, content is defined as either functional or elite. Functional values are ways that people in an organization normally behave and whose objective is to orient and act upon the goals, functions, and how to operate of the organization (Wiener, 1988). Elite values refer to the determined motivation to accomplish goals related to the organization's performance (Wiener, 1988). By this definition, both the functional and elite content value of an organization can be used to measure organizational effectiveness. In other words, the values of a culture can

influence organizational effectiveness. However, this assumes perfect alignment and cooperation.

Adoption of values can be key in ensuring organizational effectiveness, and the opposite can create less optimal conditions. In terms of innovation, a similar approach to examining concepts can begin with identifying attributes. The adoption of innovation can be related to four traits: the relative advantage that innovation brings to the organization, compatibility with current norms, ease of use (trialability), and the presence or absence of visible results (Rogers & Shoemaker, 1971). Clearly defining each of these traits might better provide insights to possible recourse for organizational effectiveness (see Figure 28). *Relative advantage* refers to the organization's ability to utilize the innovation toward achieving organizational goals, internally and externally. *Compatibility* refers to how well an innovation might integrate with current processes and thinking. *Trialability* refers to the ability for an organization to evaluate an innovation before committing to it. This evaluation period allows organizations to compare the innovation against their mental models of how things can be or behave (Rogers & Shoemaker, 1971). Should the innovation be easier and can demonstrate a qualified better way, then the trialability component will be satisfied. Finally, *observability* relates to the organization's ability to compare results of innovation to expected results, internally or against market expectations.

Figure 27. Adoption of Rogers & Shoemaker's innovation model (1971) demonstrating how an organization should receive inputs for innovation.

This model also helps demonstrate a possible threat to organizational effectiveness: organizational lag. Effective organizations are ones that meet organizational goals; therefore, unmet goals against expectation, regardless of whether they are lately or simply not accomplished, have contributed to organizational lag. Organizational lag can be defined as the difference in the rate that new technical or administrative ideas are adopted within an organization (Evan, 1966). This concept implies that the rate of innovation can be measured and thus be a real detriment to organizational effectiveness. However, this does not mean that innovation cannot occur within or as a product of an organization. It simply indicates an obstacle. The remedy, it seems, to get an organization out of organizational lag, is to create small wins for innovation to be adopted. As administrative innovations are adopted, so too will more advanced technical ones be (Damanpour & Evan, 1984).

This hints that knowledge-based innovations might have a larger role within an organization. It appears that innovations based on knowledge management can be mechanisms driving an organization, and perhaps driving organizational effectiveness (Zheng, Yang, & McLean, 2010). The logical response would be to try to connect the fact that innovations

happen through knowledge management, and knowledge management drives organizational effectiveness; therefore—through transitive logic properties—it means that innovation is critical to organizational effectiveness. This may not be a good logic statement, and in fact, it is doubtful whether that is what Zhang et al. (2010) intended as the conclusion of their research. What is clear is that the way knowledge is managed is based on how well cultural values are converted to value creation activities, and therefore into value for the organization. If building a culture of innovation proves so fruitful, it follows that everyone would want to try fostering cultures of innovation. However, that is not the case.

What stops some organizations from advancing innovation is a non-openness to innovation in the first place. Thus far, the literature has revealed how innovations are generated and how culture model frameworks function; however, an assimilation process may need to be activated. Activation requires the basic assumption of three factors: knowledge-awareness, evaluation-choice, and adoption-implementation expectations (Meyer & Goes, 1988). Innovation in this regard, embedded within a culture, might seem fluid. The question that may naturally arise is how predictably one can assume that innovations will occur; however, this is likely not the correct frame for evaluating a culture of innovation. The reason goes back to the concept of inertia previously discussed. In lieu of risk of inertia, a traditional frame for an organization must be acknowledged, and that is leadership. The next section discusses possible leadership attributes and activites that can aid in facilitating innovation within an organization and fostering a culture to surround it.

Leadership

With both innovation and culture literature identified, the third concept for review is leadership. An introduction to the importance of leadership in an organization is likely a redundant topic for discussion. Again, the topic of transformational leadership notwithstanding, other leadership theories and styles apart from cultures of innovation are of interest in the discussion of the formation of leadership attributes within an organization, only because the

majority of the literature reviewed here is in regards to structural frameworks and components (Mendenhall, Osland, & Bird, 2012).

However, a discussion on leadership within organizations could provide insight into the impact it has on the development of innovation and beyond. Prior to the twentieth century, the study of leadership rarely extended beyond military studies or historical analysis (Mendenhall et al., 2012). Throughout the twenty century until present day, the development of leadership theory and application has progressed from domestic interest to global domains (Mendenhall et al., 2012). Generally speaking, current research may be categorized by five approaches, which include trait, behavior, situation, power-influence, and integrative approaches (Mendenhall et al., 2012). Of these approaches, an integrative perspective of leadership provides the most relevant framework of focus. By pulling the other four approaches into a system level perspective, the integrative perspective allows for new insights into leadership (Yukl, 2002). Addressing the complexity of organizational variables as well as dynamics are keys in leadership studies focused on an integrative approach (Wheatley, 2006). The implications of such studies examining cultures of innovation may foster global leadership best practices in leading the development of innovations.

While leadership theories, such as transformational leadership, address the perspective of the leader, the perspective of the follower may provide additional insights into how leadership may impact the ability of an organization to innovate. For instance, following a path-goal theory of leadership perspective, the subordinates' performance is based on a leader's behavior (Northouse, 2012). However, the level of satisfactory behavior from the leader may also vary depending on the conditions and situations within the organization (House, 1996). In the case of organizations seeking to produce innovation consistently, this may become an issue. When subordinates feel a lack of direction in their attempts to create, their willingness to follow is weakened (Elkins & Keller, 2003). However, when creativity is bounded by too many organizational constraints, it tends to fail to produce innovation (Mumford & Licuanan, 2004).

These findings seem to indicate the need for path-goal leaders to carefully balance needs for followers and subordinates to feel empowered to create.

Another perspective in leading for innovation is examining leadership as a relationship. Leader-member exchange (LMX) theory examines the dynamics between leaders and subordinates (Northouse, 2012). The facilitation of high-quality exchange between the leader and subordinate allows for increased organizational performance (Graen & Uhl-Bien, 1995). That performance can extend to developmental areas like innovation (Graen & Uhl-Bien, 1995). The notion of organizations being fluid and dynamic allows for the possibility for innovation to occur with the right environmental factors enacted.

Aggregating all the literature and perspectives using heuristic methods may produce sufficient research on leadership in innovation. However, using literature that reviewed the topics as a large-scale study helps summarize some of the key ideas. For instance, a multi-dimensional framework examining organizational innovation, such as Mary M. Crossan and Marina Apaydin's 2010 study as published in the *Journal of Management Studies.*

Crossan and Apaydin (2010) used a systematic, explicit algorithm to conduct their search for academic articles. Using the ISI Web of Knowledge's Social Sciences Citation Index (SSCI) database, Crossan and Apaydin were able to collect over 10,000 papers to investigate. They then filtered the process down by keywords, grouping publications, reviews and meta-analysis, highly cited papers, and recent papers. This yielded an acceptance rate of 4.8% of the articles reviewed. In other words, over 500 academic, peer-reviewed quality scholarly works were accepted for their study. They then grouped papers by topics and tags. The final step was to synthesize the results.

Among the number of themes that arose from the study, identifying several leadership theories was one. Innovation leadership is a broad generalization for a set of leadership theories that might be associated with innovation (Crossan & Apaydin, 2010). This meta-construct model of innovation leadership includes attributes at the first order, second order, and group level.

Table 1

Attributes Linked to Innovation Leadership

First order (Individual level)	Second order (Upper echelon theory)	Group Level
Tolerance of ambiguity	Leadership behavior is derived from values, experiences, and personalities	Team composition & characteristics: education, age, tenure, diversity, background and experience, and extra-industry ties
Self-confidence		
Openness to experience		
Unconventionality	Leading creative efforts requires substantial technical and professional expertise, along with creative skills and ability to process large, complex sets of information	
Originality		
Rule governess		
Authoritarianism		
Independence		
Proactivity	Motivation	
Determination to succeed		
Personal initiative		
Managerial tolerance to change		

Table 1. Note. Adapted table of attributes linked to innovation leadership (Crossan & Apaydin, 2010) demonstrating leveling attributions.

The generalized framework on innovation leadership can be followed up with examples. For instance, functions within organizations might provide a somewhat myopic view on how leadership theories can be associated with innovation. Examining a R&D function within an organization might provide the example needed. Due to the nature of R&D and the most

common form of innovation (i.e., product), the R&D organization is a sensible focal point (Elkins & Keller, 2003). It can be linked to several leadership theories including transformational leadership, path-goal leadership, and leader-member exchange (see Figure 29). At least one of these theories is expected to be apparent within an innovative organization (Elkins & Keller, 2003). Further definitions should be provided. Transformational leadership theory can be defined as a leader encouraging intellectual stimuli, having individual considerations, a clear and motivational vision, and the charisma to relate to the people in the organization (Bass & Avolio, 1990). Path-goal leadership theory involves leaders who act in ways to facilitate goal attainment and maximize the value received from achieving that goal. This behavior should also influence subordinate's expectations, disposition and feelings, performance, and job satisfaction (House & Dessler, 1974). Leader-member exchange leadership theory refers to the description of the exchange of roles between leaders and subordinates at various times, with high organizational outcomes expected (Graen & Uhl-Bien, 1995).

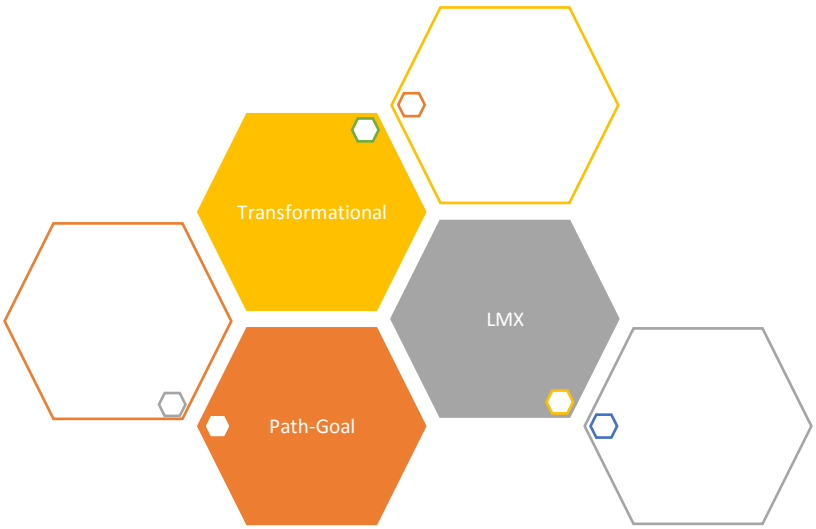

Figure 28. Adapted model depicting innovation leadership as relational yet not necessarily interlocking (Elkins & Keller, 2003). Other complimentary factors may share in the connection.

Based on the attributes collected in Crossan and Apaydin 2010 study, it seems as though current models attempting to capture innovation leadership may not have enough overlapping relationships. Perhaps future studies will examine the confluence of specific innovation orientations, distributed organizational cultures, and interactions between various leadership theory models. Aside from investigating organizational orientations to facilitate innovation and possible ways it might manifest within an organization, the research reviewed should provide the basis for expanding the body of knowledge presented to include models of operation currently outside the scope discussed.

As a summary, while innovation is not constrained to corporate firms, framing innovations in terms of an organizational activity may help identify profitability or provide an advantage that management seeks. Making innovation work within the confines of an organization requires skill and discipline (Davila, Epstein, & Shelton, 2012). Furthermore, the profitability of innovation is not constrained to the innovator, but may be passed onto competitors bringing derivative products to the market (Green & Scotchmer, 1995). This is evident for many technology producers and a common problem leading to incremental innovations (Aghion, Harris, Howitt, & Vickers, 2001). Organizational efforts to unlock innovation require tapping into the brainpower of an organization (Edvinsson & Malone, 1997). If the knowledge is considered esoteric in nature, the organizations will have another advantage. Building upon this knowledge requires organizational competencies to bring it to production (Tornatzky & Klein, 1982). Few organizations have the competencies to bring about consistent innovations, let alone focus on a single domain like computer-aided engineering. Technologies based on esoteric knowledge create new standards in light of the lack of standard processes that popular research dives into (Marczyk, 1999). Deriving insights from sub-domains becomes even more problematic when searching for common practices.

Managing knowledge assets such as engineering methods of a CAE firm is a complicated matter. From dynamics to performance, knowledge assets are critical for

organizations to manage (Albino, Garavelli, & Schiuma, 2001). Even government agencies are trying to develop organizational practices to integrate disparate activities of esoteric technology users (Reddy, Wood, & Cleetus, 1991). Functions within organizations, even Human Resource departments, are exploring ways to meet the challenging needs of this type of workforce (Campbell & Warner, 1992). The adoption of organizational and development strategies is indicative of organizations that require specialized management and leadership to maintain the culture.

Managing the ability of an organization to generate innovation continually is a problem many Human Resource departments, managers, and executives face. The culture of innovation is not only elusive, but aligned research may not exactly fit the conditions of every organization. However, standards for examining a culture of innovation tend to focus on an organization's climate, culture, and ability to create (McLean, 2005). Creativity, for example, is a key theme associated with innovation. Regardless of the type of innovation, creativity seems to be a well-accepted component of innovation (Bharadwaj & Menon, 2000). As organizations attempt to address the growing desire to be more innovative, the organization relies on strategies to build and foster that creativity (Martins & Terblanche, 2003). Combining the right ingredients for fostering creativity is the first step. These interactions and dynamics can be conceptualized as part of the collective creativity (Hill et al., 2014). Utilizing a method that fosters abrasion (difference in ideas), agility (ability to adjust), and resolution (arrival at a consensus) within a construct provides the platform for creativity to shine.

Once an organization is able to foster creativity consistently, activities directed toward innovation can be instructed. Methods, which provide a generative framework for creative learning, enable the distribution of creativity (Truman, 2011). With the adoption of the methods, more creativity permeates an organization. Otherwise, the adage that leadership drives innovation is looked to as the default mechanism of creativity. Transformational leadership, for example, assumes that innovation can be a directive from leadership and that leaders can

fostering creativity directly (Gumusluoglu & Ilsev, 2009). The importance of leadership within these cultures of innovation may undoubtedly be substantial, as it is in all organizations. However, the utility and prominence leaders give creativity to drive innovation within esoteric technology producing organizations may not be as clear. By studying leaders who have shepherded innovative results within their organization, and comparing and contrasting their actions to common methods within a framework of evaluation, the goal is to discover how to grow esoteric technology innovations.

Chapter 3: Research Design and Methodology

Introduction

The purpose of this study is to describe how innovations arise in esoteric technology providers. The research design and methodology section will describe the steps to be taken to plan, conduct, and analyze the activities of this phenomenological study. According to Creswell (2012), a study of this nature should adhere to a process and be based on a framework (Creswell, 2012, p. 44). However, before stating these objectives, a re-statement of research questions and an exploration of the nature of study will be described. Here the process will include a qualitative research method, plans for research design, interview protocol, acknowledged limitations, data analysis protocols, and a summary. By utilizing a defined process, the research should provide rich insight into the phenomena of interest (Creswell, 2012, p. 65). Furthermore, no new material has been included.

Re-Statement of Research Questions

The phenomenological inquiry into cultures of innovation within an esoteric technology provider can be addressed by investigating the leadership within the organization. By employing a qualitative research approach to this study, the richness of the experiences shared by leaders in the organization will come to light. Directed research questions, therefore, are needed. The following research questions (RQ) guide this study:

RQ1: What strategies and practices are employed by the executive leaders of esoteric technology companies to promote a culture of innovation?

RQ2: What challenges are faced by the executive leaders in esoteric technology companies to prompt a culture of innovation?

RQ3: How do the executive leaders of esoteric technology companies measure success in promoting a culture of innovation?

RQ4: What recommendations for promoting a culture of innovation would executive leaders of esoteric technology companies make for future leaders in the field?

Nature of the Study

By using, a qualitative approach to evaluate shared experiences of esoteric technology leaders within an organization, the underlying "how" and "what" is experienced during times of innovation might be illuminated (Creswell, 2012). The unique lived experiences of these leaders should provide key insights into the innovation process (Moustakas, 1994). The essence of these experiences is key in reconstructing the experiences felt (Creswell, 2012). Leaders may examine their experiences in different ways. Thus, there is expected to be a subjective component, along with objective recollection, in their feedback (Creswell, 2012). This is not to say all feedback is required to be perfectly objective, however. Part of this process is to acknowledge the normative behaviors within an organization (Sanders, 1982). Of course, as the subjects acknowledge their subjectivity, the researcher must also acknowledge their own biases (Creswell, 2012). Bracketing, as it is termed, is a technique researchers must use in order to acknowledge the personal experiences that may be associated with the study. Framing the study this way may provide the conscientious researcher the ability to understand the keys to the data collected. The data will be collected through interviews. These interviews will provide units of analysis and detailed descriptions summarizing the "what" and "how" of esoteric technologies existing within organizations (Creswell, 2012).

The design of a qualitative research study is used because it is important to examine how innovations, especially esoteric technology innovations, arise and are regenerated. Innovations cannot easily be labeled if these variables are not easily measured. Thus the complexity of how cultures of innovation arise, survive, and thrive is difficult to encapsulate clearly. Utilizing a methodological congruence approach to the research design means that the purpose, questions, and subsequent methods are interconnected (Creswell, 2012).

Strengths. A rich qualitative study can provide great insights into difficult to explain phenomena like innovation. Qualitative research can be used when quantitative studies and statistical methods cannot fully address a problem (Creswell, 2012, p. 48). Qualitative studies allow researchers to add color and develop existing theories that are yet to be discovered. In other words, qualitative research excels at addressing processes, justifications, context, and deeper thoughts about a shared experience (Creswell, 2012). The resulting document represents a collective narrative that highlights complex details of an experience into a more digestible format (Creswell, 2012).

Weaknesses. However, qualitative research also presents its own challenges, specifically regarding ethics (Creswell, 2012). Items involving personal interaction, recording emotional data and personal time present issues that qualitative researchers must consider (Hatch, 1993). Qualitative research can be a time-consuming exercise whereby the participant may feel taken advantage of if nothing is returned. This may be something as simple as acknowledging and respecting the subject's space and attempting to cause as little disruption as possible. This is especially relevant as researchers may encounter emotional situations that could damage the research being conducted. Regardless of the issues, researchers acknowledge both the bad and good of qualitative research doing the best possible job to conduct excellent and ethical research.

Methodology

The search for wisdom and understanding may depend on the ability to follow a sound phenomenological method. Accounting for the subjectivity, epoche, suspending judgment, may allow for the development of the experience to naturally come out of the stories (Groenewald, 2004). Encapsulating the stories in their totality provides the opportunity for insights and conclusions to be drawn. Using a structured approach to the study requires a dedicated process.

Assessing the merit of a particular type of study by its strengths and weaknesses may outline the expectations for the study. A phenomenological study excels in developing a deeper understanding of a shared experience that is typically difficult to synthesize amongst a group of individuals. Assessing common experiences aides in facilitating societal development through social workers and policy makers (Creswell, 2012). Phenomenological studies can also provide a way to consolidate multiple perspectives into a single context. Narrowing the focus of a phenomenon may allow insights for non-experts into the experience and shape corresponding processes (Moustakas, 1994).

However, there are drawbacks to utilizing a phenomenological study. First, researchers are expected to have some knowledge of the domain of study. The researcher will need to be familiar enough with theoretical and abstract principles involved in the study, but must also bracket personal experiences in order to avoid bias when generating results (Creswell, 2012). This may be difficult due in large part to the ambiguity of the results prior to interviews. Moreover, a phenomenological study requires a very specific set of subjects. Without a tight control over the sample, a shared perspective may be difficult to obtain. Finally, the researcher must be able to acknowledge his/her biases at the appropriate time (LeVasseur, 2003). Addressing what impact these personal insights may have on the study may lessen the risk of biases affecting the study.

Structured process of phenomenology. Utilizing a structured process of phenomenology, the experiences, conditions, and context will be considered. According to Creswell (2012), this process requires:

- Examining multiple common and or shared experiences
- A phenomenon of inquiry, such as innovation
- Broad philosophical assumptions, for example, innovation through the lens of critical theory (Feenberg, 1991)
- Data collected from interviewees who experienced the phenomenon

- Broad inquiry: “What have you experienced in terms of the phenomenon?” and “What contexts or situations have typically influenced or affected your experiences of the phenomenon?” (Moustakas, 1994)
- Data analysis via horizontalization and clusters of meaning (Moustakas, 1994)
- Describe the experience (textual description) in context (structural description)
- Derive the essence of the experiences and underlying structures.

Appropriateness of phenomenology methodology. Utilizing a phenomenological methodology may offer the best approach for studying innovation involved with esoteric technologies. While this study will not focus on esoteric technologies or the actual development of technologies, it will attempt to reduce down the complex issue of how innovation takes place in a privately held CAE company. The organization of study provides the subjects that helped facilitate the production of innovative products. These shared experiences are the focus of this study (Creswell, 2012). The uniqueness of the mission of a privately owned CAE company narrows the experience of leaders to a limited group of individuals. In examining these lived experiences, the choice to select a phenomenological study approach is appropriate.

Other qualitative study approaches simply do not address these specific conditions (Creswell, 2012). This study is not attempting to identify components of innovation for the purposes of replicating the results. In other words, this study would not be appropriate for a grounded study. Moreover, this study will not focus on the underpinning socio-cultural systems associated with this or multiple organizations over time. Therefore, ethnographic research is also considered inappropriate for the study proposed. Furthermore, the collective responses within the organization exclude the use of the single narrative study of narrative research and are not limited to a single instance, as it is for case study research (Creswell, 2012). Describing leadership in this context, however, does have its strengths and weaknesses.

Strengths and weakness. As aforementioned, a key feature of a phenomenological study is a focus on shared experience. The strength of this kind of study is the ability to distill

the essence of a shared experience as well as the reasoning behind conscientious actions (Creswell, 2012). However, the weakness of a phenomenological study lies in managing subjects' as well as the interviewer's personal bias (Creswell, 2012). Furthermore, this type of study requires a depth of knowledge by both subjects and the interviewer. Still, a qualitative approach is best suited for research at hand.

Research Design

Research design intends to define the units of analysis, population, and sample (Creswell, 2012). Specific design allows for well-guided research procedures. Furthermore, the intention for specific design increases assurance the study can be conducted per the requirements of a research institution, like Pepperdine University. The following sections outline the premise and reveal details of the intended research.

Analysis unit. The unit of analysis in this study is a private equity owned CAE software company. The company is a multi-location organization with multiple business units; however, each organization is legally referred to and listed as one organization. The population for examination includes an estimated 1300 employees, not including ownership.

Sample size. The sample size for qualitative studies may differ from those required in quantitative studies (Van Manen, 2014). While quantitative research relies on a broad sample to provide statistical significance, qualitative studies may provide relevant insights through more concentrated representation (Mason, 2010). The saturation point in this case can be defined as a sample size where experiences of subjects fail to produce deeper insights relevant to the phenomenon (Chowdhury, 2015). Selection of the sample size will rely on purposive sampling (Creswell, 2012). An appropriate sample size for this type of phenomenological study ranges from as few as three to as many as 15, according to Creswell (2012). Therefore, in order to represent the diversity of experiences, the sample size will be 15.

Purposive sampling. This study utilizes purposive sampling. With a phenomenological approach, purposive sampling narrows the range of subjects for consideration (Creswell, 2012).

The key is selecting subjects who have shared an experience (Horsburgh, 2003). For example, random subjects may not have a shared experience in cultivating innovation within the organization. Rather, specific leaders within the organization, across various geographies and business units, will have been responsible for developing innovation initiatives and thus make up a homogenous population. More specifically this is a sample comprising Senior and Executive leadership. This will generate a mix of functional responsibilities such as product development, marketing, sales, engineers, and G&A executives. By including high-level decision makers as subjects, their shared experiences might also triangulate perspectives and contextualize product and customer perspectives, which might influence behaviors involved in their contribution to innovation. Therefore, aside from clearly stating the sample size, purposive sampling should include identifying qualified subjects and having a defined sampling strategy (Creswell, 2012).

Participant selection. The implementation of a sampling strategy will include how to address a master list, criteria for inclusion and exclusion, and maximum variation (Creswell, 2012). Defined steps in identifying possible subjects will provide a master list based on a sampling frame. Once the sampling frame has been identified, filtering the master list by the profiles to be included and excluded will generate a narrower list. Furthermore, using maximum variation on the master list will provide the desired level of diversity among participants.

Sampling frame to create the master list. A master list will be cultivated by identifying qualified subjects using a defined process. This process will include:

- Creating an Excel spreadsheet to document profiles based on a LinkedIn search.
- Across the first row of the spreadsheet, Column headers will include, “Full Name”, “Title”, “Current Company”, “Location”, “LinkedIn Profile URL”, and “Contact Information”.
- Search parameters will be defined and recorded in a second tab within this Excel spreadsheet.

- In order to identify these profiles, the researcher will search LinkedIn (www.linkedin.com) using the “Search” field located at the top left of the home page.
- After entering the search parameters into the relevant fields and selecting the “Search” button, the results of the search will be presented in list format.
- Each profile will contain the data needed to populate the fields for the Excel sheet.

Once a population has been identified as possible subjects, a determination is made regarding those who would qualify as possible subjects to discuss leading innovations in an esoteric technology provider.

The sampling frame for qualifying subjects will come from public sources, the first of which is the company’s website. The company website has an “About Us” section with a “Management Team” page identifying key executive management. Then utilizing the social network site LinkedIn, additional qualified subjects will be sourced. In LinkedIn, the researcher will search for all titles with “Director,” “VP” or “Vice President,” and CEO. Potential participants meeting the search criteria (Miles & Huberman, 1994) will appear from the search. This list can be cultivated by accessing the public search bar function at the top of the LinkedIn homepage after logging in. Signing up for a free LinkedIn account is required to be able to access this function. Once signed in and after selecting the search bar, selecting the “advanced search” feature will allow for keyword search. In the “company name” field, the researcher will enter “MSC Software” and all of its wholly owned subsidiaries including “Free Field Technologies (FFT),” “e-Xstream engineering,” and “Simufact.” Under the “title” field, the researcher will enter the titles as it appears, “General Manager,” “Director,” “VP,” “Vice President,” or CEO. The syntax in the “title” field is important, as LinkedIn’s search function requires specific groupings of text in order to identify the sought-after names.

Once the fields have been entered, the researcher will select “search” to populate the names of qualified subjects. This is a public list, and permission is not required to obtain it. In order to remove former employees of the company from these search criteria, the researcher

will simply select “current” under the company field. Of this group, qualified subjects may include anyone listed. Once identified, a recruitment script will be sent out requesting additional preliminary questions to determine whether potential participants are considered executive leadership. Qualified executive leader positions include the CEO and any positions reporting directly to the CEO or within two levels removed, with priority being given to subjects with the least number of levels removed. Geography and years of service at the company are not criteria for exclusion.

Criteria for inclusion. The criteria for inclusion of subjects also include the settings, actors, and events or process (Marshall & Rossman, 2010). Each level represents components by which a subject’s experience is felt. The setting will be defined as the organizational construct of the company. Actors are defined as the leaders within the organization. The events or process will be defined as those who had leadership responsibility within a function of the organization. The compilation of the efforts within the organization would then be the shared experience of interest. The criteria for inclusion will include:

- Only personnel still employed by the company
- Only those with management designation
- Only those with a title of: “Director,” “VP” or “Vice President,” or “CEO”

Criteria for exclusion. This study will exclude any members of the population who are not currently employed and those who do not have insights into the level of sampling detailed (Gay & Airasian, 2000). The criteria for inclusion will include:

- Profiles with “Current Company” other than “MSC Software” and all of its wholly owned subsidiaries including “Free Field Technologies (FFT),” “e-Xstream engineering,” or “Simufact.”
- Profiles without designation of name, company, title, and or location
- Profiles without connections

Maximum variation. Defined as the largest set of qualified targets by the organization (Creswell, 2012), maximum variation will be applied to this list, as it will return a list of more than 20 with a target sample size of 15. A final list will include:

- Select the highest-ranking executive in as many unique functions and business units reported.
- Should anyone decline to participate, the next highest-ranking executive in that function or business unit will be selected until there is representation.

Human Subject Consideration

In accordance with the master list of Pepperdine University's Institutional Review Board (IRB) governance, strict human considerations will be applied. The University's IRB guidelines exist uphold ethical research standards set forth by the university in order to protect the human rights of participants. According to the United States Department of Health and Human Services, *The Belmont Report* (1979) outlines conditions for ethical treatment of human subjects for research. This report outlines three principles that must serve as a guiding force for researchers to consider, and these include: respect for persons, beneficence, and justice.

However, prior to engaging with subjects, site approval (see Appendix A) and recruitment letters (see Appendix B) will be sent out to confirm the progression of this study. Respect for subjects will be upheld by requesting an informed consent document (see Appendix C) outlining procedures and protections intended to minimize any risks to participants. Finally, in accordance with *The Belmont Report* (1979), procedures will ensure that subjects are not exploited and are treated fairly. As such, the researcher for this study will submit an exemption application to Pepperdine University's IRB for review and approval prior to the recruitment of subjects.

Confidentiality and anonymity will be addressed by carefully managing identifiers. The organization will not be identified, nor will names or job titles be mentioned in this study (see

Appendix C). Job functions will be referred to but not cited directly, as the limited number of Senior and Executive staff within the organization might otherwise endanger the privacy of the subjects. Subjects will also be made aware of the study's design considerations and its compliance with ethical guidelines (Creswell, 2012).

Site permission (see Appendix A) will be acquired before approaching and recruiting subjects. This will include a letter to the organization's CEO requesting solicitation of cooperation from other members of executive staff. Executive staff will be sent emails requesting their participation in this study (see Appendix B). Considerations include, but are not limited to, time for interviews that will not impede or conflict with work schedules, respect for cultural norms and procedures, and proper disclosure of the intent and process of the study. The interviewer will be prepared to accommodate subjects' requests for extra privacy considerations.

Information collected through the interviews will not appear or be distributed in the organization (see Appendix C). By avoiding dissemination of raw, unscrubbed data, subjects may be protected from what they say. Only the final report will be distributed. By allaying any fears subjects might have about sharing their experiences, a more honest response is expected. Finally, non-disclosure forms will be provided to subjects in order to assure they will not share their interview results with other subjects, i.e., colleagues.

Data Collection

Data collection for the study involves interviewing (Creswell, 2012). Each participant will be directly recruited by the researcher. First, a LinkedIn message will be sent inviting the person to participate in the study. Upon agreeing to participate, subjects will be asked for an email address that can be used to send them Pepperdine University IRB's approved recruitment script and informed consent form, as well as the interview protocol guidelines that will be used. Upon agreeing to the email notifications, participants will be contacted within five business days to determine their availability within the month of January 2017 until February 13, 2017.

The data collection interview process can provide rich details that help researchers develop insights into a shared experience (Creswell, 2012). Catering the interview technique to accommodate leaders of an organization requires additional preparation (Odendahl & Shaw, 2002). It is reasonable to expect these executives to have a preconceived notion that the interview itself takes into consideration their public achievements. This suggests that a semi-structured interview technique will work better than an unstructured one, or an inflexible, structured interview technique based on the profile of the subjects.

While they can be helpful in eliciting the details of lived experiences, alternatives to a semi-structured interview, namely structured and unstructured, are incongruent with the goals of this study (McMillan & Schumacher, 2006). For instance, structured interviews are reliable and can be conducted quickly. However, structured interviews are not designed to be flexible and the data collected cannot always capture the nuances of a person's experience. On the other hand, unstructured interviews are flexible and allow rich stories to emerge from experiences shared in the interview. However, the lack of structure is a concern for the repeatability of the process, as not all the subjects may communicate a shared experience.

The strength of leveraging a semi-structured interview is that it gives researchers the ability to design interview protocols that allow subjects to open up and talk about their experiences. Conversely, the weakness associated with the semi-structured interview process may include interview fatigue, equipment issues, and interviewer skills and ability. Furthermore, the interaction between interviewer and interviewee may be impacted by an imposing interviewer (Kvale & Brinkmann, 2009), an interviewee withholding truth (Nunkoosing, 2005), and or the ability of the interviewee to accurately articulate his/her version of the phenomena (Weis & Fein, 2000). However, using good semi-structured interview technique will reduce issues (Creswell, 2012). An outline and plan on how to use good interview techniques will, according to Creswell (2012, p.163-166), include:

1. Deciding on research questions that focus on leadership in an esoteric technology company.
2. Identify the best people that can answer questions about leadership in an esoteric technology company.
3. Settle on a semi-structured, phone interview in order to capture responses through the use of recordings.
4. Define recording procedures that will support the goal of transcribing interviews for coding and analysis.
5. Design an interview guide to be used during interviews (Kvale & Brinkmann, 2009).
6. Iterate refining the interview questions for the purpose of increasing validity and until an interview protocol is affixed.
7. Decide on an environment that will provide as few distractions to the interviewer.
8. Retrieve the informed consent form, or ensure one has already been collected, before starting an interview.
9. Maintain good interviewing procedures such as stick to the topic, managing time, being respectful, and remember to be a good listener.

A confirmation email will provide suggested date and times for a phone interview to be conducted lasting no more than one hour. The following are steps outlining how the coordination of interviews will occur:

- From the identified profiles, a LinkedIn request will be sent requesting participation and an email address for future direct correspondence.
- Once subjects have replied, researcher will propose dates and times for follow up.
- Once dates and times have been confirmed for a telephone interview, the researcher will request confirmation of contact phone number, if the subject already offered one, or if

not previously provided, request the appropriate phone number where the subject can be reached.

Research questions and interview questions will be posed to subjects as open-ended, generally focused questions involving generating innovations and cultivating the right conditions to support these innovations. Interviews will be conducted over the phone, providing direct and individual access to subjects (Creswell, 2012). Phone calls will all be conducted over voice over internet protocol (VOIP; e.g., Skype). Interviews will be recorded in two ways: via a recording on the computer, and via a speakerphone recording using a dictaphone. Recordings will be saved on an external hard drive and playback will be used for transcription. Should the participant not wish to be recorded, the researcher will take notes using a Word document and notepad.

Interview Techniques

Good interview techniques include using standard procedures. A standardized interview process is dependent on the interviewer adhering to the set questions that allow the study to be repeated, and if needed, replicated. By staying on track, the interviewer is able to complete interviews within a pre-specified amount of time. Scheduled interviews allow subjects to allocate time to volunteer for questions properly. During the interview, the interviewer should be respectful and courteous without interrupting the subjects during responses. Being a good active listener is key (Creswell, 2012).

Interview Protocol

An interview protocol containing the list of all the interview questions used in data collection is developed. The protocol is then tested for content validity using a three-step process (prima facie, peer review, and expert review). The validated protocol is then tested for reliability using two pilot interviews.

Interview questions. The following interview questions were designed by the researcher, based on the review of literature and the researcher's knowledge of the subject matter:

1. Can you tell me about the planning process involved with facilitating innovation within your team?
2. Can you describe the processes used to facilitate innovation among your team?
3. What other strategies did you use to promote innovation?
4. How did you overcome resistance or opposition to your plan?
5. What challenges did you face introducing a new plan?
6. Did anything you had not planned for go wrong?
7. What do you think was a critical factor that led to these challenges?
8. How did you define success for this intervention?
9. What final outcomes were you willing to accept that met your basic expectations?
10. How did you measure and track your success?
11. What were signals outside of the organization that indicated success?
12. What factors of your organization's culture helped or hindered that success?
13. If you could start over, what would you do differently?
14. What would you like to have known before you started to innovate?

Relationship between research and interview questions. The following describes the relationship between research questions and interview questions.

1. What strategies and practices are employed by the executive leaders of esoteric technology companies to promote a culture of innovation?
    - 1.1. Can you tell me about the planning process involved to facilitate innovation within your team?
    - 1.2. Can you describe the processes used to facilitate innovation among your team?
    - 1.3. What other strategies did you use to promote innovation?
    - 1.4. How did you overcome resistance or opposition to your plan?
2. What challenges are faced by the executive leaders in esoteric technology

companies to prompt a culture of innovation?

2.1. What challenges did you face introducing a new plan?

2.2. Did anything you had not planned for go wrong?

2.3. What do you think was a critical factor that led to these challenges?

3. How do the executive leaders of esoteric technology companies measure success in promoting a culture of innovation?

3.1. How did you define success for this intervention?

3.2. What final outcomes were you willing to accept that met your basic expectations?

3.3. How did you measure and track your success?

3.4. What were signals outside of the organization that indicated success?

3.5. What factors of your organization's culture helped or hindered that success?

4. What recommendations for promoting a culture of innovation would executive leaders of esoteric technology companies make for future leaders in the field?

4.1. If you could start over, what would you do differently?

4.2. What would you like to have known before you started to innovate?

Reliability and validity of the study. Validity was established through a three-step process. First prima facie validity was established by the researcher by developing a table demonstrating the relationship between interview questions and each research question. The results were then subject to content validity through a process of peer-review. Any unresolved issues were subject to review by an expert committee consisting of the members of the dissertation committee.

Prima facie validity. Prima facie validity relies on the researcher holding him or herself accountable. Moreover, there are protocols that can be applied (Creswell, 2012). Validity of a phenomenological study concerning the interviewer's integrity may include questioning

interviewer influence over the participant during the interview, transcription accuracy, analysis of transcriptions, connections, and avoidance of myopic translation (Polkinghorne, 1989). Another set of standards includes understanding the philosophical intent of innovation, demonstrating a clear intent in studying innovation, good data analysis procedures, conveying the overall essence of the experience, and a demonstration of reflection by the author (Creswell, 2012). Both methods highlight the importance of a mindful interviewer during and after each interview session.

Prima facie validity was established by the researcher by demonstrating the relationship between each research question and the corresponding interview questions (Table 2).

Table 2.

Prima Facie Validity: Research Questions and Corresponding Interview Questions

Research Questions	Corresponding Interview Questions
RQ1: What strategies and practices are employed by the executive leaders of esoteric technology companies to promote a culture of innovation?	IQ 1: Can you tell me about the planning process involved to facilitate innovation within your team? IQ 2: What other strategies did you use to promote innovation? IQ 3: How did you overcome resistance or opposition to your plan?
RQ 2: What challenges are faced by the executive leaders in esoteric technology companies to prompt a culture of innovation, and so on?	IQ 4: What challenges did you face introducing a new plan? IQ 5: Did anything you had not planned for go wrong? IQ 6: What do you think was a critical factor that led to these challenges
RQ3: How do the executive leaders of esoteric technology companies measure success in promoting a culture of innovation?	IQ 7: How did you define success for this intervention? IQ 8: What final outcomes were you willing to accept that met your basic expectations? IQ 9: How did you measure and track your success? IQ 10: What were signals outside of the organization that indicated success? IQ 11: What factors of your organization's culture helped or hindered that success?

RQ4: What recommendations for promoting a culture of innovation would executive leaders of esoteric technology companies make for future leaders in the field?	IQ 12: If you could start over, what would you do differently? IQ 13: What would you like to have known before you started to innovate?

Content validity. Content validity was developed through a peer review and an expert review process. By keeping an open mind and challenging the validity of aspects of the research, peer reviewers provide the researcher with honest feedback (Creswell, 2012). He or she may find the feedback difficult but may end up reflecting on questions regarding methods and interpretations of the study. Iterations of this process may help smooth out inconsistencies within the reported research findings.

Peer review validity. The intent of the peer review establishes the next step in content validation. Two peers review the research and interview questions with the intent to challenge discrepancies (Creswell, 2012). Peers are introduced to the questions and asked to fill out a peer review validity form (see Appendix D). After review, each peer will record their feedback and provide recommendations for change (see Table 3). Subsequently, the next review of will be performed by an expert.

Expert review validity. Expert review validity provides a challenge for the researcher. By employing expert review to go over data, analysis, interpretations, and conclusions for review, the researcher receives heightened scrutiny of the research conducted (Creswell, 2012). Both accuracy and credibility can be judged through the scrutiny of drafts. Recommendations for revisions may include changes to language, observations, interpretations, and conclusions (Stake, 1995). The utilization of both peer and expert review validity processes provides further accountability for the researcher in following good procedures, thereby reducing the risk of faulty conclusions (see Table 4).

Table 3.

Peer Review Validity: Final Research Questions and Corresponding Interview Questions

Research Questions	Corresponding Interview Questions
RQ1: What strategies and practices are employed by the executive leaders of esoteric technology companies to promote a culture of innovation?	IQ 1: Can you define for me your leadership approach as it pertains to the planning process involved in facilitating innovation within your team? IQ 2: How did you overcome resistance or opposition to your plan?
RQ 2: What challenges are faced by the executive leaders in esoteric technology companies to prompt a culture of innovation?	IQ 3: What challenges did you face introducing a new plan? IQ 4: Did anything you had not planned for go wrong? IQ 5: What were critical factors that led to these challenges? IQ 6: What are the cultural barriers to promoting a culture of innovation within the organization?
RQ3: How do the executive leaders of esoteric technology companies measure success in promoting a culture of innovation?	IQ 7: How would you measure the success of a culture of innovation? IQ 8: How did you measure the success of a culture of innovation?
RQ4: What recommendations for promoting a culture of innovation would executive leaders of esoteric technology companies make for future leaders in the field?	IQ 9: If you could start over, what would you do differently? IQ 10: Is there anything else you would like to add?

Expert Review Results

Expert review validity was achieved by secondary confirmation provided by dissertation committee. Preceding validity was first completed through prima facie validity and then followed by interrater reliability process with an Doctor of Education in Organizational Leadership (EDOL)

Leadership Excellence and Innovations Project (EIP) cohort group. Committee members reviewed the development and finalization of research questions and corresponding interview questions for this study. After discussion with dissertation committee, we have concluded these (see Table 4) to be the final research and interview questions. Based upon the feedback and recommendations provided as a final confirmation, the following ten semi-structured interview questions have been used, and to which correspond to the core four research questions for this study.

Table 4.

Expert Review Validity: Final Research Questions and Corresponding Interview Questions After Expert Review

Research Questions	Corresponding Interview Questions
RQ1: What strategies and practices are employed by the executive leaders of esoteric technology companies to promote a culture of innovation?	IQ 1: Can you define for me your leadership approach as it pertains to the planning process involved in facilitating innovation within your team? IQ 2: How did you overcome resistance or opposition to your plan?
RQ 2: What challenges are faced by the executive leaders in esoteric technology companies to prompt a culture of innovation?	IQ 3: What challenges did you face introducing a new plan? IQ 4: Did anything you had not planned for go wrong? IQ 5: What were critical factors that led to these challenges? IQ 6: What are the cultural barriers to promoting a culture of innovation within the organization?
RQ3: How do the executive leaders of esoteric technology companies measure success in promoting a culture of innovation?	IQ 7: How would you measure the success of a culture of innovation? IQ 8: How did you measure the success of a culture of innovation?

RQ4: What recommendations for promoting a culture of innovation would executive leaders of esoteric technology companies make for future leaders in the field?	IQ 9: If you could start over, what would you do differently? IQ 10: Is there anything else you would like to add?

Statement of Personal Bias

The limitations of the research may be due to the focus on esoteric technologies. It can be problematic if the organization that fits the definition of an esoteric technology producer does not have enough executives to be sampled. Moreover, this might impact lower level computer-aided software that is not esoteric in nature. Furthermore, focusing on a single organization may limit the generalizability of any findings. While this may seem like a delimitation, the relatively small sample population and therefore sample size may conflict with the research timeline. Scheduling conflicts may reduce the time to complete the interviews. However, generally speaking, these risks are well known and will not pose a substantial risk to the quality of the interviews or research. Personal bias may provide an issue in a different way, and the issue of personal bias needs to be addressed.

Epoche. Epoche is a technique intended to limit personal bias through the acknowledgment of personal bias and the use of bracketing personal experience, in an attempt to perceive the situation for the first time (Creswell, 2012). For instance, knowledge of the organization and some of the possible subjects can be bracketed by the knowledge that none of the principal investigators has held executive roles with the organization of the study. While access is not an issue to the study, the results of the study may not show that there is significant differentiation of activities that might classify the organization as uniquely qualified to meet the

distinction of fostering a culture of innovation. A relative industry outsider with little technical training from the company will conduct this study. While an employee of the company will conduct the research, the researcher acknowledges that non-employees cannot obtain the same level of general knowledge about technical products and innovation. However, he will have knowledge regarding the company's operations and thus schedule. While this information can be obtained via interviews with subjects from the sample, this insight may provide the conceptual linkages necessary to conduct a phenomenological interview. Utilizing this knowledge in the interview to guide conversations with subjects will create bias; however, the same knowledge framed by asking for clarifying answers to questions may further the interview, especially if the interview process runs up against known issues

Data Analysis

By organizing the data for analysis, researchers are better able to manage it and make sense of the information they have. Well known strategies such as interpretive framework (Madison, 2005), a systematic approach (Miles & Huberman, 1994) or traditional approach (Wolcott, 1994) provide frameworks for analysis. These qualitative data analyses all have a similar basis: coding, combining codes into broader themes, and displaying results to make comparisons (Creswell, 2012). Utilizing an approach may help focus the research and provide a basis for consistent findings.

Reading, memoing. Reading and memoing requires diligence and thoroughness. In order to understand the data gathered more fully, it is recommended that transcripts be read and reread several times in order for the details of the interview to be engrained (Agar, 1980). A holistic view of the interview provides greater opportunity for dissection (Creswell, 2012). By memoing the interview, researchers can explore key concepts, ideas, and make notations on observing themes. The ability to synthesize, analyze and therefore create a critical perspective on how innovation may be formulated is key.

Describing, classifying, interpreting (coding). Utilizing coding to translate interviews will help better describe, classify, and interpret how a culture of innovation is fostered within the organization (Creswell, 2012). Segmenting codes into generalized categories such as information expected, surprise information, and interesting information can help provide an overview level of coding. Themes can be developed to evaluate different types of information, such as semantic differential (meaning one thing, but saying another), the content of what isn't said, and contradictions, out of place concepts, metaphors, and biases.

For instance, using structured coding techniques allows the interpretation of the data to be parsed neatly into themes for further analysis (Creswell, 2012). Meanwhile, a semi-structured coding approach may utilize a simplified version of structured coding, such as “lean coding” which involves a short list of categorized codes (Creswell, 2012, p. 184). Other variations of coding approaches fall in between a structured and unstructured approach (Saldaña, 2012). The study and cycle of coding can play a role in deciding an approach. However, the use of unstructured coding will allow data interpretation to occur more naturally and will lessen the limitations of the study (Creswell, 2012). For this reason, the use of unstructured coding best fits the needs of the study.

Manual coding of data will be used to capture explicit feedback before analyzing for themes derived from tacit insights (Saldaña, 2012). Generalized units for analyzing words and phrases from the data include cultural practices, episodes, encounters, roles, relationships, group dynamics, organizations, environment, and subcultures (Saldaña, 2012). These units of analysis can be framed into cognitive aspects, emotional aspects and hierarchical aspects depending on data provided (Saldaña, 2012).

Following a generic coding method, two cycles of coding will direct data interpretation for thematic interpretation (Saldaña, 2012, p. 64). First cycle coding will include: attributes coding (basic descriptive information), holistic coding (outline of overall content and possible categories), descriptive coding, and in vivo coding (participants’ own words). Second cycle

coding will include eclectic coding (refine first cycle codes by reflecting back to the data) and pattern coding (constructing themes). Patterns derived from the data will then be shaped into meaningful themes (Creswell, 2012).

Interrater reliability and validity. The use of interrater reliability protocol will be utilized to assess the validity of data analysis. Interrater reliability is a form of external validity, which broadly examines factors that might block the ability of data analysis to be compared for a proper translation (LeCompte & Goetz, 1982). Such factors might be sussed out by establishing interrater reliability (Creswell, 2012). In other words, a four-step interrater reliability process will be used for data analysis.

- Step 1 - Once the interviews have been conducted and transcribed, the researcher will code the first three interviews to be presented for review.
- Step 2 - A peer review committee, comprising other doctoral students in the EDOL EIP program, will review the coding results of these interviews. Should there be differences of opinion and evaluation by the peer review committee that cannot be resolved, the researcher's dissertation committee will act as the final arbitrator in the matter. Each issue should be specific as to avoid having the dissertation committee overly involved in the process.
- Step 3 - After the first round of review, the researcher will use the feedback as a reference for the remaining coding of interviews. Furthermore, the feedback in the first round of peer review will serve as a benchmark for the research, as a basis for decisions regarding coding on moving forward.
- Step 4 - The agreed upon coding scheme used will then allow the peer review panel to expect the appropriate changes for reviewing all fifteen coded interviews in Round 2. Again, should consensus not be found, the dissertation committee will step in to make a decision to resolve the differences.

Representing, visualizing. Representing data visually can provide a connection of key concepts and bring to life the research. The raw data extrapolated from the memoing is key to transforming the data. By examining key themes in drawing conclusions to form positions by which a thesis can be derived can be detailed visually through graphs, tables or other artifacts (Creswell, 2012). A diagram of the relationship between key concepts should be the result of the inductive analysis.

While relationships and context may be discovered through visual aids, another form of representing data may come in the form of utilizing metaphors (Creswell, 2012). In this instance, an analysis of data may be best represented by comparing it to other examples. The comparison may allow the data to become more relatable as a generalizable form. By making the connection, the phenomena of study may become more digestible and easier to transfer keys concepts into another context.

Summary

The proposed process of the research design and methodology reflects the intention behind and thoughtful adherence to IRB approved (see Appendix E) guidelines for research. Processes directed at a qualitative phenomenological framework for this study were discussed at length (Creswell, 2012). The restatement of the problem, as well as research questions, provided context for the design and implementation of the study. Following the process of a qualitative method approach, exploring the plans for research design, elaborating on interview protocols, highlighting limitations, and detailing data analysis protocols enables future research on this topic to be replicated. The following chapters will discuss the findings and potential for further research.

Chapter 4: Findings

Introduction

This study is an effort to understand how leadership may influence cultures of innovation. Findings here within is an attempt to better understand not the individual attributes of a culture of innovation (Crossan & Apaydin, 2010), but rather as a collection of cultures (Jucevičius, 2010) within esoteric technology providers. The pressures teams face to innovate in highly specialized technology fields places unique constraints (Lemon et al., 1980) for leaders to attempt to solve. Organizational cultures may require deeper insights (Zairi & Al-Mashari, 2005) into developing and sustaining cultures of innovation specifically for esoteric technology providers.

The examination of how innovations arise in esoteric technology providers is accomplished by interviewing organizational decision makers across various functions of senior and executive leadership. This study presents findings related to innovation, culture, and leadership. The purpose of this study was to further the research in models used to develop a cultures of innovation model for esoteric technology companies, highlight capabilities for replication, and address organizational needs in order to support cultures of innovation. Research questions for this study attempted to determine:

- *RQ1:* What strategies and practices are employed by the executive leaders of esoteric technology companies to promote a culture of innovation?
- *RQ2:* What challenges are faced by the executive leaders in esoteric technology companies to prompt a culture of innovation?
- *RQ3:* How do the executive leaders of esoteric technology companies measure success in promoting a culture of innovation?

- *RQ4:* What recommendations for promoting a culture of innovation would executive leaders of esoteric technology companies make for future leaders in the field?

Participants

Participants were selected using a sampling strategy to define a master list, with implemented criteria for inclusion and exclusion, in an effort to include maximum variation (Creswell, 2012). Sampling frame was the population identified by sourcing names publically available through MSC Software's company website and public LinkedIn profiles (Miles & Huberman, 1994). Participants were solicited for participation in this study via LinkedIn InMail messages and email. Criteria for inclusion (Marshall & Rossman, 2010) were met by confirming with respondents that they were currently employed by the company, maintained a management designation, and had a Title of: "Director," "VP" or "Vice President," or "CEO" at the time of solicitation through interview. Criteria for exclusion (Gay & Airasian, 2000) were that respondents were not associated with "MSC Software" and all of its wholly owned subsidiaries including "Free Field Technologies (FFT)," "e-Xstream engineering," or "Simufact" or did not hold a rank and file position commiserate with the study requirements; any respondents meeting any of these criteria were not asked to participate. Maximum variation (Creswell, 2012) included the first 15 interviews conducted from the time of Pepperdine University IRB approval to conduct the study as well as soliciting unique functions and business units with a mix of senior and executive level participants.

Data Collection

Data collection was conducted between January 2, 2017 to February 13, 2017 (see Table 4). This range of time includes solicitation, qualification of subjects, and interviews. Interviews began January 12, 2017. Interview protocols followed a semi-structured approach to interviewing (Creswell, 2012). A set of standard questions was compiled to be used for each

interview. The protocol was verified for content validity using prima facie, peer review, and expert review. The validated protocol was tested for reliability using two pilot interviews. Finally, to relate interview questions to these four research questions, the following interview questions (IQ) were utilized:

- IQ 1: Can you define for me your leadership approach as it pertains to the planning process involved in facilitating innovation within your team?
- IQ 2: How did you overcome resistance or opposition to your plan?
- IQ 3: What challenges did you face introducing a new plan?
- IQ 4: Did anything you had not planned for go wrong?
- IQ 5: What were critical factors that led to these challenges?
- IQ 6: What are the cultural barriers to promoting a culture of innovation within the organization?
- IQ 7: How would you measure the success of a culture of innovation?
- IQ 8: How did you measure the success of a culture of innovation?
- IQ 9: If you could start over, what would you do differently?
- IQ 10: Is there anything else you would like to add?

Table 4

Dates of participant Interviews

P01	1/11/2017
P02	1/11/2017
P03	1/12/2017
P04	1/12/2017
P05	1/20/2017
P06	2/2/2017
P07	2/6/2017
P08	2/9/2017
P09	2/10/2017
P10	2/10/2017

(continued)

(continued)

P11	2/10/2017
P12	2/10/2017
P13	2/13/2017
P14	2/13/2017
P15	2/13/2017

Data Analysis

Data analysis was conducted using coding system, combining codes into broader themes, and displaying results process to make comparisons (Creswell, 2012). After interviews, key concepts and ideas were memoed as possible themes. Codes were then used to translate interviews into more solidified themes (Creswell, 2012). Structured and manual codes were both used to set the final themes (Saldaña, 2012). The validity of the themes was verified using interrater reliability protocols which involved a peer review of the first three transcribed interviews and codes by a doctoral student committee from the EDOL EIP program, and the resulting feedback was used as basis for iterative revisions when necessary to align back to research questions.

Data Display

Data is organized in a flow consistent with the design of the study. Research Questions segment corresponding Interview Questions. Common themes have been grouped within each Interview Question; and represented graphically with the number of responses corresponding to each of the fifteen interviewees who responded at least once to a theme noted. Subjects, also known as interview respondents, are distinguished as participants with unique reference numbers, such as P01, which represents Participant 1.

Research Question 1

Research Question 1 asked leaders of an esoteric technology provider to describe their approach to leading in cultures of innovation. Leaders were asked to discuss strategies they felt were relevant to their approach. This research question consisted of two primary questions.

- IQ 1: Can you define for me your leadership approach as it pertains to the planning process involved in facilitating innovation within your team?
- IQ 2: How did you overcome resistance or opposition to your plan?

Interview Question 1

Interview Question 1 asked, “Can you define for me your leadership approach as it pertains to the planning process involved in facilitating innovation within your team?” Five major themes were identified: inspire abilities, personalize everything, think way outside of the box, embolden the entrepreneur from within, and dream bigger than customers can dream.

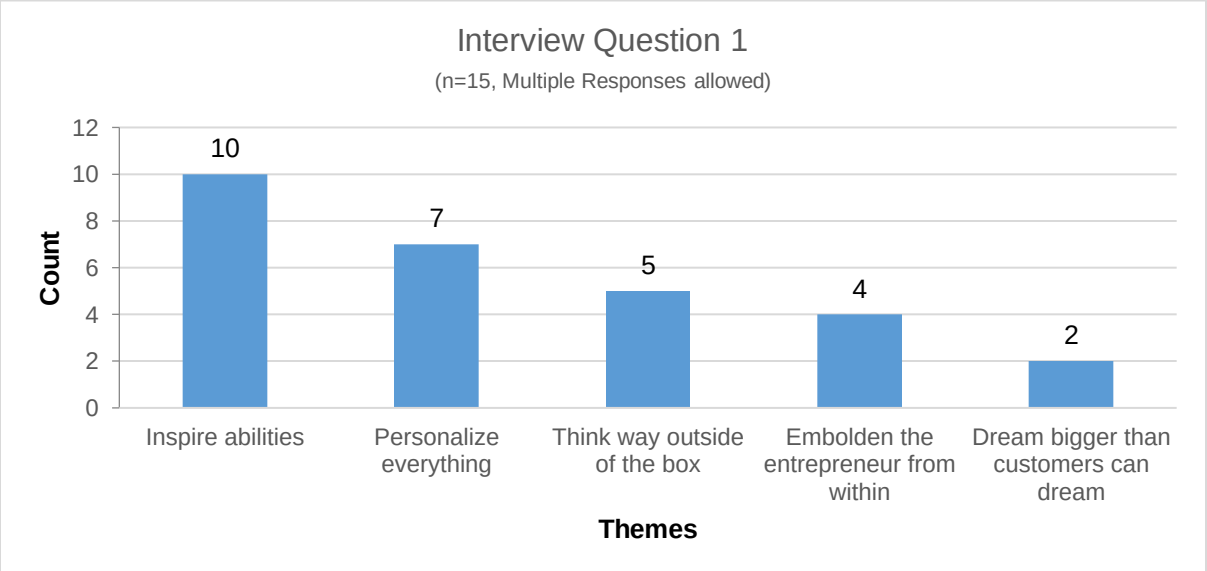

Figure 29. Interview Question 1 (IQ 1) : Can you define for me your leadership approach as it pertains to the planning process involved in facilitating innovation within your team?

Inspire abilities. This strategy and practice relates to leaders seeking to evoke deep talents from within their staff in order to be feel confident they can take on really tough

challenges. Items that were coded under this theme include: selecting a trusted team to provide a safe environment to encourage employees to address problems head on without trepidation to solve difficult problems, where inclusion, collaboration, active listening and feedback are valued activities. Furthermore, items such as: building confidence through supporting creativity, empathy, freedom to discuss problems and appreciative inquiry allow leaders to build group confidence through successive wins. As an example of this, interviewee P11 said:

> One of the key things of promoting innovation is to allow people to basically take a topic or take a project and have the maximum independence, while still fitting the spirit of the group goals that are required. And I think that's always a direction that I always took. So if you needed to do a particular task, one needed to achieve the overall guidelines of what that task was, but the way to reach the goal was effectively up to the individual or individuals.

Another representation of this is reflected in interviewee P07's response:

> And at first, people kind of are afraid of it and they don't think that that it can be done and then making sure that whenever we promise something it's delivered. And it's kind of create a snowball effect, then the next time the team believes it and come with their own also innovative idea and this is in us.

Personalize everything. This strategy and practice relates to leaders, who acknowledge the challenges in front of employees attempting to innovate, relating to their staff and demonstrating that they share in the trials and tribulations. Items that were coded under this theme include: leaders having personal investment in staff to empower highly talented people in setting challenging goals they will own and be accountable for. Leaders provide items such as pace setting and removing negativity to foster the belief that self-determination and conscientious commitments will help staff overcome the challenge of preconceived notions and past mindsets. In reference to this theme, interviewee P1 said:

> It means my personal involvement that people really have to really make them believe that we're going to do something, not we're going to start and we're going to have ADD and stop. You have to get very personally involved in this. I think that there is a couple of things that are key even to motivate that first three people. The first thing is of course your time commitment and your involvement in the brainstorming discussions.

Think way outside of the box. This strategy and practice relates to fostering the ingenuity required to develop something ground breaking. Items that were coded under this theme include: leaders having an imaginative vision to articulate into action plans that challenge employees to think outside the box and through the fog of ideas coming up with blue sky solutions. To represent this, interviewee P13 said:

> I take different approach often, means I assume what will be the future, maybe five years from now? What kind of society? What kind of engineering technologies? What kind of solutions, problems will be happening in five years, for example? Then, how we can resolve such kind of problems from now.

Interviewee P15 said more about this, stating:

> I normally go through is completely blue screen, or blue sky, and let me go and pitch them, 'Okay, here is the innovative stuff happening on outside our industry. What about can we bring that ideas into here? Here are things my thought, what do you guys think about it?' And then there is a goal and everything I enforce from me, because of the corporation look to explore that new innovation stuff also.

Embolden the entrepreneur from within. This strategy and practice relates to identifying the key character trait within individuals that can be counted on to drive development so that the output is real innovation rather than incrementalism. Items that were coded under this theme include: leaders selecting the right people to own, defined to be the belief that nothing worth doing is without immense effort, and solving customer problems by rapid trial and error until the problem is solved. Representing this theme, interviewee P2 said:

> Challenge them to describe how what they're doing is new and different. If they use the semantics of reference to past products or other products then you challenge them again. Then of course, we always have to tell them that it's okay to fail. If it were easy to do this job, then anybody could do it. In order to be innovative, we have to take a harder approach and we will fail sometimes and we will succeed. When we succeed, it will be outstanding. You have to pull them forward and you have to tell them its okay if they fall over.

Another related response by interviewee P4 was this:

> People come in with all sorts of talents, and mindsets, and brains that are different than yours and so, just clearing the obstacles out of their way and letting them lead the role that you've hired them to do, is a first step to promoting innovation in the team. Because that allows people to feel responsible for their actions, but also allows them to feel like it's okay to fail, because it allows them to feel like it's okay to fail, and failure is a necessity in innovation, in my opinion.

Dream bigger than customers can dream. This strategy and practice relates to the need to really think big when attempting to innovate because if the customer can image a solution, that is not innovative. Items that were coded under this theme include: leaders thinking big and celebrating success. To represent this, interviewee P01 said:

> Celebrate and amplify success. How do you do that? Well, first and foremost is there's nothing more proud than winning an award, right? The Oscar's and the Grammy's. Well, for our development team, it's no different, the pride in winning an award for their product…Over this time, just in our next generation big innovation project, we've been awarded 14 product awards. Never been done in our industry, 14 for one product. Never been done in our industry.

Interview Question 2

Interview Question 2 asked: How did you overcome resistance or opposition to your plan? Five major themes were identified which include: supporting an agile organization, address fears head on, energize the team, guide roadmap to achieving imaginative goals, and prioritize strategic initiatives.

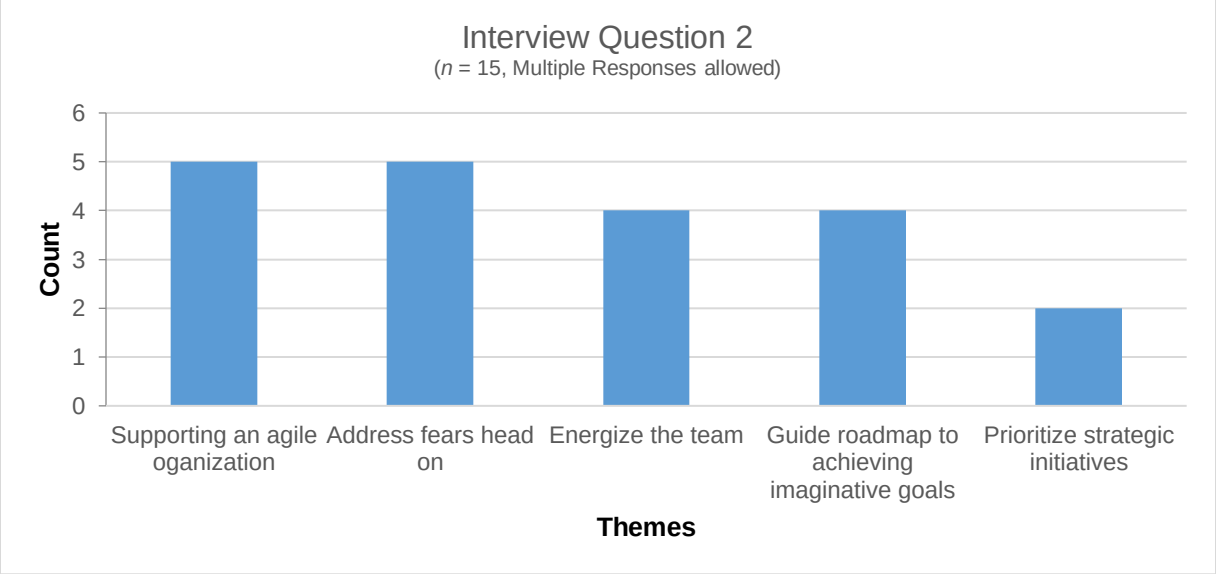

Figure 30. Interview Question 2 (IQ 2): How did you overcome resistance or opposition to your plan?

Supporting an agile organization. Resistance to strategy and plans in promoting cultures of innovation relates to the desire to orient the organization toward systems that will allow innovation to develop. Items that were coded under this theme include: organizational structures such as, group size, physical and or functional separation of staff, and agility; management practices such as, managing expectations, staff buy-in, claims of lack of resource availability, time management; and individual resistance to change such as, accepting alternative solutions and lack of self- confidence in abilities by the staff. This theme also includes dynamics such as creative conflict in the form of lack of collaboration, in ability to seek alternatives to resolve disputes, trust, and disjointed perspectives regarding how to solve the problem. Without vigorous discussion, agile organizations struggle to gain effectiveness and

active management of staff abilities and levels are necessary. To represent this, interviewee P6 said:

> I would say one anecdote is to show the team flexibility. In other words, not only am I asking them for their input but I'm listening. I repeat what I think I've heard, and a lot of times I adjust. So like I mentioned, sort of being 80% of the way there, or maybe 70%. And I think typically it's generally true but if the team says, "What about this thing that you haven't taken into consideration?" And I'll think about it and I can tell you that I have been flexible. I let my team know that my interest is just, there's no ulterior motive. My interests are the company's interest. And if it's the right thing to do for the company, therefore I am flexible and I think when you show the team that flexibility and that thoughtfulness and that respect to their feedback, then it goes a long way. It goes a real, real, real long way.

Address fears head on. Resistance to strategy and plans in promoting cultures of innovation relates to the crippling effect fear can have on a person, especially when asking someone to take a leap of faith and try something completely new. Items that were coded under this theme include: leaders attempting to act as a partner to focus and renew beliefs in team members when there are reservations about the project. Leaders, who listen and respect objections by staff, gain credibility as a leader the team follows. To represent this, interviewee P12:

> There's always going to be push back. And it comes in very many forms right, but typically people are saying, “Are you sure you're going to see it through?” “Is the project going to get canceled?” “What about the other things I might be doing?” “What happens if we get behind schedule?” “Does the company really believe in this?” “Is innovation really necessary?” There's normally a huge number of questions that would undermine a sustained and committed effort to evolve. The only way you actually succeed, of course, is you try inspirational leadership, and you can help to frame the issue in terms of the

goal setting and you can give some kind of emotional appeal and a PowerPoint, and so on, but it is actually the sort of sustained commitment over time that wins the day. You have to keep coming back week after week after week and say, “Guys have you achieved the goal yet?” And each time, they will say, “No, we made a bit of progress. We're stuck. We don't know what we're doing.” And you just got to keep coming back, time after time after time and say, “Guys, actually, I know you don't think you can do this but maybe you think I've asked for too much from you, but the goal is the goal and I know you have it in you to achieve the goal.” And in a way over time, people start to inspire themselves as they make the small steps, and sometimes big steps, sometimes they surprise themselves.

Energize the team. Overcoming resistance to strategy and plans in promoting cultures of innovation involves picking teams up when difficult and discouraging time periods inevitably occur. Items that were coded under this theme include: leaders setting “big hairy goals” with team buy-in to the plans. Leaders focus their effort on inspiring the team and energizing those who care about the new initiative. In order to keep the team motivated, leaders identify obstacles that may cause inaction and attempt to remove them for the staff. To represent this, interviewee P1 said:

I should say that when you create a plan, the best innovation plan has big, hairy goals. If you just say, “Let's do a next generation product,” who cares? You're going to fail by the way. If you make goals that say, “We want to do an intake process 50 times faster,” wow, right? We had about eight big, hairy goals for our next generation project. What was great about it is that of course you can't hit all the goals with the version one of the software, but what was fantastic was we probably hit half of them just in the version one of the software. [But] there are always the detractors, always the detractors. I had a team member say, “You won't deliver this, in your next generation product, in my lifetime.” That's a pretty big detractor. What I said, again, back to my three, four, three

> rule, those three, you're not going to get on board with the new stuff, so don't waste your time getting them onboard. Focus your time with those three on making you feel great about their products and spending time with their products.

A similar response came from interviewee P09, who said:

> Make sure that they continue to be part of the team and continue to work and don't, let's say, passively resist by not participating. It's all about this communication piece, which is to make sure that we all see the goal, we see that we're getting closer and that feedback is continually provided.

Guide roadmap to achieving imaginative goals. Resistance to strategy and plans in promoting cultures of innovation relates to leaders providing direction and articulating a more tangible path to reach tough goals. Items that were coded under this theme include: helping the team visualize imaginative goals, communicating the goals of the project or initiative, demonstrating definable success, and communicating progression along with status until goals are met. To represent this, interviewee P10 said:

> Having success and leading them not too aggressively is important, and making them see that it's for the best of the team for them. So not to have too much of a heavy hand, but to show assertiveness and confidence in your own ideas, so that they can feel confident that what you're proposing is going to work for them and for the team.

Prioritize strategic initiatives. Resistance to strategy and plans in promoting cultures of innovation relates to focusing on important activities as they relate to broader strategies for the company. Items that were coded under this theme include: redirecting disparate activities to centralized focal areas and reinforcing company commitments for the purposes of highlighting the connection to future success measures. To represent this, interviewee P12 said:

> I believe, it's set a big goal and put sustained pressure on people to achieve it over time. Obviously, if they feel inspired by the goal, they bring much more to the table. Very

often, projects flounder when there's a poor match between what's asked and what people really want to do.

Summary for Research Question 1

RQ 1 asked: What strategies and practices are employed by the executive leaders of esoteric technology companies to promote a culture of innovation? The two interview questions addressed RQ 1: IQ 1: Can you define for me your leadership approach as it pertains to the planning process involved in facilitating innovation within your team? IQ 2: How did you overcome resistance or opposition to your plan? The responses provided highlight the closeness leaders intend to cultivate with their staff. In fact, intimate knowledge of the team's abilities and progression provides leaders with the ability to act quickly in the best interest for innovation. It is a point that serves to introduce more detailed knowledge regarding possible complexities in managing cultures of innovation.

Research Question 2

Research Question 2 examined challenges leaders faced in promoting cultures of innovation. Here leaders were asked to more closely examine the nuances in leading groups tasked to create innovations. As such, leaders responded by providing insights into how they were able to continue forward despite barriers placed in front of the mission. The interview questions asked were:

- IQ 3: What challenges did you face introducing a new plan?
- IQ 4: Did anything you had not planned for go wrong?
- IQ 5: What were critical factors that led to these challenges?
- IQ 6: What are the cultural barriers to promoting a culture of innovation within the organization?

Interview Question 3

Interview Question 3 asked, “What challenges did you face introducing a new plan?” Six major themes were identified: loci of control, lack of motivation, communication, lack of excitement, tolerance for taking risks, and inability to act.

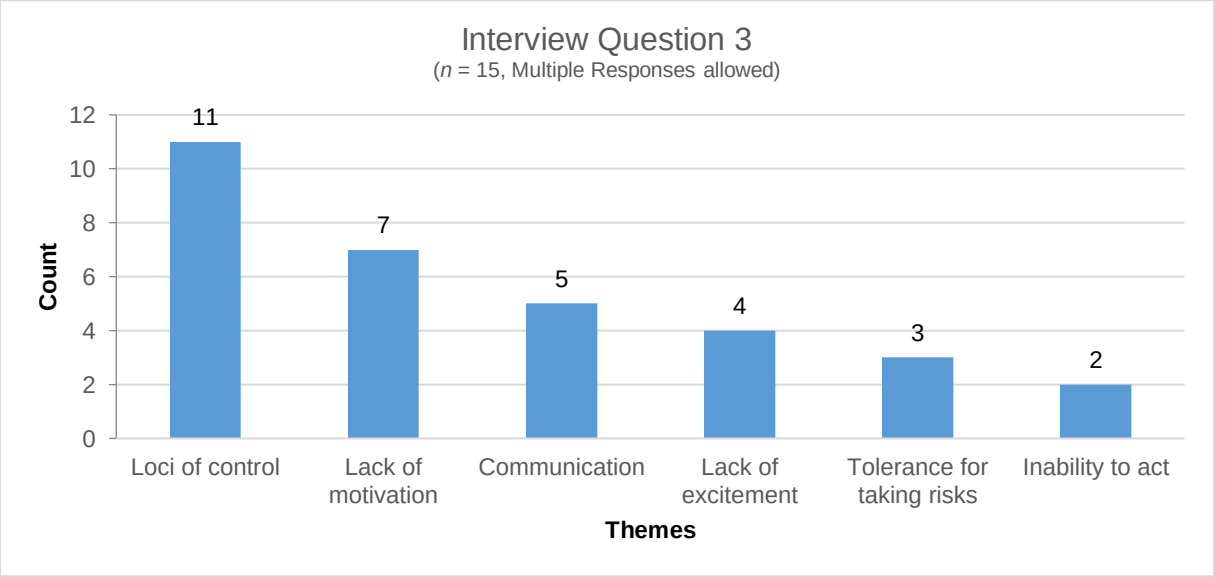

Figure 31. Interview Question 3 (IQ 3): What challenges did you face introducing a new plan?

Loci of control. This challenge facing leading cultures of innovation relates to employees believing their ability to act is curbed by strong external forces and or low internal control. Items that were coded under this theme include: external pressures such as lack of support, foreign cultures, possible political agendas, and changing role and delivery expectations; as well as internal doubts such as, a lack of self-belief, a skepticism about the plan, complacency, and a fear of self-fulfilling prophecy that the project will fail. An individual’s feeling of inability to challenge status quo limits the person’s perspective on growth and further stifles the ability to act and thus innovate. To represent external loci, interviewee P03 said:

> When you work on a global company where a dispersed resource are sitting in two different time zone, three different time zone, in MSC it is four or five different time zone

> for R&D. It's a challenge how you collaborate, co-ordinate and discuss and deliver it. That is the second challenge. And the third challenge is, in the innovation sometimes what happens is, when you allow somebody to go and do an innovation, or fix particular problem and openly discuss the solution, what happens is, things may change. What happens is we always try to change the direction of that particular task or that particular problem, or we stop, we'll say, “No, no, no, don't work on it, work on this.” Then what happens, the person who is already self-motivated to do some innovation, he finds that as a discourage.

To represent low internal loci, interviewee P01 said:

> We're not a research organization. We're 60% is just good enough, so it's a big innovation. It's a big new, but a personal lack of confidence that actually delivers something that satisfies customers and makes money. Back to the first one, fear that the project's going to get cut. Well, if they never see my body expressions, if they never hear from me, then you're introducing more fear. As I said, being very intimate with the team, attending meetings with them, communicating how important it is, communicating that it's funded and it's staying funded. They just need to hear that again and again and again. Fear of failure of not the entire project, but my work. I think (‘my work’) that's a trickier one. I think the only way to overcome that is that you got to try. You may not get it right the first time, but you got a chance in the second version of the software and the third version of the software to get it right. We're going through that right now with some capabilities. We actually started developing it three releases ago. We decided it wasn't completely not ready. We delivered it in the last release, and it didn't quite hit the mark. In this release, we're finishing it, and it's really great. This is really hard stuff.

Lack of motivation. This challenge facing leading cultures of innovation relates the individual or group’s lack of desire to participate in the innovation objective. Items that were coded under this theme include: uncertainty of executive buy-in and commitment and a self-

constraining perception highlighted by an unwillingness to leave a comfort zone due to the belief that change is not needed, fear of failure, or feeling of a lack of appreciation for any new effort given. This lack of motivation is noticeable by individual passive aggressive attitudes by some. To represent this, interviewee P02 said:

> I think the biggest challenge that you face in trying to introduce some new plan is that, the passive aggressive reaction. Which is, you don't need to do that. You are taking risk unnecessarily and you don't need to. They throw out. Everyone will throw out in front of you all of the existing tools and technologies that solve the problem. Shouldn't we use those things and solve the problems that way? Shouldn't we turn it back into an incremental on what we already have?

Another representation of this came from interviewee P04, who said:

> Well I felt like I came in like the mailman that offered to give them the stock market report and analyze the latest political news of the day, and cook them fancy dinner. It just seemed so out of place, that I think people at first were taken by surprise, to say the least. And so the first step was just educating and getting people used to the fact that yes marketing is truly a strategic position and a strategic department. And I think the buy-in from the CEO was the biggest... was the only way I was able to do it. Because the CEO buy-in was obvious, into that's what the department should be, everything else just eventually fell into place, not completely, but fell into place.

Also, interviewee P12 said:

> You're dealing very much with the way the team thinks of themselves, whether they think of themselves as smart and creative, whether they think of themselves as being able to think out of the box, and whether they are prepared to, as a team, bring their A game or are they just going to meld in and try and hide behind other people and escape observation.

Communication. This challenge facing leading cultures of innovation relates how well the objectives and activities are articulated in a way that the organization understands the difficulties that may invariably arrive and the support needed to foster confidence. Items that were coded under this theme include: planning for the unknown with pivoting objectives and a narrow field of vision. The challenge then becomes stitching together a platform for bigger change that will help verify activities and help evolve the plan. To represent this, interviewee P13 said:

> Yeah, of course, continuously we have to verify the plan and also the future, the future plan is right or not. So, every time repeatedly, we have to actually confirm that assumption is right or not, and internally discussing how we can modify our plan quickly, smoothly, in that case our plan is not feasible or our future direction is not right. So it means, quickly making decision, quickly making the action, then quickly modifying the plan. So that what we have to do to resolve such kind of challenges. Always a plan is plan. Reality is not completely matching to the plan, but how we can adjust and also closer to the plan is continuous work for the team.

Another response to represent this, interviewee P07 said:

> Also whenever a decision is taken, it was justified even if it doesn't need to be justified. So whenever something is agreed on, it was justified why we have to take this risk, why we have to do it this way. So basically buying in people, by convincing them by a demonstration basically, saying why we have to do it, never imposing one single idea.

Lack of excitement. This challenge facing leading cultures of innovation relates to the collective agreement in providing internal feedback that what is being attempted is truly innovative and worth their very best effort, and possibly more. Items that were coded under this theme include: detractors, who are not open to new ideas, or believe the trade-off between innovating and production means innovation always is a secondary priority and thereby lose focus on the innovation goal. To represent this, interviewee P12 said:

> If you aren't asking for something that people perceive is impossible, it's unlikely you're going to represent much of an innovation. So you have to be setting big goals and you can expect people initially saying, “Can't be done,” “Tried it before,” or “We don't have the skill set,” or “Some other company might be able to do this but because of these limitations, we could never do it.” So people are very self-constraining, and until you change that mindset, really your project won't go anywhere.

Further representation of this is demonstrated in interviewee P11’s response:

> There was a feeling that certain things are not necessary. I think that's the biggest challenges, is when individuals think it's not necessary to do a particular item, it's not necessary to do a particular project…And I think the way to overcome those challenges, of course, is to attempt to be as persuasive as possible. But I think the other part, and this is really what leadership is all about, is to really, to effectively say that we are going to allocate certain amount of resources to do something that's innovative. And to really do something that may overcome some individual's objections, while at the same time maintaining the resources to do what's necessary to achieve the current requirements, meaning the current generation of revenue associated with a product.

Tolerance for taking risks. This challenge facing leading cultures of innovation relates to how far individuals and groups will traverse to make something amazing happen. Risk refers to the tail ends of a bell curve that represents industry acceptable ideas. The goal is for individuals and organizations to have the bravery to continually push for what is less known by the industry and try to deliver something they really want. Items that were coded under this theme include: individuals who believe the organization is adverse to taking risks to develop new products and therefore project their own skepticism to quickly react negatively to risk taking. As a reflection of this, interviewee P08 said:

> The biggest challenges are usually when people haven't seen the results yet. And it's not so much challenges, it's more a skepticism. And, again, the way that I've piloted through

> that is having small successes that lead to larger successes. So, for example, it's hard to get a very large budget to do something brand new, but if you kick something off as a side project, show that it's successful, and then build upon that into the larger project that you want.

Inability to act. This challenge facing leading cultures of innovation relates to leaders addressing obstacles in the paths of those attempting to innovate. Items that were coded under this theme include: logistical constraints and an inability to act quickly. To illustrate this, interviewee P03 said:

> The challenges, the first thing, in any product development company, the first challenge you will face is a time to delivery. There is always, even though somebody says that, "Plan such a way that... Don't worry about the end date or delivery date, plan by keeping every..." Truly speaking, that's not true. There is always a date when this product need to go out. You just have to plan backward. So that is the one of the challenge always. Now it is no longer a challenge, it is part of your job. Your job is to deliver certain things on a particular date.

Interview Question 4

Interview Question 4 asked, "Did anything you had not planned for go wrong?" Five major themes were identified: missing empathy for the difficulty of the problem, well-intended plans that don't work out, cracks in the foundation, problems with commitment, stopping short of pushing through, and resource constraint.

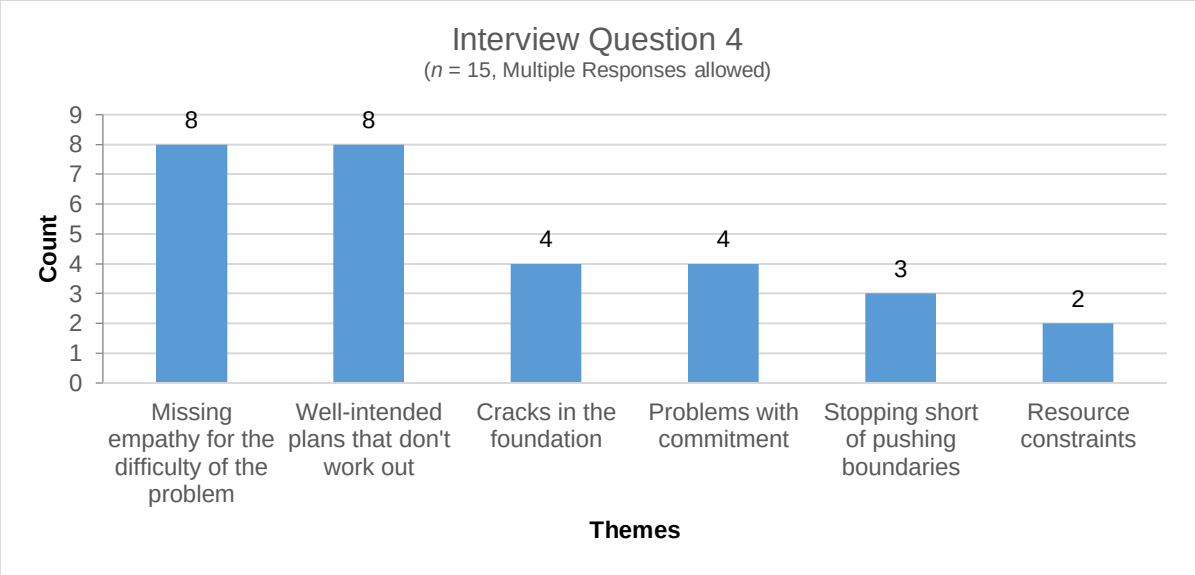

Figure 32. Interview Question 4 (IQ 4): Did anything you had not planned for go wrong?

Missing empathy for the difficulty of the problem. This challenge facing those leading cultures of innovation relates to anticipating that challenges will have eventual failure, and being prepared as a leader to temper expectations; but continuing to push forward after setbacks. Items that were coded under this theme include: the enormity of the situation, unforeseen variables, managing vastly diverse view points and backgrounds, overestimating capabilities, and trying to keep up with the business has an inherent risk for failure. Accepting this risk means having empathy for how difficult the problem is and hoping for the best, while planning for the worst. To represent this, interviewee P01 said:

> I think as a leader, you got to hold people to time scales certainly, but you have to have empathy and understanding of the size of the challenge and the task and have empathy to we were in this together. We made this decision together, not at that point to be a leader and say, “You guys screwed me because you told me it was going to be one year and it took two and a half years,” that type of thing. Again, that was the big picture. Back to, let's say, a feature level. We had one feature that we're doing now that it took us three releases to get it right, but it's fantastic. If we stopped it and just say, “No, we're not

doing it anymore. We got it wrong." You're going to have a very demotivated group that won't want to challenge the next never been done thing, because what's the point?

Well-intended plans that don't work out. This challenge for leading cultures of innovation relates to the fact that no matter how well leaders plan for outcomes, setbacks will happen. Items that were coded under this theme include: surprises always come up to disrupt holistic plans and as such there is always a need to prepare for the unknown; even if teams naively believe anything is possible and account for disruptions with an agile plan, managing crisis is always a challenge. To represent this, interviewee P05 said:

> It's not one single plan. Oftentimes, it's multiple plans that mesh together to make kind of a directional thing, make a direction that we're heading. So if I look at it from a forest, part of it is pointing the direction for the team to march. And sometimes, we get things that pop up for the team to go forward with. As an example, we might have a critical customer situation come up that may require us to turn and approach that... To solve that problem before we can continue moving on.

Cracks in the foundation. This challenge facing leading cultures of innovation relates to coming to terms with the fact that without continual upgrade to basic competencies, the ability to innovate will always be stifled unless there's an iterative process to improve it. Items that were coded under this theme include: small details can derail a plan and expose blurry objectives forcing teams to circle back to reinforce a better foundation acting as a contingent for the next time something goes wrong. To represent this, interviewee P06 said:

> A good and thoughtful decision today is better than a perfect one tomorrow. Because it's not going to be perfect until you think about it, socialize it, and then implement. And once you implement, then you realize the nuances that probably weren't going to get caught through more planning. So sometimes you have to, again, put your best foot forward, be very thoughtful, be very communicative, and then there's going be stuff that you didn't plan for. And so what's critical is communication the entire way and then once that thing

you didn't plan for happens, then you work as a team to put corrective action in place. You could never plan for all of the gory details, sometimes you just have to say when good is good enough and then you roll it out and then you get to the finish line through time and through experience.

To further represent this, interviewee P02 said:

> Attempting to reach the right goal and be innovative. We simply didn't see coming some of the gaps and concerns and challenges. Because in fact, down three levels down in their organization, you're trying to get them to deliver something toward the innovative solution. They just simply didn't meet their necessary goal. It's because they didn't understand them. The biggest thing that we didn't do well enough, is we didn't reiterate the goal and trace it and follow it all the way down to the bottom of the development staff.

Also, interviewee P01 reinforced this and said:

> Building the foundation was much harder than we thought to get it right how we wanted it. There was no criticism for the team. They're working hard. They were innovating, but it was just bigger, which is always what these new development projects ... If you take shortcuts as you're building the foundation to the building, then when you put up the 50 story building, it's going to shake.

Problems with commitment. This challenge facing leading cultures of innovation relates to individuals losing focus and forgetting their commitments not just to themselves but to the group. Items that were coded under this theme include: staying committed when things go wrong, looking for team buy-in, staying positive, and curbing those that have a change of heart, revoking their commitment to the endeavor. To represent this, interviewee P11 said:

> I think if you're managing any project, and something doesn't go wrong, then you've probably picked a pretty boring project. So, I think part of being innovative or being involved with innovative things is to effectively have things go wrong. But I think, there

> are effectively in terms of management and leadership of these things, there are two important aspects. And that the first is of course, recognizing that things are going to go wrong, and having the appropriate safety factor associated with that. And the second thing is, knowing when something goes wrong to encourage still the continued march on something, and at the same time knowing when something goes wrong, know when it's time to terminate something.

Resource constraints. This challenge facing leading cultures of innovation relates to instances where team resources are altered due to various business or organizational reasons that are not intended to stifle activities directed towards innovation. Items that were coded under this theme include: compounded pressures by people leaving and loss of skill set. To represent this, interviewee P03 said:

> It doesn't matter whether in India or any other location in the globe. They do not plan on something based on the person. They'll say assume that the person is there for the whole period of the project or the whole period of delivery. We never, never... That is not the luxuries given to anyone, the assumption of a person is leaving. And when it happens, a person who is driving and leading and delivering, making things happen, or senior member, or architect, when a person goes, then certainly that is the time you hit the biggest roadblock on delivering any of it. So that is sometimes I have faced, and that's the very difficult phase of time where you can't say, ‘Oh, I can't do anything because this person left.’ You have to do something. You have to find a way of sticking to the plan for delivering it.

Stopping short of pushing boundaries. This challenge facing leading cultures of innovation relates to abating the desire of individuals to show restraint when pursing innovation. Items that were coded under this theme include: changes to priorities and a failure to redirect other activities ensures boundaries are not continually being pushed. To represent this, interviewee P15 said:

> Well there are some crisis happening, so without even you knowing it, that resource that is earmarked to you is reassigned back to some other crisis happening out there, or some other project is assigned to. Monday morning, you come back and they wake up, and that's, “What happened?” “Oh, they asked me to work on this project,” so the resource is completely gone. That project on hold or killed or put aside on that. Those kind of things, approach is happening there also. And that's one of the biggest problems we ran into quite a lot. And other problem we ran into that, okay, we heavily bet on something and we interpret it, certain requirement, here is the way supposed to go and then we went through it and then we presented weekly, semi-weekly or monthly, “Here is the progress, here is the approach" and you doing that and as soon as you come to 90% complete, you did almost closing our presentation, “Here is it's status,” and then somebody somewhere immediately wake up, and “Oh my goodness, you guys haven't done it.” “Yeah, we didn't do it because nobody asked us to do it or it's not considered on this version.” “No, it had to be on that version” and that kind of things are there. So, final changes always throw you off. And then, either project gets completely lost or completely backfires on you, in a failure mode. Those are the problems we run into quite a lot.

Interview Question 5

Interview Question 5 asked What were critical factors that led to these challenges? Five major themes were identified: resource flux at critical times, challenging mental models, exceed the customer’s value creation expectations, unknown complexity, and design challenges.

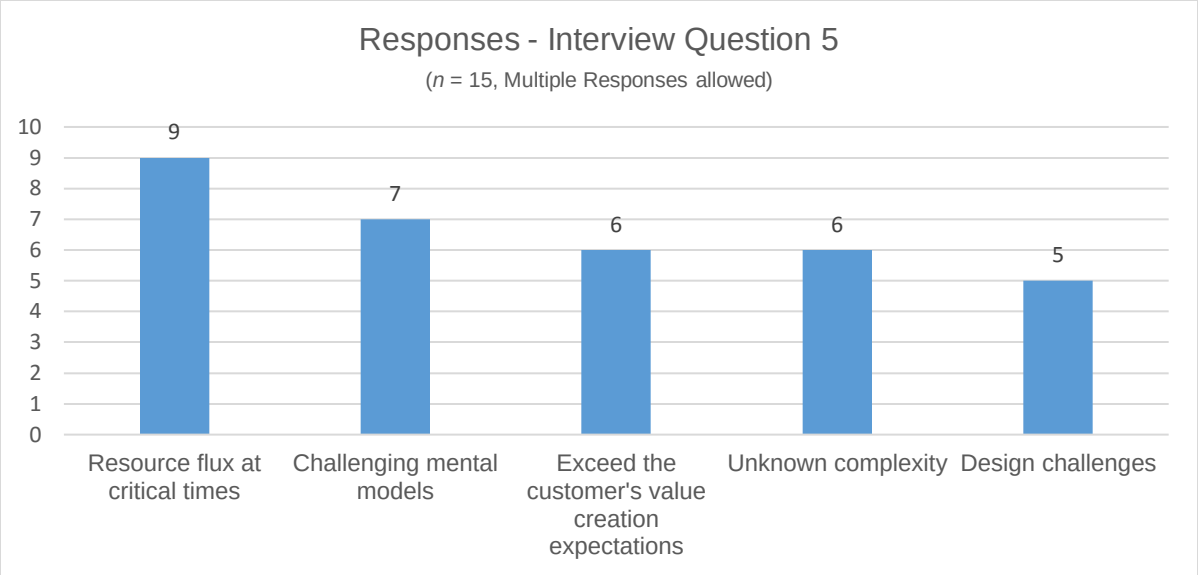

Figure 33. Interview Question 5 (IQ 5): What were critical factors that led to these challenges?

Resource flux at critical times. This challenge facing leading cultures of innovation relates the inability to guarantee that the needed resources will be available especially when teams are trying to get to a critical path for delivering an innovation. Items that were coded under this theme include: technical challenges to innovation initiatives present challenges such as appropriate oversight, loss of critical resources at critical times of development, a shift in plans and priorities, responding to “fire drills” which distract from the mission, and being forced to settle for a “quick and dirty” solution. Secondarily, the impact of technical challenges shorten initiative timelines and shift team dynamics, requiring teams to scramble to accomplish their goals. To represent this, interviewee P12 said:

> Time is a critical challenge, right, because very often you've carved out a team, and so on, out of a group of people that have other responsibilities. So there's a big challenge, both in getting their time and preserving their time. Another big challenge is developing the right set of goals and actionable steps towards those goals. Another challenge is getting the right balance between the goals and the plan, if you like, and the skill sets of the people you've managed to assemble. Another big challenge is team dynamics.

> Teams, as I said previously, tend to self-limit. They tend to develop a persona as a team which can be either ‘can do’ or ‘cannot do.’ It can be one of huge distrust and a lack of information sharing or it could be very open and supportive.

Challenging mental models. This challenge facing leading cultures of innovation relates to static mindsets toward particular subjects that may or may not be based on anything relevant to the challenge presented. Items that were coded under this theme include: adjusting to the reality of innovation requires changing mental models as they pertain to a common understanding of innovation, getting team members more committed, creating a real human connection to break down possible distrust of the plan or overly optimistic attitudes, as well as enforcing feedback loops to normalize polarizing attitudes toward the innovation. To represent this, interviewee P02 said:

> I think the biggest factor is that, when you're trying to do something innovative, it's very difficult to have all participants understand the innovation itself. It's often the case that the semantics of the innovation can be misinterpreted to be very much like what we already think we know how to do. The biggest challenge factor to me was getting everyone to actually understand what was innovative about what we were doing. Again, you get these people who you are trying to persuade them to do something. It's going to be hard. They say, ‘That's not innovative. Everybody does that. You say, “Everybody who?” Then they show you something that semantically similar but actually ends up falling short of the intended goal. The people misinterpret was innovative, or they think the innovation isn't very important. As you get further away from the core leadership that understands the innovation deeply, you realize that it quickly drops off in the depth of understanding. You got an implementation of the idea that actually doesn't match what was intended. That's just is, just a communication challenge, in my opinion. It's very difficult to talk about innovative ideas in old semantics. You end up using words that you understand to be descriptive of your innovation as the leader. It's heard as descriptive of

> the past. You're using words in ways that are new and they don't recognize that the words are new. They don't actually end up doing something new. It really takes a lot of re-communication.

Exceed the customer's value creation expectations. This challenge facing leading cultures of innovation relates the challenges in attempting to outdo the customer in vision, scope, and execution. Items that were coded under this theme include: dream big for the customer, keep an eye on the goal, pull together the right high performing team, set appropriate actionable priorities to exceed expectations, adopt the right technology, and find a way to balance the right priorities that will lead to a big hit. To represent this, interviewee P07 said:

> So it's more like inventing and pushing an idea to the market and listening to the market and kind of develop a product on the... To give you an idea, one of the products that we developed lately was created in my mind during a drink with somebody on a bar, the next day I draft it on a napkin and the third day it was presented to, basically, to one of the biggest (industry) company.

In addition, interviewee P01 said:

> It was never been done, absolutely complex stuff that requires a combination of deep customer understanding of what the problem was, innovator on a product management user interface of how you would interact. Then, development of mathematics that's never been developed before. There's three legs of stool that you got to get right. Again, I think that from day one, the first, like the customer, what the customer challenge was, we understood that.

Unknown complexity. This challenge facing leading cultures of innovation relates to trying to do something that has never been done and trying to qualify (and/or quantify) the problem in terms for business administration. Items that were coded under this theme include: underestimating the complexity of the problem and wanting to be perfect without a clear understanding of details requires teams to be resilient when things go wrong and leadership to

be empathetic as the innovation is being built from scratch. To represent this, interviewee P08 said:

> I mean the factors that lead to that challenge was we thought we understood the details of that particular industry and that particular workflow, when we didn't have the insight that we needed. And we certainly gained that insight as we went through the process, and there's probably no way to get that insight beforehand. We really had to get into the technology, get into those groups to understand the nuances of what they were doing and why our technology would or would not work.

Design challenges. This challenge facing leading cultures of innovation relates to the design paradigm and the need to shift from internal standards to meet new objectives. Items that were coded under this theme include: design challenges require leaders to visualize the goal in mind and have purposeful communication for engaging the team and avoiding misunderstandings, which then can bring about a real measure of success. To represent this, interviewee P09 said:

> I believe that communication is critical to maintaining people's engagement in projects, and goals, and so forth. I think that this was something that, I'm not going to say I didn't get it back then, but in terms of... It was an opportunity there that I, perhaps, didn't understand the importance of, that had I fully engaged this guy, who quit on me, in what was communicated with him, what we were really trying to achieve for this customer, what it would really take to get there. Here are the difficulties but there are opportunities and challenges and everything else.

Also, interviewee P07, said:

> It started the same even from the company's creation it was not built on a detailed market study which is you can make it say whatever you want, it's more based on the gut feeling that [this is] important and we can come up with what the customers need as you need it because it was creating the company or a product as the same time as

creating some market for it. It's not an established market where you have competition and you enter it to do better than the competition, you have to go enter, no competition and exactly, it's very difficult to enter into market where you don't have competition.

Interview Question 6

Interview Question 6 asked, “What are the cultural barriers to promoting a culture of innovation within the organization?” Five major themes were identified: competing structural culture typology, competing behaviors, ladders of inference, organizational framework, and controlled chaos.

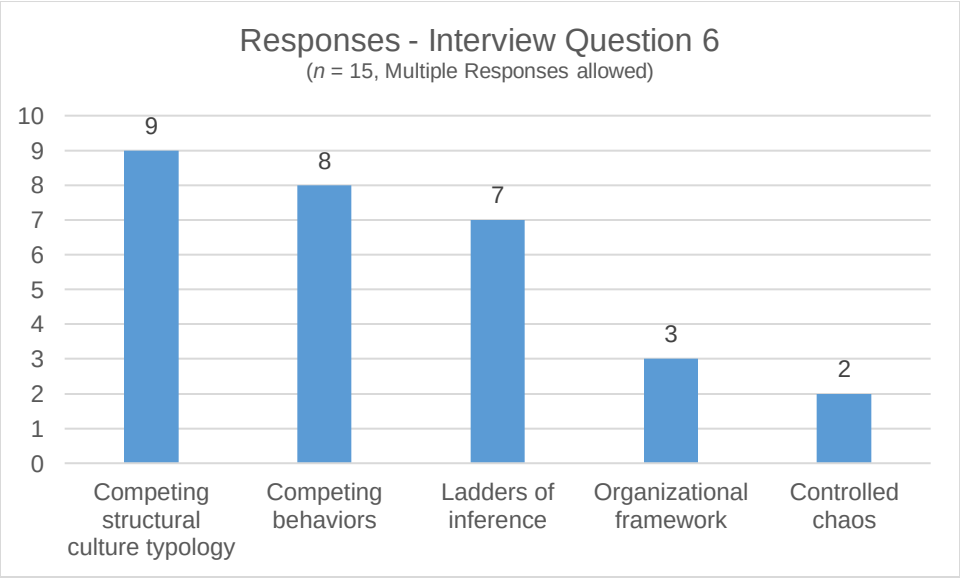

Figure 34. Interview Question 6 (IQ 6): What are the cultural barriers to promoting a culture of innovation within the organization?

Competing structural culture typology. This challenge facing leading cultures of innovation relates to the orientation of the organization towards supporting innovation goals. Items that were coded under this theme include: overcoming institutional obstacles, removing blockers, and changing the way things are done, especially with insular teams to foster permeable communities with the right pieces working together in light of local cultural nuances, implicit role expectations, and uneven shared knowledge. To represent this, interviewee P01 said:

> It's my three, four, and three rule. Those are the barriers, right? There's two kinds of people in the last three. One are I'm just a negative and skeptical. There's another kind of person that isn't skeptical. They just don't care. They know what they know. I'm working on this 40 year old product. This is what I like doing. It's my comfort zone, and I just don't actually care about the other stuff, right? Just to be able to let the people that really don't care and just are in their comfort zone, let them do what they do, because we need that. The negative people, those are the people that need the attention in that last three. They need the attention in two ways. I think the first important way is that you have to spend time with them making their project and their, let's say legacy, product important. Then, driving them to results. Forget about these new stuff. Forget about that. I don't care about that. What I care about is where the hell are the results in the product that you're so proud of that's 40 years old? Where are your results? That's how you deal with the negative part of the last three. The positive part of the last three, leave them alone. They love what they're doing. By the way, if you bring them into the next innovation product, if you just force them to do it, they're going to fail anyway.

Competing behaviors. This challenge facing leading cultures of innovation relates to differing individual priorities not connected to assignments, but rather individual preferences. Items that were coded under this theme include: inefficient collaboration such as, challenges in interpersonal communication styles, team cohesion and lack of camaraderie, self-serving desires, and homophily networks and rigid group norms degrade the speed of trust and confidence in new endeavors. To represent this, interviewee P12 said:

> Culture's a huge factor, and people of course are completely unaware of these workplace cultural factors. I think if they were aware of them they probably wouldn't exist to the extent that they do. So you're really looking at a set of individuals collected in a team and a collective blind spot with respect to things they do badly compared to things they do well. Very often it's... People have, because they don't have the ability to step

back and observe themselves, they think they're doing an equally good job across all aspects of the work. But generally if you compare team to team to team, inside companies, across companies, you'll find that a team has two or three strong points and it has many weak points. And of course different teams have different strong points and different weak points; different companies have different strong points and weak points. But to the extent that you can create self-knowledge that, 'Hey guys, this is what you do well and do more of it, but this is what you do badly and you need to do better at this, or you need to at least think, introspect, about why you're bad at this,' that can be really very helpful. The other cultural factor I think is confidence. People, and it doubles up to teams, obviously to countries as well, can only achieve what they believe they can achieve. So to the extent that they have narrow ambitions or a limited sense of their abilities, that will be an iron clad cap on what they can produce. The secret sauce is to somehow say, "Guys, don't think of yourself as an individual or think of your individual limitations, think about how you can make the people around you smart by inspiring them and challenging them, and be open to them doing the same to you." And if people are instead of being focused on themselves, if they're focused on the team or the person next to them, all of a sudden you have a completely different team dynamic because it's not every person coming in and thinking, "Hey, I don't know what, I'm crushed by this goal." You're coming in and you're saying, "I'm gonna help the rest of my teammates to feel they can solve this goal." If everybody's giving that kind of support to everybody else, you have a team that starts to feel like it's super human after a while, and out of that confidence nearly always comes good things.

Ladders of inference. This challenge facing leading cultures of innovation relates to how individuals examine their beliefs and actions; whether their reality is aligned with the group's efforts to innovate. Items that were coded under this theme include: lack of awareness, living with past glories, intrinsic interpersonal motivation, differing attitudes to achieving goals,

group think, altered role expectations, lack of ownership, and effort. To represent this, interviewee P12 said:

> People who had success in the past and the people who believe that success can be continued. There is no other way to be successful. So those are the biggest barriers always. So that we have to actually make sure we have to move forward by thinking, by new ways… there are such kind of people as I said who had successes in the past and who are believing, 'Oh by this way we have been successful, why should we change?' It's kind of the typical as a human being. So how we can change it? With customers, by our team, that's a key. Customers always like that. But we have to show better way to make them more successful, to pay to us more. We cannot change human nature by easy manner but we have to try to change it. Otherwise we cannot move for the future.

Controlled chaos. This challenge facing leading cultures of innovation relates to the ever-present whirlpool of activities and events that can distract from the focus of attempting to innovate. Items that were coded under this theme include: connect customer and internal expectations, consider the cultural disconnect, have an approach to deal incongruences (P04), and act to quickly bring alignment to focus efforts to the customer needs. To represent this, interviewee P4 said:

> Sales people got very used to selling. Selling them in a certain way. They were selling to a very particular group of people, which was the same group of people over and over again. And then, in the last seven years when the new CEO came on board and the development of Apex took off, seeing the resistance from... The sales people who have been selling... They're used to selling to one particular market, now having to go outside of this group, having to go to people they've never had to really address before, or with our Digimat product. Again a new product having to go to material scientists in the company, so a new role. Even in the same accounts that they already have has been extremely uncomfortable for them and you could see how uncomfortable that is, just

> even from my perspective. Pushing the sales force to sell the new innovative product into the new markets is one of the huge challenges. Another challenge is with innovation there is the innovation, what is it called, the innovation curve, from Geoffrey Moore, what's the book, *Crossing the Chasm*. In *Crossing the Chasm* and many other marketing leaders in the industry, it's very obvious that in order to get the product adopted into, or technology adopted into a field or a market, there are steps that you have to take. You have to first find early adopters then you have to find the early majority or however you call it. Before you get to the main majority, the main people who will be using your software.

Organizational framework. This challenge facing leading cultures of innovation relates to the configuration of the organization as it pertains to the models that govern the ability for employees to contribute to innovation. Items that were coded under this theme include: leadership counts to create an environment that is open to change, and normalizing similar values against local cultural customs and norms. To represent this, interviewee P01 said:

> Leadership is unbelievably important in managing remote people. Next week, I'm going around the world for literally two meetings. One is I acquired a company in Japan. It was very conservative, very traditional Japanese company. Just to spend the day with the CEO, because he has a ton of questions. I really need him motivated. Just sending an email back and forth ain't going to do it. It's going to be a day of question and answer, a day of what I expect. Then, a dinner, and he'll be more motivated. Then, I hired a new VP of IT putting in India. Same story. No, I could say I could wait until he comes through the next quarterly business review in three months, but no, I got to be there with these guys. I'm literally flying 22,000 miles for two meetings.

Another response to represent this, interviewee P12 said:

> I think that depends on size of company, and age of the people. We created the company, just the two of us. And we progressively, added very young people right out of

university, or right after their PhD. And they joined us to take that technical and scientific risk, and so we... Actually, they came to us with a very strong culture of innovation, change, and technical risk-taking.

Summary for Research Question 2

RQ 2 asked: RQ 2: What challenges are faced by the executive leaders in esoteric technology companies to prompt a culture of innovation? The four interview questions addressed RQ 2: IQ 3: What challenges did you face introducing a new plan? IQ 4: Did anything you had not planned for go wrong? IQ 5: What were critical factors that led to these challenges? IQ 6: What are the cultural barriers to promoting a culture of innovation within the organization? The challenges leaders faced in promoting cultures of innovation within their organization can be summarized as the totality of incongruity within the team and its orientation to moving forward. These challenges resulted in certain activities being disconnected from their intended outcomes. Several perspectives emerged, however; leaders agreed that regardless of the challenges faced, in order to innovate, teams must have models for success to aid in dissolving of barriers.

Research Question 3

Research Question 3 involved leaders describing their preferred approach for removing obstacles to innovation and their keys to success. Leaders reported that measuring success against a preferred model of success would create an appropriate mechanism for promoting cultures of innovation. This meant that leaders gave examples of lived experiences to be compared with piecemeal solutions of more ideal methods. The questions posed to leaders in this study included:

- IQ 7: How would you measure the success of a culture of innovation?
- IQ 8: How did you measure the success of a culture of innovation?

Interview Question 7

Interview Question 7 asked, “How would you measure the success of a culture of innovation?” Five major themes were identified: fostering autonomy, wow factor, finding the right motivation, having an articulated vision, and normalize risk.

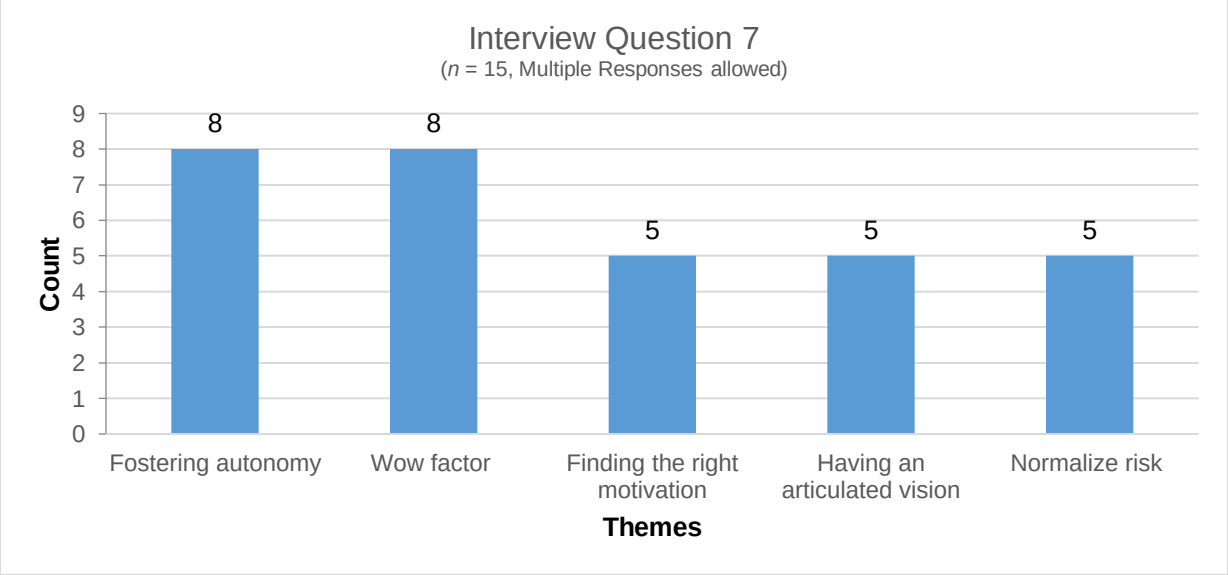

Figure 35. Interview Question 7 (IQ 7): How would you measure the success of a culture of innovation?

Fostering autonomy. This measure of success relates to how leaders view their most prized assets as it pertains to innovation. Items that were coded under this theme include: making the team feel empowered, employees are self-directed and free to make personal decisions to create, people try new things and seek alternative solutions, ideas are cultivated within the group and there are a lot of prototype/proof of concepts, outputs in all forms are being measured, there are open discussions about the efforts made, which are reflected in how people feel and there is resiliency within the innovation cycle. To represent this, interviewee P15 said:

> Culture of innovation in my mind is actually is okay you... And ideally you want to get the things perfectly polished up and then ready to go run. When you're doing a very

> innovation, it's nothing coming free. You're not going to get it working in the first shot and you may plan your task one, two, three, four, five, and task one and two not going to work at all. You need to have a 1.1 or even for you start again. New one, task one, new task two also. So when the task one and two failed, you did not able to reach to three but rather than go and said what went... Questioning them and nail them down, drilling them and punish them, understand why that went wrong. How can we learn from the mistake, and the next time can we quickly recover because the time out also. So can we learn from your mistake, can we avoid that mistake next time, and then every single staff let them learn, let them fail, but don't harshly punish them. Guide them through their failures, let them learn from the failures and they'll actually always help you. “Yep, he started trusting me so I need to prove myself, I need to work extremely hard to make sure I don't fail next time. So what went wrong?” They'll start educating themselves. Then they come back when very, very, very creative way to do all kind this are there. And then also tell them, coach them, guide them.

Wow factor. This measure of success relates to the ability for teams to come up with something that customers were not thinking of, but that now they see if, they don’t want to live without. Items that were coded under this theme include: commercial customer value creation that is validated by the customers’ willingness to pay for your time; with delayed market acknowledgement of game-changing achievements, and getting big ideas to the market has a multiplier effect on success measurements. To represent this, interviewee P02 said:

> I do to measure the success of an innovative culture is, you want to listen to the subjective reaction to what you have delivered. If somebody looks at what you have done and they say, “Wow, that's really game changing.” Or, “That's really different.” Then you know you have succeeded. If they ask you, “Well, why did you do that?” Then you have succeeded in getting something innovative. Because they need to themselves now understand it. I think you have to deliver something in order to measure success of

your innovation. You have to deliver it and then you have to listen to what's said about the delivery, the deliverable. Does it get the reactions of being different, it disturbs them, they are wondering why you did it that way. They ask the questions. They are usually very supportive. It's not that they are asking the questions like they think you're crazy. They just want to understand why you did it. They want to understand the goal setting and thinking that led to the innovation. They are not trying to challenge the innovation itself. If you can get those kinds of reactions, then you have succeeded. Otherwise, if they say, “Oh, that looks nice.” I can use that immediately, and don't need to change anything myself, then you have not been innovative. You have just done something incremental.

Finding the right motivation. This measure of success relates to ensuing the right motivations are in place to foster group collaboration for the purpose of efforting the activities to create something new. Items that were coded under this theme include: people are personally invested and take ownership; people are comfortable with change and are curious on how they can contribute to big goals. To represent this, interviewee P01 said:

Well, I mean, innovation, by the way, isn't only product development. It's fundamental because that's the only value that our customers perceive. They don't really care about our HR department. Our customers don't care about our accounting department. They don't care about any of those things, but a culture of innovator is a culture that is year after year doing change, right? Doing change to drive efficiency, doing change to drive the brand, doing change to drive revenue production, doing change because the way we're doing it today is expensive and is legacy and it doesn't add ... Change for value creation. Value creating in the accounting department, value creation in the legal department, all those types of things. Number one, we have, in our own company, something called the vital few. I would say Vital Few is all about change, right? Everyone of our vital few where we have goals scattered around the company, but what is it that

you can articulate to your employees in just a few pages that they could really get it. If that list is short, then there's not much innovation in the company. If the list is long and powerful. Then, this is a culture of innovation.

Having an articulated vision. This measure of success relates to crafting the right message from the distilled vision whereby individuals can take action. Items that were coded under this theme include: having a creative strategy and vision that transform the idea factory to activity and being forward looking to do something no one has done before based on an internal spirit of imagination. To represent this, interviewee P12 said:

> Well, first of all, try to make people understand the strategy and vision. But to do so, we have to show how we are creative and also imaginary for the future. And also showing by this manner, they can be successful by challenging to see the future. So importance is creativity and imagination, how people can have such kind of that things. So we have to actually discuss often, "What will be the future? Imagine what we can do for the company, for the customers, for the future." That kind of daily activity is a key.

Moreover, to further articulate this, interviewee P01 said:

> Definitely financial results are backwards looking for a company, but patents, awards, product awards, and patents and those types of things are forward looking, right, and really measure innovation. For me, how many patents do we file in a year that we think are very useful? How many product awards that we get are pretty good measures, at least of product innovation, which is what our customers really value.

Normalize risk. This measure of success relates to removing the fear of failure as a negative and using risk as a way to embolden individuals to think big and continue pushing forward. Items that were coded under this theme include: viewing risk as a positive thing, challenging status quo and managing past performance, and aggressively seeking to be on the cutting edge. To represent this, interviewee P09 said:

> I think that I have always been very focused on making sure that people are empowered to be successful. And success, I guess, to me is whether or not that innovation is a sort of a direct part of what they think that they're doing. And so then if they do or they don't do it you can have a discussion about why that might have been the case and how things can get better the next time in process improvements and so on and so forth. You're always, as a manager, trying to keep an open mind and an open ear for when employees have ideas about how things can be done differently, or more efficiently, or more effectively.

Also, to represent this, interviewee P10 said:

> I think maybe related to it, how aggressively is the team on the cutting edge in terms of the tools they're using? How often are they sitting in meetings, attending webinars, to learn about the next newest thing. What's coming up next that we could be using? It's hard to give a concrete measure, but I think the types of daily activities that the employees and the team in general participates in will give you an idea. I think one big overall measure is the communication amongst the team within a culture. If there isn't a lot of cross-fertilization of ideas within the team, people aren't probing questions, then you definitely are not going to have really a culture of innovation, in my opinion.

Interview Question 8

Interview Question 8 asked, “How did you measure the success of a culture of innovation?” Six major themes were identified: align with customer expectations, frame risks as common sense, observe vision transform into reality, celebrate intrinsic and extrinsic validation, facilitate purpose, and have a vital few to focus on.

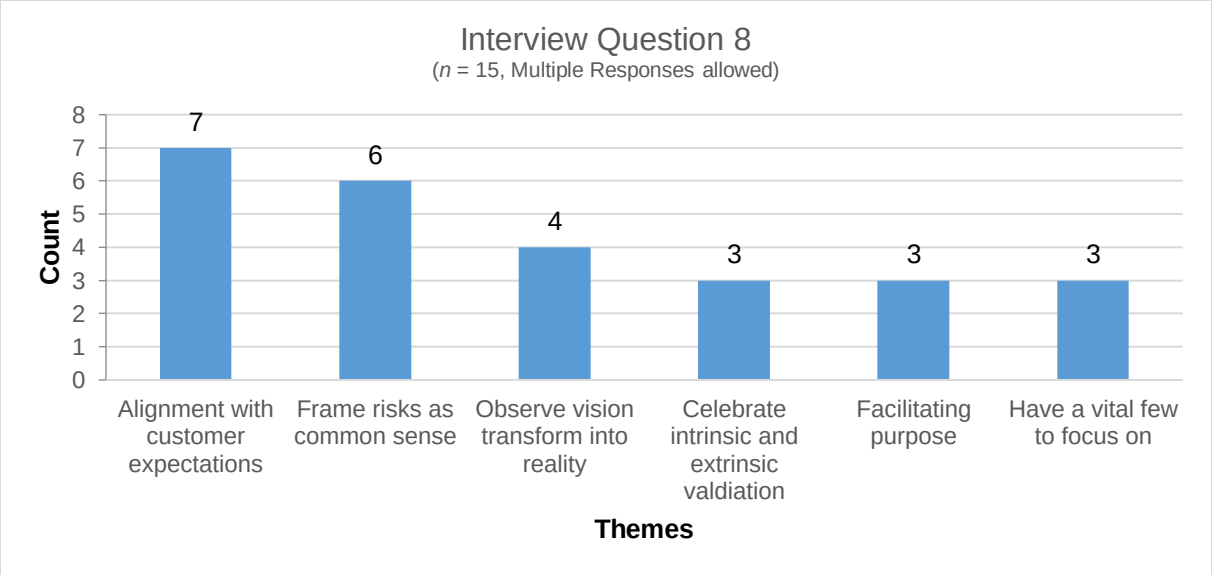

Figure 36. Interview Question 8 (IQ 8): How did you measure the success of a culture of innovation?

Alignment with customer expectations. This measure of success relates to intimately understanding the needs and wants of the customer by partnering with them in identifying areas for possible innovation within their domain. Items that were coded under this theme include: aligning to customer expectations and feedback, add value, completeness of deliverables, measure what you can, and get live feedback on ideas that might affect supply & demand models. To represent this, interviewee P01 said:

> I mean, a culture of innovation is, is there initiatives in change in every organization? Is it complacent? The world changes constantly, and if you're not changing, you're not innovating. Again, it's an accounting process. It's an order processing process. It's my IT organization, all those types of things. Then, I go back to the customer and what does the customer value? They don't really care about our order processing system. They just don't care about it. What they care about is are we bringing functionality that they considered very high value. We measured that.

Frame risks as common sense. This measure of success relates to using common values, attitudes, and beliefs within and around the organization to focus risks as a possible

option rather than risks viewed as radical alternatives. Items that were coded under this theme include: steer the culture from past mistakes to push the limits of what is acceptable, highlight individual activity that is progressive in solving the big problems, and acknowledge that innovation is happening. To represent this, interviewee P05 said:

> Try to grow the culture in a particular direction. So as an example in our development process, we have learned very obvious but sometimes difficult, particularly for our global team, is to include stakeholders. And stakeholders for us can be located around the globe. So making sure that is done, as part of our process to make sure everybody's voice is heard, is very critical. So basically, the culture is being always on the limit of what is acceptable, winning time basically, going with some solution which is innovative, but it's so innovative it cannot be complete and true from day one. And do small wins, basically, pretend like it's done without ever cheating, without ever lying or without ever anything. But basically go fast not being frozen in front of difficulty and not waiting for everything to be perfect before talking about it. So accept imperfection but at the limit of what is acceptable and gaining it after six months, after six months, after six months like working on the edge between failure and success basically for the time needed to become fool-proof and as we go correct from customer basically from the market feedback.

Observe vision transform into reality. This measure of success relates to acknowledging the great work the team has contributed and reflect on how the innovation may make a difference to the customer. Items that were coded under this theme include: teams pushing a group agenda to think outside of the box for new ideas and treating innovation as a byproduct, not a goal, and customers buy into a vision that is already on its way to become a reality. To represent this, interviewee P13 said:

> How those team members are sharing those vision and based on that vision, they can actually, they're executing or not continuously. But our major is more like that. Not only

just the revenue of those, how they see a vision and execute. So through discussion, is this team or this guy really understand direction or are only showing on the surface they understand but actually not understand. So that we have to actually make sure who are really understanding, who are not really understanding, but who are showing to understand but actually not. So three distinctive differences. And success is based on how more people really see that, or understand the vision and also execute. And, of course, gradually success is actually coming. If they enjoy that success, then they can move forward more quickly because they enjoy what they do. So that in order to major those, we have to make sure they can be successful, they don't fail the project. It's not easy to answer but...So not actually by numbers unfortunately, more like at stage how to actually... How to create new solutions for the future direction, how those solutions can be well received by our client step-by-step. That's the kind of measurement in the beginning. After that, once we have a better success, how much revenue, of course, can be generated by which project, which strategies, which project doesn't work well, how those projects should be modified. Those can be repeatedly reviewed, for measuring.

Celebrate intrinsic and extrinsic validation. This measure of success relates to seeking constant feedback within the organization and from the industry alike to verify that the effort produced to create something new is valuable to the customer. Items that were coded under this theme include: bringing something new to the world that has market acceptance, industry accolades, and during the development small wins can be cultivated and measured within the organization. To represent this, interviewee P02 said:

I don't know that we have measured it early on. I believe we have proven the case that we succeeded at being innovative. We have won several innovation awards, so other see us as innovative. That's how we could measure it today or at least we could say that we are confident that we've been innovative is that, our customers tell us that we are innovative. External groups have awarded us for being innovative. I think that those are

both fair measures. Again, it's not one to 100. It's just, if you get some of these successes, then you can claim you, I think you can rightly claim that you succeeded. If you don't get any of them, then I think you don't know, and so probably have failed.

Another representation of this, interviewee P07 said:

> Instead of saying since (a large customer) could not do it, why could we do it. We created it because my assumption was like a small company with a can do attitude is much more agile than a large organization and basically ignoring the difficulty, kind of naively saying that it is no so difficult instead of being frozen in front of the difficulty. Instead of being frozen... Instead of climbing the mountain for instance, instead of saying it's too hard to go up but you'll say let's start going up and we will find some help as we go and with the attitude of always... We are not dumb, we are not more dumb than others, so if we want to do it we can do it.

Have a vital few to focus. This measure of success relates to having lots of big goals across the organization. Items that were coded under this theme include: focus on the imperatives and on survival, and go full throttle with activity. To represent this, interviewee P14 said:

> We created that to have, to do business, to earn money and to be able to grow and pay people and so on. But we also did it for fun, to have the freedom to do what we wanted. And for [my partner], that meant to investigate all possible directions of innovation and without having to actually measure where we were right or wrong. But that's, in itself is the culture of innovation we wanted. Everything was possible as long as it was going towards the goal that we had. We did not really measure the innovation in any way, we had no metric for that. I would say for me, the ultimate measure was our financial success. Because we were really a... If you look at it from an I/O point of view, we were a company in which we were feeding intelligence, and innovation, and the output was the software that brought money to the company.

Facilitating purpose. This measure of success relates to individuals understanding the purpose of the mission and reinforcing it to the point that the individuals becomes vocal ambassadors of the vision of the organization. Items that were coded under this theme include: breaking silos, providing a sense of purpose, and make sure everyone has a voice. To represent this, interviewee P03 said:

> I felt that, since we have enabled, empowered people to think, innovate and work for a particular product independently, giving them free hand, creating flexible hours so that they're not restricted to a particular set up time. I felt that people are happy and people are staying with MSC for a longer time. [Another] one is that features develop. I see that because we are developing certain features and [my] team are part of it. I see there is a confidence level has increased in our people. So that itself says that, “Yes, somehow some innovation is taking place.”

Summary for Research Question 3

RQ 3 asked: RQ3: How do the executive leaders of esoteric technology companies measure success in promoting a culture of innovation? The two interview questions addressed RQ3: IQ 7: How would you measure the success of a culture of innovation? IQ 8: How did you measure the success of a culture of innovation? For Research Question 3, leaders articulated their preferences for addressing obstacles to cultures of innovation. These leaders asserted that static activities, or acting according to the status quo, was not in the best interest of the company. Furthermore, they identified the need to have the appropriate access and levels of resources to address innovations in esoteric technologies was extremely difficult to keep level set.

Research Question 4

Research Question 4 asked leaders to broaden the discussion of promoting cultures of innovation to include personal insights that may have influenced and shaped their approach to

leadership. The responses provided highlight exactly how deep and insightful these leaders are in thinking about their approach and the extent of their influence on cultures of innovation. Here leaders were asked the following questions:

- IQ 9: If you could start over, what would you do differently?
- IQ 10: Is there anything else you would like to add?

Interview Question 9

Interview Question 9 asked, “If you could start over, what would you do differently?” Six major themes were identified: leading and fostering talent ecosystems, embrace the challenge, keep iterating – start fast, fail fast, shoot for the stars, ignore the detractors, know your “Why,” and actively manage urgency.

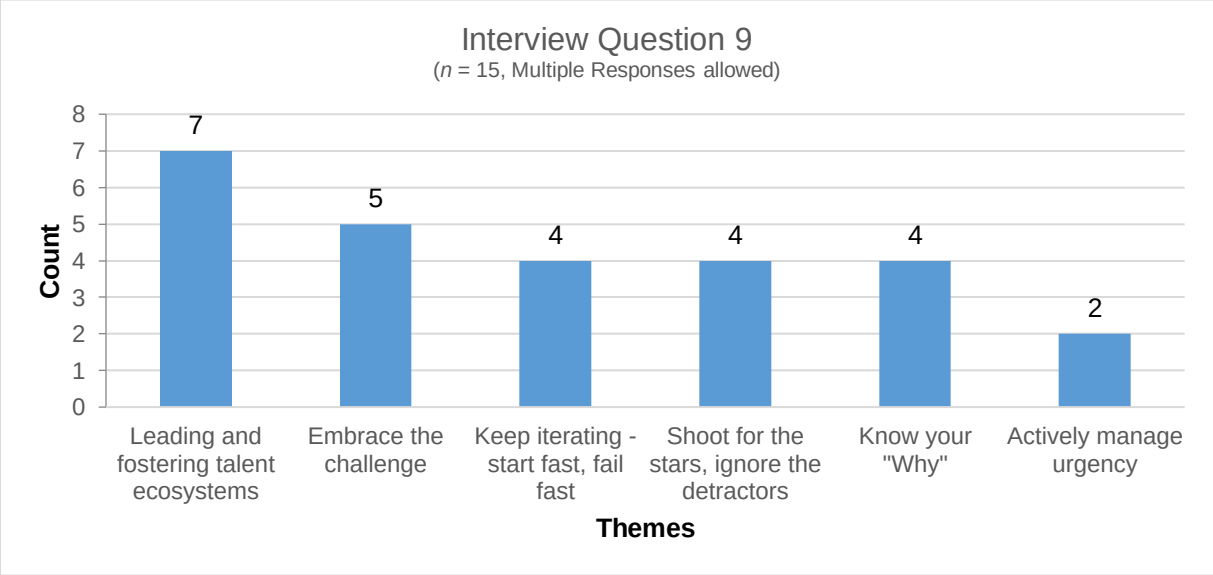

Figure 37. Interview Question 9 (IQ 9): If you could start over, what would you do differently?

Leading and fostering talent ecosystems. This best practice relates to acknowledging the value of the people within the organization and doing everything possible to cultivate great talent pools that will generate real innovation. Items that were coded under this theme include: hire exceptional talent and empower, protect, trust and respect, give lots of freedom but expect ownership. In this way, build teams to work closely together who reflect real purpose and joy in

their hearts, and will accept appreciation of their contrition. To represent this, interviewee P12 said:

> Innovation often is more likely to come by people working closer to the end user, to the real needs. But it has to be in a work climate that actually celebrates innovation and reinforces it. And very often, there's a failure to celebrate, period, innovation or anything else. In fact, work is just monotony and there is no sense of success for people involved in the daily grind and it's just a set of things that you do as you come into work. And as soon as that becomes the ruling corporate culture, I think all creativity is lost. People have to come to work with joy in their hearts and full of the possibilities that can be achieved in a working day, and if you can create that climate, innovation will take care of itself.

Embrace the challenge. This best practice relates to leaders and employees enjoying the challenge of doing something incredible, and not being dissuaded by the work but rather enjoying the grind until they get it right. Items that were coded under this theme include: conceptualize a holistic plan, embrace the problem, great ideas to act on come from inclusive collaboration, and always keep learning to help evolve your ideas. To represent this, interviewee P09 said:

> The common thread, of course, is that the people that have been involved in running these companies have been entrepreneurs and that's what caused them to create their companies and grow them to the point that they were on our radar screen and became a fit for us. I think one of the challenges that we have had in terms of something that... There are many things... In terms of like big picture type of things, what could we do differently that would really address this? Have we been creating barriers to innovations? When great idea crop up, jumping on them and implementing them, and making sure that you're not necessarily doing something just because it's the way we do it.

Actively manage urgency. This best practice relates to leaders taking steps forward to ensure that innovation can happen by making the work a priority. Items that were coded under this theme include: have a “big hairy audacious goal” and manage to it, make time the enemy, paranoia for failure is ok, and always be purposeful in decisions. To represent this, interviewee P02 said:

> I think one of the hardest things to do in innovation is to start. I don't have great ... I mean, if I knew what to do differently, I would do something differently to try to start faster. It's a long selling process where you have to commit yourself of the innovation. You have to convince the technologist of the goals, of the innovation. They have to come up with ideas to implement the innovation, et cetera. Of course, you have overcome all this passive aggressive resistance. Which will claim that it's not necessary. We went through all of that and it takes an enormous amount of time. If I were to start over and do this again, I would try to find something that would shorten that time frame. To be honest, I don't know what that would be today. The other thing that I would do differently that's much more actionable and concrete is, I would make sure that the design and implementation early on in the integration activity got much more scrutiny and review than we gave it. We made this, we didn't consciously make it. In the end, we made an assumption that having explained why and explain what and got an acceptance from the participants or embraced by the participants, the goals the innovation and that means to achieve those goals.

Keep iterating - start fast, fail fast. This best practice relates to encourage individuals that continually iterating on the problem requires action, not just discussion. The more teams try, the better they will approach an understanding of the problem which then can be solved. Items that were coded under this theme include: nurture the entre/intrapreneurs, manage more critically, and start fast, there will always be mistakes so try to getter better quickly. To represent this, interviewee P13 said:

> So if I know, means if I go back to the seven years ago, based on my current knowledge and experience, then I could make corporation much more quickly because I knew who are sabotaging, who are really supporting, who are really quickly executing, who are slowly executing, so that I could have a better organization. And I could, my team could've evolved much more quickly.

Shoot for the stars, ignore the detractors. This best practice relates to leaders doing everything possible to stay true to the vision because there will always be detractors who do not care about the outcome. Items that were coded under this theme include: avoid distractions, ignore advice from people who haven't lived the experience, remember people do the best they can, and celebrate for the right reasons. To represent this, interviewee P14 said:

> You have to make mistakes. You have to develop things that do not work as planned. You have to hit the wall, in order to progress. You can't go through the maze, from the entrance to the exit, without hitting a wall at some stage. And so I would certainly, again, leave a lot of freedom to the team, as long as the long-term vision... We all know where we dream to get to. And what I would also... But I wouldn't feel personally confident in a company like Google, not saying that Google does not innovate, that's not what I mean. But what I mean by that is that I enjoy, from day one, the contact with customers, and the confrontation of our ideas, our developments, with the needs of industrial customers. We founded the company in July, 1998, and I think the first training took place in September, 1999. We only developed for one year before having actual users, inside companies, that could tell us, "This is nice, this is relevant, this is not, this should be different." Not only did we have a culture of constant innovation but also of constant confrontations, confrontation of our innovations with the industrial needs. And that's key to our culture, and that's always something I would retain.

Know your "Why?" This best practice relates to organizations, leaders especially, having a clear understanding of their purpose for why they exist and why they need to innovate.

Items that were coded under this theme include: know your “Why”, ensure innovation leadership, be genuine, and provide a strong vision. To represent this, interviewee P01 said:

> It always starts at the customer. If you want to promote a culture of innovation, the first thing you have to do is what is it you're trying to innovate? We're commercial entities, right? We're not a non-profit, so it has to be value creation for the customer. Today, in a mature software market, if there's not a return on investment, nothing gets bought. Nothing gets bought. For me, as a leader, being in front of customers is always ... I don't want to say job one, but it's job one. Everything else is easy. If you can articulate better than anyone else in the company, better than the product management guess, better than product development, better than the sales guys. What it is, what are the big trends, what is the customer spending money on? What's the value?

Further, to represent this, interviewee P11 said, “And then of course the last thing is you never want that the leaders of innovation should be non-innovative themselves. And that's a definite, that you never want that in any sort of organization that's an innovative organization.”

Interview Question 10

Interview Question 10 asked, “Is there anything else you would like to add?” Seven major themes were identified: innovation imperative, lead the dreamers in creating a new reality, innovation is profitable, get the right ingredients, believe innovation is part of your deoxyribonucleic acid (DNA), be fanatical, and galvanize high achievers.

Figure 38. Interview Question 10 (IQ 10): Is there anything else you would like to add?

Innovation Imperative. This knowledge and pearl of wisdom relates to the deep seeded feeling within leaders that innovation is more than an objective, but a way of life. Items that were coded under this theme include: the goal is not to force innovation, but to try to live by the acknowledgment that innovation is hard, but it is necessary to challenge the status quo and make a meaningful contribution. To represent this, interviewee P07 said:

> I notice is that there is a huge difference between leadership and management, which is kind of obvious for some, not so obvious for others. And if you trust people they will get you the most out of them, and managing by control or managing by force is not a good idea. It's showing the way, it's always people will follow you. So if you, how to say it, in a nutshell, there's nothing impossible if you want to do it, basically. I don't know if it's philosophical or no, but... I follow the week on innovation, I follow the full course on innovation, but honestly, it's not... In big companies, where people are at the edge, you have to create like workshops and ideas and create stage gates to go through gates, to filter out innovations, and so on and so forth. I think that there's a big difference between

innovation in large organization and innovation in smaller organization where they live by innovation. So it's not even a question.

Also, to represent this, interviewee P02 said:

> I would argue that, in order to successfully culture of innovation, you can never stop trying to innovate. I focus on some challenges and some projects. In my mind I'm thinking about the projects that we've had that resulted in innovative product deliverables and the challenges there. To get a culture of innovation established, all those things that I talked about, with respect to our project or our deliverable. Those things need to be applied to everything, every day. That's hard to do. It takes a lot of effort. Because again, I think if you had a small company and a start up in your garage, it would be easy. Why? Because you've got nothing to lose and you don't know right from wrong anyway. You might as well be innovative, but it's not innovative. It's not like it's saves you any effort, it's going to be hard either way because you've never done it before. In an organization like mine, where we've been doing it for decades, it's all about trying to get people to do harder work where they don't know whether the outcome is going to be successful instead of doing what they are used to.

Lead the dreamers in creating a new reality. This knowledge and pearl of wisdom relates to leaders viewing themselves as a shepherd who is leading high achievers to metaphorically high pastures, a place where no one has gone before. Items that were coded under this theme include: can't leave it to employees to innovate in a vacuum by themselves, be willing to lead innovation, keep an open mind and be willing to be guided. To represent this, interviewee P10:

> Kinda extend that a little bit. You also encourage conversations between maybe in meetings where you're just discussing these ideas, so mostly the conversations that go on within meetings are generally getting this project done, so there's not as much time to just sit there and shoot the... You know what I'm saying? ... Just on research ideas.

> There's lots of chances, I think, especially at a company like MSC where we could have much more innovation, much more potential for innovation, and encourage much more innovation than we do today.

Get the right ingredients. This knowledge and pearl of wisdom relates to piecing together the right talent, attributes, and conditions to facilitate innovation. Items that were coded under this theme include: foster a meritocracy, build the right team with growth mindsets and have a sense to innovate. To represent this, interviewee P12 said:

> Pursuit of the truth in other words, a meritocracy based on rewarding the guy who has the right idea or the best conception, as opposed to the guy who's most senior, or who makes the most noise, or has maybe the highest formal rank in the company. So those ideas of a very democratic organization, a very shallow organization, ability to speak truth to power, ability to tolerate no bullshit, and an assistance that anybody who can make their case in a scientific or mathematical way that is rigorous needs to be respected and listened to over above the people that maybe are just occupying a lot of time in meetings with pontification about possibilities that they can't actually rigorously quantify.

Believe innovation is a part your DNA. This knowledge and pearl of wisdom relates to leaders believing that in order to promote cultures of innovation that instill a belief that their people are capable of doing something grand because it is a part of their makeup, who they are. Items that were coded under this theme include: bridge the customers to employees by building on inclusion measure and let innovation be a part of anyone who is willing to purposefully contribute to it. To represent this, interviewee P01 said:

> Along the way, you have to look for ways to foster the innovation. It could be things like our show and tells or foster things like our customer success awards or those types of things. Make them feel that what they're doing along the way matters. Don't wait. Over communicate these types of successes. While you're defending this new team from all

> the people who are throwing rocks at them, right? I think if you do all those things and stay in touch with the customer and keep the team, obviously, incredibly in touch with customers. I've done for our next generation projects. They generate, today, over a billion dollars in revenue because that's the formula. That's the formula that works.

Innovation is profitable. This knowledge and pearl of wisdom relates to debunking the myth that innovation is for basic research to advance knowledge rather than part of the commercial process in highly interconnected, global economies. Items that were coded under this theme include: innovation is profitable once an audience is identified and time, talent, and treasure is spent on innovators. To represent this, interviewee P14 said:

> You have to create a company with a spirit of innovation. You have to hire people that have a high sense of, and a desire for, innovation. But I wouldn't know how to act if I had to take an existing company with no culture of innovation and turn it around into one with a strong culture of innovation. It's very hard to do, and if you find a way I'd be interested in reading it.

Also, to represent this, interviewee P01 said:

> I always say where there this mystery, there is margin. Customers are trying to sell us this autonomous vehicle problem right now. They're putting lots of budge in there, right, so that's opportunity. Customer number one. Number two, the first three of the three, four, three. Number three, set big goals that they can't achieve. Number four, you have to, along the way, supplement that little nascent team with the right people from the outside. That's both from experienced people and next generation. In our case, it happened to be PhDs and post-docs, because they learn new things and new skills. Some of them are just fantastic.

Be fanatical. This knowledge and pearl of wisdom relates to continually pursuing the objective to fulfill the vision and bring innovations to life. Items that were coded under this theme include: be fanatical and iterate innovations. To represent this, interviewee P05 said:

> Oftentimes, the starting idea may be the seed, and oftentimes there's multiple starting ideas. It's in going through the process of the refinement as a team is critical. I think I've said that throughout, but it's making that available. Making that as part of the culture is very critical.

Galvanize high achievers. This knowledge and pearl of wisdom relates to high achievers sometimes requiring more effort to move forward. The responsibility lies with leadership to find ways to begin high achievers down the road to innovation. Terms that were coded under this theme include: invest in the people who enjoy the challenge. To represent this, interviewee P13 said:

> Guess one thing I can say is how we can build team. To be successful that path is crucial, so I often ask my team, for example, one is successful possibilities 51%, one is 49%, which you choose and I prefer to recruit and work with the people who choose 49% success rate rather than 51%. The reason is simple, 80% to 90% people will choose 51%, much less people choose 49%. Then, which can have a higher return on investment? 49%. Because profit can be shared by much less people. So, how we can do that such kind of team, such kind of people is my style and my business model. So building a team who can challenge, who can enjoy challenging is a key. We have to make our customers, our market industries more shocked, positively shocked by what we propose, what we do.

Summary for Research Question 4

RQ 4 asked: What recommendations for promoting a culture of innovation would executive leaders of esoteric technology companies make for future leaders in the field? The two interview questions addressed RQ 4: IQ 9: If you could start over, what would you do differently? IQ 10: Is there anything else you would like to add? Research Question 4 demonstrated the consistent efforts these leaders have made to improve better promote

cultures of innovation within their organization. Their desire to continue to be personally involved in fostering the right mechanisms for innovation was apparent. Leaders gave the impression that their own contribution to the process was personally important to them. In this sense, each leader made promoting a culture of innovation their own priority, which was apparent in the emergent themes revealed by this study.

Summary

The purpose of this study was to attempt to understand the directed effort in developing and sustaining cultures of innovation within an esoteric technology (e.g. CAE) company. Interview questions developed for data collection answered the four research question this study attempted to discover:

- *RQ1:* What strategies and practices are employed by the executive leaders of esoteric technology companies to promote a culture of innovation?
- *RQ2:* What challenges are faced by the executive leaders in esoteric technology companies to prompt a culture of innovation?
- *RQ3:* How do the executive leaders of esoteric technology companies measure success in promoting a culture of innovation?
- *RQ4:* What recommendations for promoting a culture of innovation would executive leaders of esoteric technology companies make for future leaders in the field?

The feedback provided determined a cross section of attributes aligned to typical attributes of a culture of innovation (Crossan & Apaydin, 2010) as well as demonstrated that difference may exist across different cultures of innovation (Jucevičius 2010). Responses demonstrated the difficulties and successes within these cultures and how leadership was able to guide outcomes. Findings of this study and future recommendations are discussed in chapter five.

Chapter 5: Discussion and Conclusion

The description of innovative cultures applied to organizations has several applications. An examination of the appropriate lens by which organizations might be considered innovative can be determined by the orientation of the organization (Crossan & Apaydin, 2010). Innovation can be considered through the lens of an organization's capability to innovate (Crossan & Apaydin, 2010), or through the lens of its delivery of products and services that are considered innovative (Crossan & Apaydin, 2010). Also worth considering is the organization's orientation to innovate, such as innovation at the individual, group, or process level (Crossan & Apaydin, 2010).

Summary of the Study

Whether an organization is considered innovative is not the focus of this study, but is a notion that acts as a basis for the findings henceforth. Organizations with an innovation culture are determined by a set of characteristics (Crossan & Apaydin, 2010). What this study suggests is that at the core of an innovative culture is the ability to "get better year after year" (P01). Yet, the matriculation of a culture of innovation within an organization often morphs into more diverse characteristics representing various constructs within groups (Crossan & Apaydin, 2010). As such the notion of an innovative culture is not necessarily the same, as this research suggests, as the cultures of innovation (Jucevičius, 2010) of an organization as reflected by the responses to the research questions noted in chapter four:

- *RQ1:* What strategies and practices are employed by the executive leaders of esoteric technology companies to promote a culture of innovation?
- *RQ2:* What challenges are faced by the executive leaders in esoteric technology companies to prompt a culture of innovation?
- *RQ3:* How do the executive leaders of esoteric technology companies measure success in promoting a culture of innovation?

- *RQ4:* What recommendations for promoting a culture of innovation would executive leaders of esoteric technology companies make for future leaders in the field?

Summary of Findings

A snapshot of the responses from the interviewees summarizes key findings from the study. Respondents provided their perspective to the interview questions to the best of their ability. Without leading interviewees and bracketing my own assumptions during analysis, the results show a range of responses between two and eleven. Each response corresponds to unique interviewees. While respondents to interview questions may have provide responses that for any given interview question may result in a response that result in multiple themes, the results only reflect the number of respondents and not responses. As such, the average number of respondents to any interview question was five with the most common number or respondents equaling four. With an average difference of two and a median of seven to eight, Strong indicators of consensus from respondents resulted in nine to ten responses with less precise indicators a result of six to five responses per question. The least consistent responses came from themes with only three to four interviewees responding a certain way.

The research finds that various themes appear as common responses from interviewees. Common responses are classified as those with respondents at the midpoint, i.e., seven or eight respondents. Each category interview question contained at least one common theme, except for IQ 2. Beginning with IQ 1, the common strategy and practice leaders employ to promote a culture of innovation reported was "personalize everything." Motivation was a clear response for leaders to engage and promote staff. However, leaders at MSC Software believe that leadership is tied to both the goal and the relatability of that goal to both the leader and member. Referencing a path-goal leadership approach, respondents commented on how the key for them was to share in the personal commitments they were asking of each team member.

Leaders in this organization had an interesting reaction to describing challenges (IQ3). The surprise came in the themes that emerged. Technical abilities and creativity were not called out specifically as challenges. Rather both concepts were assumed by leaders to already exist. Perhaps, this is the case for esoteric technology producers in which the minimum requirements to be a part of the organization requires both. Referencing both topics in the rest of the findings, however, should not be a problem. The common challenge for leaders at MSC Software was the lack of motivation to try something new. To innovate, these leaders articulated their belief that finding the right motivator for each person is key. While they acknowledged that articulating a vision for the innovation was necessary, they said it was not the common challenge to focus on. The leaders thought that the issue of producing something truly new is that the staff, those creating, would need to find the right reason to connect with the innovation and therefore understand how their efforts may impact a customer base, who themselves do not yet know that they need or want what is being created.

These leaders expanded on this common challenge and described the issues that arose when plans went awry. Two common themes emerged in these cases. One was that "Well intended plans that don't work" (IQ 4) refers to plans to innovate which had issues in development. Whether through a lack of good information available or a change in direction due to shifting customer demands, these plans ended up being reduced and therefore activities shifted away from pursing innovation. The other common theme relates to how plans may be affected by the complexity of the innovation proposed. Technical abilities may be considered a staffing and or competency, however, as applied to this common theme, the concept of "Missing empathy for the difficulty of the problem" (IQ 4) relates to managing expectations around trying to solve "never been done before" innovations. This is an important note; in one sense, the objective to innovate may be regarded as a process, but the findings suggest that the activities alone do not necessitate innovation as an output for esoteric technology companies. Both

scenarios seem to suggest that the literature involving organizational agility may help offset or reduce issues relating to the changing landscape and refocus of problems.

In addition, leaders at MSC Software identify the most common critical factor relating to "Challenging mental models" (IQ 5). This is another interesting point. Unlike some assumptions regarding innovation, the respondents indicate that the generation of the idea and imagination are less critical than some literature suggest. Instead, the mental models of the staff are a common issue to the culture. The dispersal of mental models ties in closely with common cultural barriers (IQ 6) such as "Ladders of inference" and "Competing behaviors." Leaders stated that how individuals process information can derail the ability for this person to accept the possibilities of the innovation and its application. This has been recognized as a huge issue when promoting a culture of innovation. The inability for an individual to conceptualize and or visualize the goal of a new technology or product can occur in any team around the world. These leaders identified this as a theme across the organization. Furthermore, these leaders identified that these construct can and will impact the orientation of the teams employees work on. Team members can influence the effectiveness of the group through their attitude. Referencing back to Bolman and Deal (2012), the symbolic organizational frame comes into question as leaders face cultural barriers in accepting innovation initiatives. Respondents cited engaging in more personalized interactions with team members. This behavior reflects the notion that leader membership change theory is an active part of the organization.

Meanwhile, IQ 7 and IQ 8 probed the measures of success for promoting cultures of innovation. As an ideal scenario, respondents commonly responded that "Fostering Autonomy" (IQ 7) and having a "Wow factor" (IQ 7) were ways for leaders to track the activity and impact of the culture. First, leadership at MSC Software commonly look for ways to foster self-efficacy for staff to tackle tough problems. Respondents often acknowledged that autonomy plays a key behavioral role that can be observed day-to-day in the form of brainstorming, prototyping, etc. Also, respondents tied these behavioral activities to outputs such as products and processes. It

would seem that the ability to distill something exciting from the vision for the customers is a common measure for the organization. Furthermore, leaders at MSC Software referenced "Alignment with customer expectations" as a common theme that perhaps other organizations use as a measure, but most certainly is done at MSC Software. This seems to match the triple helix innovation model by Dolfsma and Soete (2006), which considers related influences, including economic factors, to innovation.

Leaders at MSC Software feel that a key common best practice is in "Leading and fostering talent ecosystem" (IQ 9). What they mean by this is that people are the number one asset and not specifically their talent. Respondents commented on hiring practices and what they look for to make great teams. While a common set of key attributes was not identified (perhaps a question for follow up study), technical capabilities were assumed present. Therefore, leaders generally were seeking skills that focus on abilities for inclusion and challenging mental models rather than other technical abilities. Each of these decisions come under scrutiny. Even group make up within the organization is modeled in such a way as to foster cultures of innovation. According to responses, there is a maxim referred to as the "Gallello Principle" (3-4-3) which highlights the orientation of those who are willing to try new things, those who wait before joining, or who prefer not to work on innovative projects. In other words, the organization is aware of its culture typology and works to finds ways to support it. Efforts such as moving team members around and talent acquisition are central points of discussions at nearly every level of the organization. Respondents were clear that people make all the difference in their world.

In IQ 10, the question was posed to the interviewee whether topics or concepts were missed during interviews. Respondents' common feedback was highlighting the importance of innovation to their organization. These findings suggest that there is an "innovation imperative" associated to the cultures of innovation for MSC Software. Respondents claimed that the "innovation imperative" meant that in order to survive, they must find a way to bring about value

creation for its customers. For many of these leaders, their educational background meant they had few skills outside their narrow field of discipline. One interviewee said that if he did not start his company after his Ph.D. he did not know what he would be doing now. Others have spent formative years developing insights into esoteric technology domains and that simply doing something else was described as difficult to imagine. Innovation may be part of these respondents' DNA, but it seems that there was also a conscious decision to make it part of their identity.

This feedback may mean that an organization is less inclined to choose whether they will be innovative, but instead the degree to which they will be innovative. It may be that cultures of innovation have less to do with the choices made to deliver innovation and more to do with the identity of the organization--its DNA, as it were. So it may be that identifying the cultures of innovation within an organization is really a question of examining its raison d'être.

If cultures of innovation at this esoteric technology company prioritize people and innovation, then it may stands to reason that examining responses with the highest yield may help construct a more clear vision of the culture. Responses with strong indicators might represent the needed insight required. For instance, regarding the topic of strategies and practices (IQ 1) to promote a culture of innovation, creating a personalized space reflected a common strategy. However, the interviewees were clear that the top priority is to "Inspire abilities." Respondents differentiated this from personalizing actions by focusing on the motivations that would elicit action. Examples of this that came up during interviews included: providing more opportunities to ideate, challenging naysayers, championing ideas on behalf of employees, and even acknowledging employees' fear. Leaders in this organization believe in a common mantra "We have two ears and one mouth, we should use them in that ratio" (P01). Listening is a key component not only to discern the needs of the customer, but seemingly to allow employees the space and opportunity to initiate concepts for development.

The converse issue these leaders face was highlighted as a priority challenge in IQ3. Unlike the common response of a lack of motivation to challenges in promoting a culture of innovation, the right balance of loci of control is very important. The responses to this theme differentiate themselves from motivation in that loci of control is a deeper, more vulnerable space for employees and is much harder to identify for leaders. Respondents reported that loci of control is an issue wherein individuals actually feel helpless and find it difficult to take the first step towards innovation. In the "Gallello Principle", it was discussed that this is the group of 4, who are waiting to activity demonstrating that things are moving in a positive direction before following the trend.

The tentativeness of individuals is difficult for these leaders given organizational movement. By placing customers at the heart of the activities for innovation, leaders observe that to be successful in meeting needs and exceeding expectations, their organization must be flexible. This appears to manifest in two high priority challenges. In IQ 5, the "Resource flux critical times" theme served as the area of greatest pain for respondents. In this situation, the issue leaders face is how to manage the "never been done before" challenge at hand. Many times, either a shift in priority, loss of headcount, and or even a loss of time become barriers to delivery. Another issue leaders at MSC Software discussed were the cultural barriers (IQ 6) based on "Competing structural culture typology." This insight indicates that the orientation of teams differs at times due to priorities and group formation. Interestingly, based on the respondents' feedback to the Measure of Success research question, the interviewees struggle to concretely identify ways to measure the success of their culture of innovation. However, based on this feedback, some broad critical success factors may be inferred.

Key Findings

Innovation imperative is an interesting concept in that it relies on a survival mentality. This may be based on the orientation of the organization. Each of the interviewees acknowledged that MSC Software is a commercial entity (Dolfsma & Soete, 2006) and not a

research lab or a solitary research & development; R&D (Homburg & Pflesser, 2000). This is may seem like common sense, but for each interviewee to acknowledge the same concept interview after interview may mean that leaders within MSC Software are highly sensitive to the difference in organization structure, especially knowledge infrastructure (Phillips & Philips, 2002), and therefore output expectations. While further research can be done to investigate the differences in organization orientation and cultures, this study does highlight the need for each leader to acknowledge the importance of the customer. Whether there are options or not for these leaders, they seem to all believe they belong in this organization, doing what they are doing, and that survival is based on them doing this well.

Taking this concept one-step further, if esoteric technology providers are linked to this notion of an innovation imperative, it might mean that esoteric technologies may in fact be a good investment. An argument can be made that unique technologies with a focused approach to customers can produce commercially viable products. The constant requirement to innovate means that customers can expect a more rich solution. In the end, this business strategy may enable esoteric technology providers to not only create a market place, but to dictate the industry needs that may not yet exist. One interviewee said, "There's margin in mystery" (P01) and this concept seems to validate it.

Another critical success factor that came from the research is approaching innovation in a fanatical manner. What this implies is that innovation relies heavily on effort. Based on an innovation imperative, the need to survive is so overwhelming that the instinct to prevail is constant. The level of effort then to create something that makes an audience rethink their expectations is high. Again, the amount of technical ability needed is incredibly high. The math described in the interviews is applied to methods that have not yet been imagined. To continue to push through abstract concepts and uncertainty in validating models takes a sort of fanaticism.

So a fanatical imperative can be summarized at the unyielding effort for discovery of innovation. Further definition of the fanatical imperative may be needed to further generalize the concept for use in describing other esoteric technology companies, but for now, it may aptly describe the need to formalize the overall attitude within this organization. As a practical application, a fanatical imperative may have utility as a tool for the "Gallello Principle." In the 3-4-3, the first set of three (3) individuals are properly oriented and excited to take on the challenge to innovate. The last three (3) will refuse to connect with innovation initiatives. However, the fanatical imperative may help in assessing the missing dimensions and attributes at a group and individual level; in other words acting as the creative fulcrum (Sternberg, 1991). Further studies may be targeted to shaping action plans that can address or accelerate the middle four (4) to action and participation (Elkins & Keller, 2003). Added headcount definitely matters as witnessed by interviewees, as resource flux is a big problem.

Finally, the last critical success factor can be understood to be risk tolerance. Many of the interviewees related to either themselves or to an approach as entrepreneurial. True, entrepreneurs do take risk, but again, through the lens of the innovation imperative, risk is measured and determined by each individual's experience with innovation within the organization (Dauber et al., 2012). Having these shared lived experiences may mean there's a level set of acceptable risk in trying new things. Further studies can be conducted to evaluate the sensitivity of risk each individual is willing to take on. However, at this time, it can be reasoned that risk, based on experience, is not just measured, but an accepted factor related to innovation.

Therefore, a risk imperative may be defined at the appropriate level of measured risk applied to innovation. Risk imperative in the case of MSC Software may be related to the natural constraint associated with applied mathematics. The value creation to customers by way of innovation is capped by the ability to develop the right math for the problem. Simulation is a translation of the math and, in the case of MSC Software, a translation of physics into a visual

representation of an abstraction model. In other words, an individual's effort to try to solve an unrealistic problem would likely not even be efforted. So, creativity in the sense of having a basis in reality means more about how risk can be applied than otherwise.

Evaluating extended applications for a risk imperative may include examining the possibility of an assessment (Deal & Kennedy, 1982). Measuring a person's attitude towards risk that takes into consideration interpersonal and group dynamics as well as cultural dimensions (Denison & Mishra, 1995) may prove helpful in developing future leaders (Crossan & Apaydin, 2010). An assessment may be useful in evaluating entrepreneurs in search of funding or as an investor resource augmentation. The result, of course, may be the expansion of new discoveries for the world. This is ambitious, so in the meantime, simply adding more leaders to the field is a high enough bar. The start of new possibilities, however, may very well begin with the innovation imperative and the right behaviors (Argyris & Schon, 1974), in fanatical imperative and risk imperative, to see new discoveries come to life.

Implications of the Study

The insights uncovered in this study can provide a field guide to innovation. An understanding of the results in the form of a narrative may provide future opportunities for growing this topic in the field of cultures of innovation. Strategic, operational, and tactical insights can be ambitious targets, however, by simply outlining key criteria, perhaps future researchers will be able to provide added richness to this area of study. The following comments may be construed as guidelines for constructing broader themes governing the incubation of esoteric technology development.

Interviewees all noted that innovation is largely a journey. Rather than a definable process, the journey to create, and therefore innovate, comes from a groups' willingness to discover something new and apply it to some technology. In this sense, interviewees all alluded to the idea that teams play a part in cultures of innovation. Respondents assumed the

integration of teams in their culture without directly naming it in their responses to interview questions.

Interestingly, team orientation and formation was alluded to by several respondents, but without further detail. It may be observed that the people within those teams mattered just as much as the individuals themselves in promoting cultures of innovation. The "Gallello Principle" highlights both formation and orientation at MSC Software. This may be the reason interviewees neglected to directly elaborate on team formation and orientation in their responses. Perhaps the assumption that can be made is that the "Gallello Principle" is a juxtaposition of accepted values within the organization. These values to further imbue efficacy for the first three of the 3-4-3 model may be considered maxims and overlooked as definable traits. Furthermore, respondents tangentially alluded to how assigning teammember roles and responsibilities in delivering innovations as a byproduct. Future studies may thus focus primarily on the translation of cultures and innovation delivery. What might provide further insight into this study is the orientation of these teams.

A parallel to the team formation is a similar approach developed at IBM in the late 1970s which may be used for comparison. Known as the "chief programmer" approach, Baker and Mills (1973) described the software development process as a function of utilizing a central figure, the "chief programmer," to direct programming efforts (Baker, 1973). Development consisted of the "chief programmer" directing, with at least one "backup programmer" and "programming secretary." The role of the "backup programmer" is described as being a peer to the chief programmer in developing code and weighing in on critical aspects of the project, but as being expected to branch off in research as needed, allowing the "chief programmer" to focus on the critical components. The utilization of a "programming secretary" enables the team to rely on development support libraries necessary for software production within the organization.

MSC Software deviates from a literal translation of the "chief programmer" approach, yet respondents often alluded to having an individual or groups of individuals playing similar roles (see Figure 42). For instance, there was some description of a lead or the leader describing themselves as the visionary. In some cases, the complexity of a project was such that multiple visionaries were need to stitch together a coherent projection of the innovation that would match customer need. The "backup programmer" might have been represented as a single partner to the "chief programmer" or as a group who could scale the complexities to meet specifications. Finally, the "programming secretary" could be identified by the administrative or project management facilities that were contributed to the plan. Again, depending on the scale and complexity of the innovation in progress, this could be an individual or group of individuals.

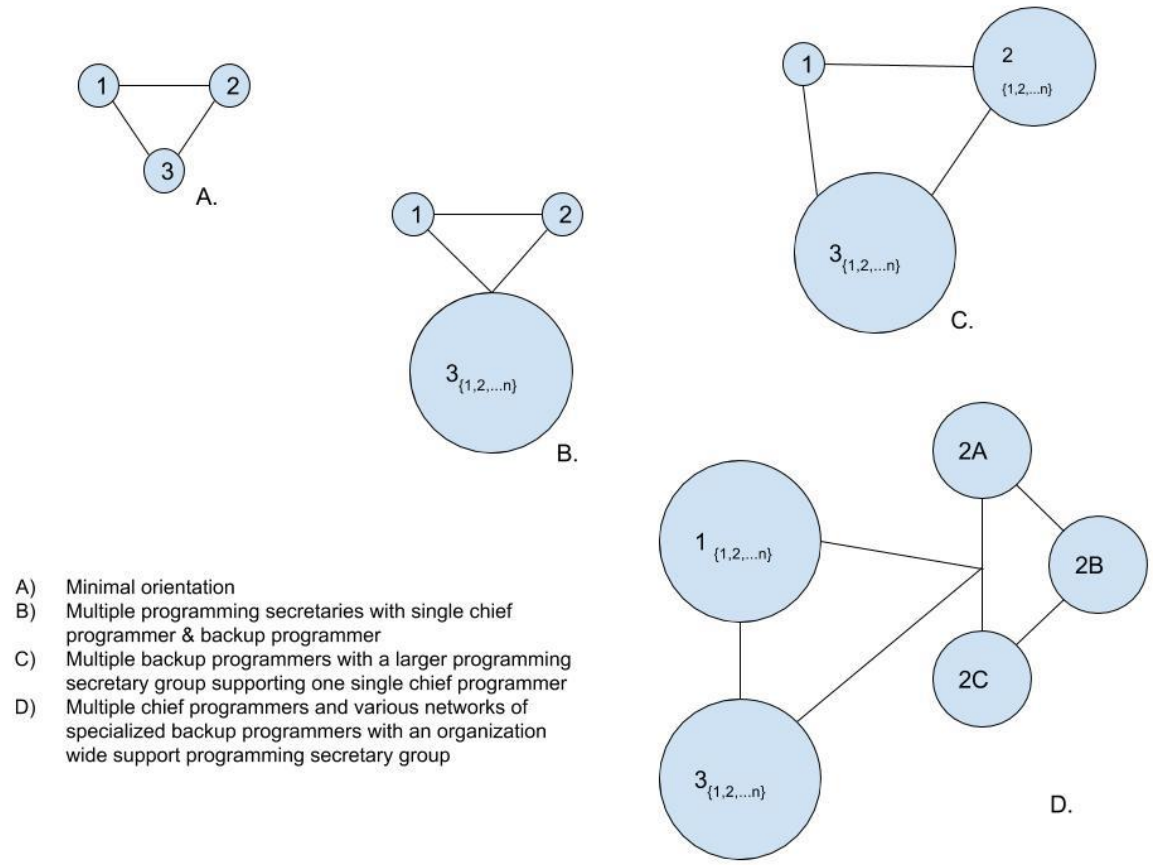

Figure 39. Adaptation of Harlan and Baker's description of the chief programmer model (Baker, 1973), including orientation, size of group, and configuration of teams less any representation of distance, network effects, and graph theory.

Actionable next steps in propagating this orientation and further strengthening cultures of innovation in an esoteric technology firm could include determining a plan for individuals to be better prepared for the roles they might be asked to play in future innovation endeavors. If, for example, using the findings in this study, critical factors for innovation relating to a necessity of some sort (imperative), fanaticism, and risk taking, and overlaying them to team orientation using a "chief programmer" approach, the result may point to an extended operational model for talent development.

Innovation Improvement Plan (IIP). Improvement plans can provide the necessary feedback for development (Carleton, 2009). Paired with continuous feedback and improvement mechanisms, improvement plans may apply to developing competencies (Carleton, 2009). Concerning fostering innovation within esoteric technologies firms that follow a chief programmer approach, an innovation improvement plan (IIP) may thus be a by-product of several of the research findings.

Again, a key challenge for the chief programmer is managing the difficulty in coming up with something truly new. The findings highlight the role customers play in defining the need and speed for development. However, the application of IIP's could mitigate the challenge presented by resource constraint by helping chief programmer(s) and the senior and executive leaders properly anticipate and deal with obstacles to innovation. Such anticipation could further an organization's ability to cultivate deliberate practice under the direction of management and leadership to be applied as expert performance in the future (Ericsson, Krampe, & Tesch-Romer, 1993).

However, unlike most improvement plans (Carleton, 2009), an IIP is intended to be a learning intervention, wherein the IIP could mirror a successive approximation model (SAM) approach to training. SAM trainings are intended to incorporate multiple, iterations to derive the appropriate learning opportunity (Biech, 2014). The design, development and testing phases are done to establish a refinement of the training (Biech, 2014). Human Resources and Learning &

Development professionals may set up an infrastructure to facilitate IIPs as part of an organization's ability to iterate new esoteric technology innovations.

The formulation of an IIP program would allow senior and executive leadership to further examine the kinds of innovation goals needed. Innovation goals would be a formulation of the next innovation imperative by considering the risk imperative and determining the level of fanatical imperative within the organization. With the complexity of innovation referenced by an esoteric technology producer, the issue senior and executive leaders need to think about will be how the chief programmer will account for the diffusion of innovation of a new product or service (Rogers, 2003). At this point, the chief programmer's involvement would be central.

An IIP also will rely on a benchmark for improvement. Enter the chief programmers, who will need to consider the three imperatives for the next innovation. Using the design thinking method (Brown & Katz, 2009), the chief programmer would ascertain the vision for the innovation with inputs from leadership as well as the backup programmer(s) and programming secretary function. Presumably, the continual iterations lead to the innovation sought after (Brown & Katz, 2009). The directives and actions moving forward would then rely on an interplay between the outputs of the design thinking exercises and the IIP training. Since the iterations will continually evolve, so must the IIP by utilizing a SAM design, deploy, and test method to coincide with the needs (Biech, 2014).

The result of the IIP and design thinking exercises may result in many iterated ideas, concepts, and near-complete innovations. Turning these items into a catalog or library of data sets may enable the organization to utilize emerging technologies like predictive algorithms to uncover hidden opportunities. For instance, applying natural language processing (NLP) algorithms to discern these libraries could simulate what could happen under specific imperative conditions (Snow, O'Connor, Jurafsky, & Ng, 2008). Creating a machine learning (ML) program could open the possibilities for development of a situation where advanced predictions, e.g.

artificial intelligence (AI), can be made to anticipate (Langley & Simon, 1995) what and how to support chief programmers in training staff and further enhancing expert performance.

Innovation Improvement Plans could provide a platform for esoteric technology organization leaders to have a meaningful contribution to the next big innovation. Whether as a structural frame as part of the organization (Bolman & Deal, 2013) or as an instructive tool used by leadership consultants, innovation improvement plans may direct organizations to overcome innovation obstacles. Moreover, turning the IIP framework into a technology would be a happy irony in that the findings of cultures of innovation within esoteric technology providers would provide a solution in and of itself that might be considered an esoteric technology. This is an emerging frontier for further study and application.

Recommendations for Future Research

Trying new things is nothing new for innovators. However, for innovators to continue to innovate, a continuous improvement mindset must be established. The findings here point to another nuanced observation, which is the established habit innovation leaders have. The cultures that are fostered are based on the three imperatives and the realization of efforts by way of new innovations with further research in the following recommended areas:

- Further examination of institutional habits – Based on identifying a market need that is difficult to create, applying intense focus, and then providing delivery with customer feedback. Altering a deeply embedded institutional habit like this can be facilitated by utilizing a golden rule of habit change approach (Duhigg, 2012). By substituting the routine for innovation with a founder's mentality (Zook & Allen, 2016), two things may happen: chief programmers may seek more innovative, next generation challenges, and chief programmers may be more deliberate in planning with backup programmers and programming secretaries. This scenario may thus open the opportunity for leaders to develop their organization differently.

- Talent development – May require the chief programmer to become the group innovation trainer. Learning models, methods, and techniques can be used to focus the chief programmer in directing internal activities for new innovation. A train-the-trainer model may allow organizations to grow their innovation capabilities (Crossan & Apaydin, 2010) by leaders providing staff exactly what they need: an environment to develop deliberate practice (Ericsson et al., 1993). A deliberate practice method argues that the acquisition of skill requires specific action directed at targeted activities. Chief programmers thinking about the next evolution in innovation may begin providing their backup programmers new assignments by which deliberately cultivated skills may invariably lead to innovation.
- Additional learning and development models may be oriented to better align with deliberate practice – Leaders seeking to develop new employee skills into deliberate performance may rely on chief programmers to identify topics and criteria for training, but face the issue of creating lasting habits. Geoffery Colvin (2008) stated that organizations must committ to transforming great talents in order to realize lasting, world-class performance. By considering the cultures of innovation at MSC Software, employee development plans that focus on fostering the values may have a lasting impact in the organization's ability to multiple, evolve, and grow.

Author's Observations

During each of the interviews, respondents demonstrated a clear intent when responding to each of the questions asked. This was not to say there was not pause or hesitation before answering, but rather that there was a clear belief underlying each of their responses. Again, respondents did not claim their response was textbook, but that it represented what they each believed to be valid and proven in their work. Such acknowledgment was interesting and led to the conceptualization that each of the respondents believed they had little to no choice in their approach to generating innovation.

It was obvious that describing this sentiment as an imperative was accurate, but it also revealed that innovation imperative had precise contexts. The pretext to innovation seemed to be a commonly mixed behavior of discipline, rigor, and drive. Many of the respondents obtained Ph.Ds and or have the shared lived experience of working in complimentary computational industries to those Ph.D. disciplines. While the discussion regarding motivation was not touched upon, the varying levels of fanaticism may correlate to the competitiveness of the respondents. No participant made mention of competition with any persons in particular, yet some indicated their resolve to achieving more than competitors. An argument may be made that these individuals, who happen to also have the most acclaim for their respective products and or services, may be the role models for expert practice in their fields.

The other contextual consideration for innovation imperative was the risk tolerance each respondent had to innovation. This was a bit interesting in that risk revealed itself as subtext in responses. There was noticeable restraint when respondents described scenarios or examples of innovation. Rather than describing their innovations as broad blue ocean strategies, respondents discussed innovations in more measured tones. Perhaps the background of the respondents contributed more than anticipated. However, it may certainly just as well account for the shared lived experiences prior to involvement at MSC Software.

While the key findings were somehow derived from observations during interviews, the "A-ha moment" came about very differently. The realization to connect how MSC Software orients teams to elicit innovation to IBM's chief programmer model came to me while standing in the lobby of MSC Software. A poster in the lobby shows a graphic of the ten original software companies in history. In the graphic, IBM and MSC Software were listed together. Staring at this for a while, a story that was told to me by my father, an old Silicon Valley executive, provided a spark that would serve as an inspiration to make a more solid connection.

The story told to me referenced a time my father and his team were working on a “never before done” information technology (IT) project. The project was of course resource

constrained and the vision for a solution was murky at best. However, given these challenges, this team was able to deliver a solution that was unheard of at the time. In this story, the team was comprised of one chief, my father, and several backup programmers as well as a programming secretary. My father would refer to this team orientation as a critical reason for their success because it allowed the technical leader to design, prototype, and validate faster than he could do otherwise. In other words, the principal innovator, my father, was allowed to test vague concepts in real-time and could iterate what worked and what didn't work. Immediately after that, I set out to research if there was any literature referencing this type of model by IBM. Sure enough, the exact terminology used by my father was the chief programmer model Baker wrote about in 1972. This was the moment of clarity, but the question remained if this model could apply to MSC Software.

Remembering this anecdote triggered similar stories that implicitly referred to the same type of team formation described at MSC Software. During interviews, respondents would refer to a hands-on approach to leading innovation. Perhaps it is unusual for senior and executive leaders to be so hands-on, but through the interviews, it became clear that this is a norm at MSC Software. As it happens, these leaders recruited top lieutenants to help develop these innovations and assign logistics support to other team members. Recalling the interviews and reviewing the notes, it seemed apparent that this was the "A-ha moment" where explaining how innovations at MSC Software rely on an organizational team structure that mirrors the chief programmer model.

Innovators, especially chief programmers, may face challenges from within as time goes on. In their pursuit of excellence, the level of effort required to continually innovate by all members of the organization can be immense. Specifically, the issue with effort may have less to do with focus and more to do with purpose. In other words, the vision may become obscure, or the mission may change and cause internal conflict by way of cognitive dissonance or

fatigue. At some point, when talent is not enough to overcome possible inertia, there is a crisis of confidence that may set in. Progress may become stunted.

The progress principle, as described by Teresa M. Amabile and Steven J. Kramer (2011), describes how the need for progress is built into the conditions and habits related to activities within an organization. Innovators, who have yet to uncover their own discoveries, may fall out of the progress loop. The progress loop provides recurring feedback of progress made and creates momentum for demonstrating progress (Amabile & Kramer, 2011). However, when the progress loop is broken, the innovator may look around and feel that there are other discoveries he or she could be contributing to, instead. This "self-authoring" mindset (Kegan & Lahey, 2009) may contribute to a failure to complete the innovation mission.

Losing key contributors is a major issue and one not well discussed in the findings of this study. Individuals must recognize the tipping point within themselves. A crisis of confidence may require these individuals to look inward to examine their own compass—that is, their internal directional guide, rather than a set of values in direct conflict with the work being done. This means there is a sort of morality associated with innovation, a right and wrong direction. Again, to clarify, this is not to say all innovations require a moral and ethical examination, however, in general, innovations are to be regarded as a benefit for the greater good (Wessner et al., 2012). This leads to more questions about how might organizations that promote cultures of innovation might foster a moral intelligence (Kiel & Lennick, 2005).

If, indeed, a moral tipping point within individuals is an issue, esoteric technology providers would do well to acknowledge this variable. Much like the concept of intelligence (Gardner, 1983), intellectual quotient (IQ) and emotional quotient (EQ) have been referenced as part of the fabric of MSC Software. Future studies may include the moral component of employee contributions (Kiel & Lennick, 2005) and its impact in stabilizing staff variances within esoteric technology companies. In the future, discoveries regarding moral implications within an organization may prove to be the unsung hero in fostering innovation imperatives.

Final Thoughts

The exploration of this topic has been thoroughly enlightening. I was unaware of the impact esoteric technology firms may have, nor of the complexity these cultures represent. The literature review for this study, discussion with committee members and cohorts, and the feedback from interviewees have put into perspective the challenges that lie ahead. Certainly more studies can, and should be, done on this topic. The notion of eliciting more esoteric technologies to embolden society to dream and think big is exciting. Perhaps now more than ever, the challenge to making the work done at esoteric technology firms like MSC Software relevant to society like it was during the 1960's American Space Race is to make the vision and mission "stick" (Heath & Heath, 2007). It would be most fitting for the leaders of esoteric technology firms to partner with leaders in other industries to help shape a future that is worthy of the efforts these men and women dedicate their focus, passion, and often their lives to.. The work done here is but a contribution to the ongoing efforts of cultures of innovation for esoteric technologies. So to synthesize this experience, I propose that a model to support the on-going endeavors within cultures of innovation within an esoteric technology provider like MSC Software may consist of the following operations: Plan, Proposal, Process, Procedure, and Protocol (see Figure 43). In other words, this is a 6 P model that can be used for replicating the innovation cycle for chief programmers and their teams. Each operation is connected to each of the five remaining operations (see Figure 44). At each stage, transmission between any two operators may initiate an iteration to refine the operation or check for quality.

Plan – The ideation phase within an organization that can emanate from a single individual to a group or team. Employees are encouraged to “think big,” and whittle down to the bare essentials of a concept. A plan acts as an aspirational goal by which simplified models can be developed and prototyped.

Proposal – Once a plan has been shaped, the messaging of the idea requires that the plan to be packaged into a digestible, customer-oriented call-to-action. The proposal is more

than a call-to-action. It also allows innovators to solicit the appropriate stakeholders' buy-in, both in resource and support.

Process – Workflows that define the critical path and outline possible integrations to other organizational processes create the guidelines for team members to follow. Workflows provide the possible integration for organizational processes and connection to other resources, such as disparate technologies. Workflows can become part of the organization through iterative adaptations and generally more acceptable practice.

Procedure – The creation of discrete, definable steps allows the process to be replicated. Procedures can assist in defining team orientation and assigning roles and responsibilities to key processes. Such activities may be subject to consideration of the culture and dynamics of team members.

Project – Identifying and managing time-bound activities provides a platform for innovations to come to life. Cultures of innovation may rely on putting conditions on development commitments in efforts to further enforce need (i.e., innovation imperative) rather than desire.

Protocol – Different from procedure, which is intended to be linear and goal-oriented, protocol describes situations rather than interprets processes. For cultures of innovation, adapting to the challenges of innovating can be difficult. Protocols can be defined to help team members orient their behaviors towards the direction of the intended goal. These behavior guardrails, as they may better be described, may facilitate the needed support by promoting cultures of innovation based on these findings.

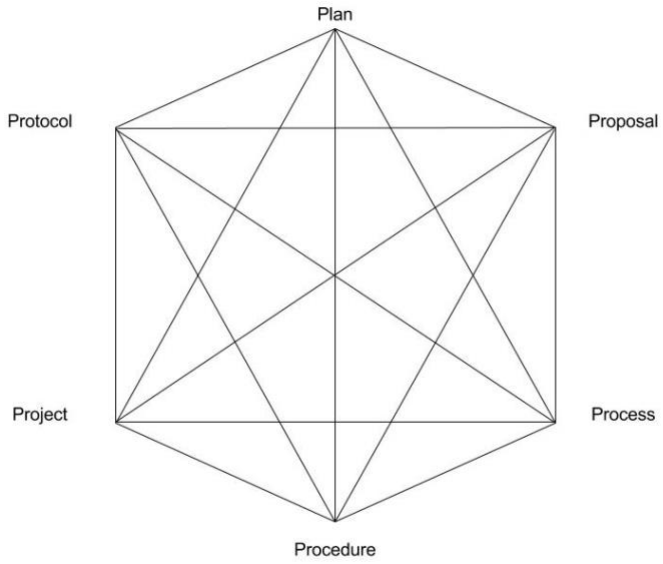

Figure 40. Depiction of MSC Software's interpretation of how the chief programmer model is oriented to promote cultures of innovation. In this model, each P represents a different stage in an abstract operational conduct model. Plan, Proposal, Process, Procedure, Project, and Procedure represent distinct activities in supporting cultures of innovation.

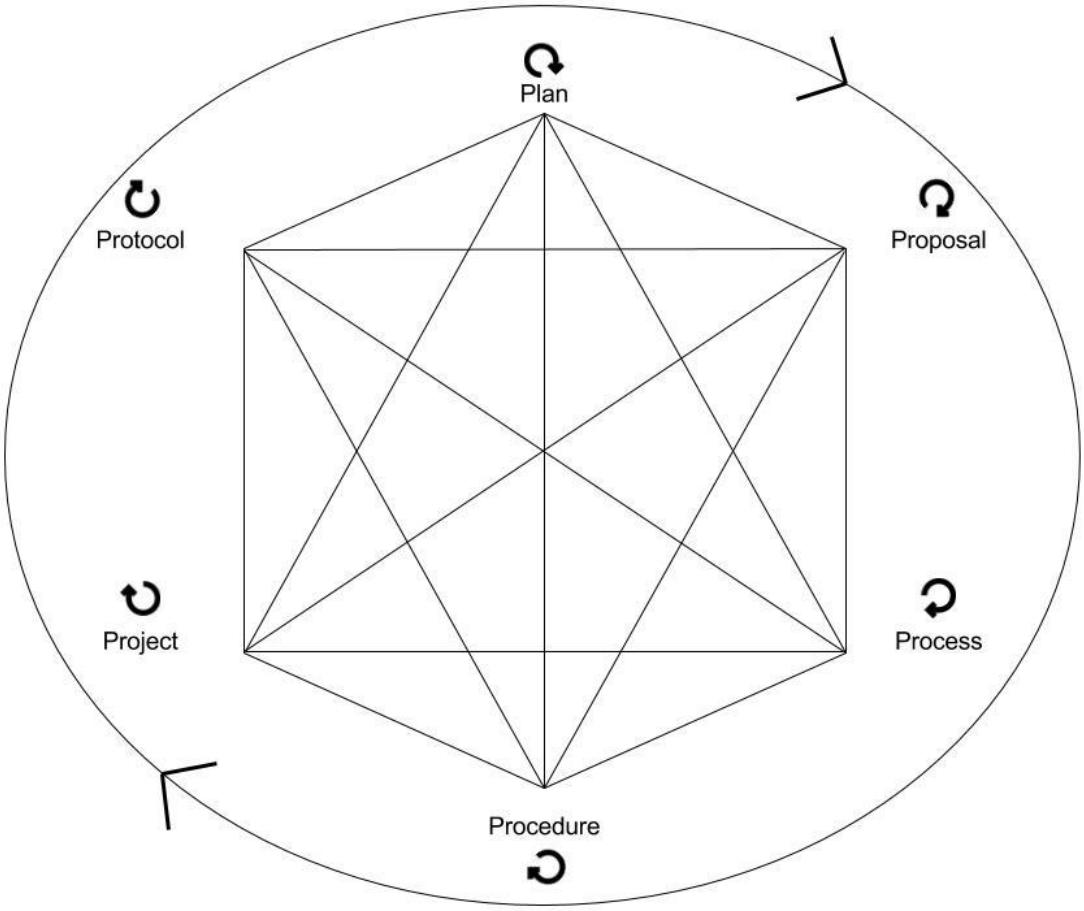

Figure 41. 6 P model for supporting cultures of innovation in motion. Starting with Plan and working in a clockwise direction, the connected points represent corresponding networks directly related to other stages. Figure 44 highlights the iterative nature of the model should the need be to quickly revise some part of the stage to better meet the needs of the team.

Examining the findings in a systems thinking manner (Senge, 1990) brings into focus the idea of how an organization, like MSC Software, might codify the lessons learned from this study. The application of the chief programmer model provides a structural framework (Bolman & Deal, 2013) of operation, while the three imperatives issue the considerations for which the Human Resources framework (Bolman & Deal, 2013) may operate within an esoteric technology provider. However, in dealing with esoteric innovations, the ability to deliver something totally new itself represents an inherent symbolic framework (Bolman & Deal, 2013) that may connect cultures of innovation together.

While respondents referenced each “P” (Plan, Proposal, Process, Procedure, Project, and Protocol) as an independent ritual related to the practice of innovation, each activity became a story about innovating. The position and the orientation of the model is based on what interviewees referred to "common sense" at MSC Software. In other words, a specific progression through the model, while possible as a linear path, represents a less critical order of operation. The important fact is that the nodes are connected, and integrations occur to generate activity. These stories represent a transfer of knowledge regarding how innovations occur at MSC Software as well as a cipher-like key into the cultures of esoteric innovations.

Further research into these operators may yet prove these elements to provide a useful method for helping esoteric technology innovators orient activities within their teams. Again, to be clear, this model is not a business strategy model or an organizational change model. However, it does suggest behaviors for outcomes within this type of culture of innovation. Assessing this model’s success in supporting cultures of innovation in private equity backed firms, like MSC Software, might then be done according to the valuation at the time of events such as change-in-control. Valuation may provide the evidence to disprove the notion that esoteric technology providers are bad investments (Schilit, 1997).

Moreover, the inclusion of innovation improvement plans to aid chief programmers in accelerating the development of staff may have several implications. Broad thinking about current and future resources could change if chief programmers began investing in people earlier in the development cycle. Training activities might be more directly applied to innovation processes like fostering creativity (Sternberg, 1999) and orienting organizations toward creativity (Hill et al., 2014), and taking advantage of the impact of networks to reinforce the culture strategy (Aviv et al., 2003). Cultures of innovation may thus benefit from further investigation into how ladders of inference can impede (or facilitate) the staff’s ability to deliver new products or services (Argyris & Schon, 1974). Future research done on removing barriers to organizational operations may yield increased delivery of value creation. The staff must

believe anything to be possible (Cooper, 2001). So perhaps as a final comment it may be fitting to highlight how future studies can encourage leaders to devise more strategies directed to supporting cultures of innovation. Many of the core competencies that MSC Software brings to market by way of innovations have been through engineering methods. Engineering methods can provide a more standard approach, or generalizability, to solving particularly difficult engineering problems (Sinha et al., 2001). Perhaps future research might then involve "talent methods" by which leaders can utilize generalizable approaches to supporting cultures of innovation. Unlocking the talent within an organization can be elusive (Edvinsson & Malone, 1997). Talent methods, of course, would vary depending on environmental conditions, influencers, and organizational orientation at multiple levels of scope; but these methods could provide a pathway for even further studies into the execution and deployment as measurable performance indicators for an organization. Moreover, the notion of talent methods can be a platform for generative development of similar research involving innovation and cultures of an organization. In other words, by coupling talent methods to determine the right pathway for supporting innovation with organizational design methods and frameworks to drive performance, leaders may be able to design (Brown & Katz, 2009) new modi operandi for the organization. This could even provide specific context of to learning organizations (Senge, 1990) for cultures of innovation. The prospect for future developments may indeed be bright, and is certainly an exciting area of focus for this researcher moving forward.

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APPENDIX A

Site Consent

Site Permission Letter

[PRINTED ON RESEARCH SITE'S LETTERHEAD]

[DATE]

Pepperdine University
Graduate and Professional Schools Institutional Review Board (GPS IRB)
6100 Center Drive – 5th Floor
Los Angeles, CA 90045

RE: Farzin Madjidi, Ed.D., Chairperson
Aaron Young, EDOL student
AN EXAMINATION OF CULTURES OF INNOVATION WITHIN ESOTERIC TECHNOLOGY PROVIDER - A LOOK INTO COMPUTER-AIDED ENGINEERING (CAE)

To GPSIRB:

This letter is to convey that I/we have reviewed the proposed research study being conducted by Farzin Madjidi and Aaron Young intended to conduct qualitative phone interviews with leaders of MSC Software at MSC Software and find AN EXAMINATION OF CULTURES OF INNOVATION WITHIN ESOTERIC TECHNOLOGY PROVIDER - A LOOK INTO COMPUTER-AIDED ENGINEERING (CAE) acceptable. I/we give permission for the above investigators to conduct research at this site. If you have any questions regarding site permission, please contact: 310 258 2828 for Farzin Majidi or 714-270-1676 for Aaron Young

Sincerely,

[INSERT AUTHORIZED AGENT'S NAME (E.G., SCHOOL PRINCIPAL, DIRECTOR, ETC.]
[INSERT TITLE]

APPENDIX B

Recruitment Script Template

Sample Written Recruitment Script Template

Dear [Name],

My name is Aaron Young, and I am an Organizational Leadership doctoral student in the Graduate School of Education and Psychology at Pepperdine University. I am conducting a research study examining cultures of innovation in a computer-aided engineering (CAE) firm, and you are invited to participate in the study. If you agree, you are invited to participate in examining best practices in the areas of leadership that may contribute to the formation and sustain of a culture of innovation. The interview is anticipated to take no more than 60 minutes.

Participation in this study is voluntary. Your identity as a participant will remain confidential during and after the study. Confidentiality will be maintained by using pseudonyms and removing potential identifiers during the interview.
If you have questions or would like to participate, please contact me at XXX@XXXX.XXX.
Thank you for your participation,

Aaron Young
Pepperdine University
Graduate School of Education and Psychology (GSEP)
Doctoral Student in Organizational Leadership

APPENDIX C

Informed Consent Letter

PEPPERDINE UNIVERSITY

INFORMED CONSENT FOR PARTICIPATION IN RESEARCH ACTIVITIES

AN EXAMINATION OF A CULTURES OF INNOVATION WITHIN ESOTERIC TECHNOLOGY PROVIDER - A LOOK INTO COMPUTER-AIDED ENGINEERING (CAE)

You are invited to participate in a research study conducted by (Aaron Young, EDOL student, and dissertation chairperson, Farzin Madjidi, Ed.D. at Pepperdine University, because you are in a leadership position at a computer-aided engineering (CAE) firm. Your participation is voluntary. You should read the information below and ask questions about anything that you do not understand, before deciding whether to participate. Please take as much time as you need to read the consent form. You may also decide to discuss participation with your family or friends. If you decide to participate, you will be asked to sign this form. You will also be given a copy of this form for your records.

PURPOSE OF THE STUDY

The purpose of the study is to understand how cultures of innovation might exist. The study will attempt to develop a cogent representation of a culture of innovation that exists to address gaps in research involving esoteric technologies. By replicating the findings, organizations will be able to initiate better and support the innovative development of goods and services. A general acknowledgment of the validity of this model will provide practitioners authority in this domain. Furthermore, the findings from this study may become the benchmark for future studies involving cultures of innovation and esoteric technologies. Also, discuss how and by whom will your results be used; e.g., consulting, preventing unforeseen mistakes, training, to modify curricula in colleges, etc.

STUDY PROCEDURES

If you volunteer to participate in this study, you will be asked to answer open-ended questions involving generating innovations and cultivating the right conditions to support these innovations. Interviews will be conducted over the phone and be recorded for transcription after the interview. Should the participant not want to be recorded, the researcher will take notes

using a Word document and notepad. Upon completion of the interview, unless needed for follow-up, no further contact will be made regarding this study with participants until the findings have been released.

POTENTIAL RISKS AND DISCOMFORTS

The potential and foreseeable risks associated with participation in this study include privacy and accommodation of time. Information collected through the interviews will not appear or be distributed in the organization. Non-disclosure forms will be provided to subjects in order to assure they will not share their interview results with other subjects, i.e., colleagues. Furthermore, considerations may include, but not limited to, time for interviews not impeding or conflicting with work schedules, respect for culture norms and procedures, and proper disclosure of the intent and process of the study.

POTENTIAL BENEFITS TO PARTICIPANTS AND/OR TO SOCIETY

While there are no direct benefits to the study participants, there are several anticipated benefits to society, which include: addition to the current literature on innovation and leadership, insights into organizational performance, and anticipated growth in esoteric technology providers in various areas of knowledge.

CONFIDENTIALITY

The records collected for this study will be *confidential* as far as permitted by law. However, if required to do so by law, it may be necessary to disclose information collected about you. Examples of the types of issues that would require me to break confidentiality are if disclosed any instances of child abuse and elder abuse. Pepperdine's University's Human Subjects Protection Program (HSPP) may also access the data collected. The HSPP occasionally reviews and monitors research studies to protect the rights and welfare of research subjects.

The data will be stored on a password-protected computer in the principal investigator's place of (*residence, office, etc…)*. The data will be stored for a minimum of three years. The data collected will be coded, de-identified, identifiable, transcribed. Etc.

EXAMPLES:

Example: There will be no identifiable information obtained in connection with this study. Your name, address or other identifiable information will not be collected.

Example: Any identifiable information obtained in connection with this study will remain confidential. Your responses will be coded with a pseudonym and transcript data will be maintained separately. The audio-tapes will be destroyed once they have been transcribed.

Example: The data will be stored on a password-protected computer in the researcher's office for three years after the study has been completed and then destroyed.

PARTICIPATION AND WITHDRAWAL

Your participation is voluntary. Your refusal to participate will involve no penalty or loss of benefits to which you are otherwise entitled. You may withdraw your consent at any time and discontinue participation without penalty. You are not waiving any legal claims, rights or remedies because of your participation in this research study.

ALTERNATIVES TO FULL PARTICIPATION

The alternative to participation in the study is not participating or only completing the items for which you feel comfortable.

EXAMPLES:

Example: Your alternative is to not participate. Your relationship with your employer will not be affected whether you participate or not in this study.

INVESTIGATOR'S CONTACT INFORMATION

You understand that the investigator is willing to answer any inquiries you may have concerning the research herein described. You understand that you may contact *Aaron Young, EDOL student, and dissertation chairperson, Farzin Madjidi, Ed.D.* if you have any other questions or concerns about this research.

RIGHTS OF RESEARCH PARTICIPANT – IRB CONTACT INFORMATION

If you have questions, concerns or complaints about your rights as a research participant or research in general, please contact Dr. Judy Ho, Chairperson of the Graduate & Professional Schools Institutional Review Board at Pepperdine University 6100 Center Drive Suite 500 Los Angeles, CA 90045, XXX-XXX-XXXX or XXXX@XXXXX.XXX.

APPENDIX D

Peer Review Validity Form

Dear reviewer:

Thank you for agreeing to participate in my research study. The table below is designed to ensure that may research questions for the study are properly addressed with corresponding interview questions.

In the table below, please review each research question and the corresponding interview questions. For each interview, consider how well the interview question addresses the research question. If the interview question is directly relevant to the research question, please mark "Keep as stated." If the interview question is irrelevant to the research question, please mark "Delete it." Finally, if the interview question can be modified to best fir with the research question, please suggest your modifications in the space provided. You may also recommend additional interview questions you deem necessary.

Once you have completed your analysis, please return the completed form to me via email to _____. Thank you again for your participation.

Research Question	Corresponding Interview Question
RQ1: What common strategies and practices do _<Participants> to address <Intervention>?	1. What planning process did you engage in? a. The question is directly relevant to Research question - Keep as stated b. The question is irrelevant to research question – Delete it c. The question should be modified as suggested: _____ _____ I recommend adding the following interview questions: _____ _____ _____ 2. How did you get various constituencies involved in the planning process? The question is directly relevant to Research question - Keep as stated

(continued)

(continued)

Research Question	Corresponding Interview Question
	3. How did you get various constituencies involved in the planning process? a. The question is directly relevant to Research question - Keep as stated b. The question is irrelevant to research question – Delete it c. The question should be modified as suggested: _____ _____ I recommend adding the following interview questions: _____ _____ _____ 3. What other strategies did you use? a. The question is directly relevant to Research question - Keep as stated b. The question is irrelevant to research question – Delete it c. The question should be modified as suggested: _____ _____ I recommend adding the following interview questions: _____ _____ _____ _____ _____ 4. How did you overcome resistance or opposition to your plan?

(continued)

(continued)

Research Question	Corresponding Interview Question
What challenges do _<Participants>_ face in implementing _<Intervention>_?	1. What challenges did you face in the planning phase of the implementation? 2. Did anything go wrong you had not planned for? 3. <<follow ups>>
How do _<Participants>_ measure the success of _<Intervention>_?	1. How did you define success for this intervention? 2. What final outcome were you willing to settle for? 3. How did you measure and track your success? 4. <<Follow up>>
What recommendations would _<Participants>_	1. If you could start over, what would you do differently? 2. What would you like to have known before you started the intervention?

APPENDIX E

IRB Approval Notice

PEPPERDINE

Pepperdine University
24255 Pacific Coast Highway
Malibu, CA 90263
TEL: 310-506-4000

NOTICE OF APPROVAL FOR HUMAN RESEARCH

Date: December 23, 2016

Protocol Investigator Name: Aaron Young

Protocol #: 16-09-397

Project Title: AN EXAMINATION OF CULTURES OF INNOVATION WITHIN ESOTERIC TECHNOLOGY PROVIDER - A LOOK INTO COMPUTER-AIDED ENGINEERING (CAE)

School: Graduate School of Education and Psychology

Dear Aaron Young:

Thank you for submitting your application for exempt review to Pepperdine University's Institutional Review Board (IRB). We appreciate the work you have done on your proposal. The IRB has reviewed your submitted IRB application and all ancillary materials. Upon review, the IRB has determined that the above entitled project meets the requirements for exemption under the federal regulations 45 CFR 46.101 that govern the protections of human subjects.

Your research must be conducted according to the proposal that was submitted to the IRB. If changes to the approved protocol occur, a revised protocol must be reviewed and approved by the IRB before implementation. For any proposed changes in your research protocol, please submit an amendment to the IRB. Since your study falls under exemption, there is no requirement for continuing IRB review of your project. Please be aware that changes to your protocol may prevent the research from qualifying for exemption from 45 CFR 46.101 and require submission of a new IRB application or other materials to the IRB.

A goal of the IRB is to prevent negative occurrences during any research study. However, despite the best intent, unforeseen circumstances or events may arise during the research. If an unexpected situation or adverse event happens during your investigation, please notify the IRB as soon as possible. We will ask for a complete written explanation of the event and your written response. Other actions also may be required depending on the nature of the event. Details regarding the timeframe in which adverse events must be reported to the IRB and documenting the adverse event can be found in the *Pepperdine University Protection of Human Participants in Research: Policies and Procedures Manual* at community.pepperdine.edu/irb.

Please refer to the protocol number denoted above in all communication or correspondence related to your application and this approval. Should you have additional questions or require clarification of the contents of this letter, please contact the IRB Office. On behalf of the IRB, I wish you success in this scholarly pursuit.

Sincerely,

Judy Ho, Ph.D., IRB Chair