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Success In Technology Organizations

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SUCCESS IN TECHNOLOGY ORGANIZATIONS

by

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ABSTRACT

In today's economic environment, it is advantageous for technology organizations to be cognizant of prevalent influences on success and failure and to incorporate this knowledge into their business and innovation strategies. Technology organizations were defined within this research as those in the business of created competence which is expressed in terms of entities consisting of devices, procedures, and acquired human skills (Clarke, 2005). Although, no organization contains the ideal mix of culture and ideological emphases, some have amassed impressive track records of great success.

A literature review was used to identify factors relevant within similar contexts such as influences on creativity, innovation, Research and Development (R&D), etcetera. The salient factors identified within the literature review were hypothesized as being very important to great success within technology organizations. A conceptual model was created that visually illustrated the interactions of those factors and their influence on technology organization success which was defined as average annual revenue growth and direct new job creation.

An internet questionnaire was utilized to test the hypotheses among 15 very successful technology organizations according to their respective Chief Technology Officers (CTOs) or equivalents. These companies were randomly chosen from a population of the technology organizations included in Inc. Magazine's Inc. 5000, a list of the 5000 fastest growing companies in America. The questionnaire primarily consisted of Likert questions designed to test the hypotheses. The dependent variable in the statistical analyses, technology organization success,

was ranked according to average annual revenue growth and direct new job creation relative to the other organizations within the sample set.

The top category in typical questionnaire Likert questions included the adjective “very” that was interpreted to imply that the particular factor was exactly or precisely essential to affect that level of success, this in the collective opinion of the CTOs. Not meeting the threshold of exactly or precisely was interpreted that the factor may not be essential to that level of success.

Rejection of the respective null hypotheses and subsequent acceptance of the alternative hypotheses were interpreted as evidence that particular factors were essential to great levels of technology organization success. And, the conceptual model was updated accordingly. Acceptance of null hypotheses demonstrated that the factors may not be essential; therefore, they were excluded from further discussion and the model. Seventeen key factors and/or categories were identified according to the Chief Technology Officers within the population of very successful technology organizations as having substantial influence on the success of those organizations. Recommendations were made to technology organizations aspiring towards prolific levels of success.

As a check, three open-ended questions were included and used to verify that no consensus crucial elements were omitted within the Likert question section of the questionnaire. There were no consensus factors identified within those open-ended questions.

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LIST OF ABBREVIATIONS

CVF	Competing Values Framework
IRB	Institutional Review Board
IT	Information Technology
NPD	New Product Development
OAI	Organization Assessment Instrument
RDS	Respondent Driven Sampling
R&D	Research and Development
ROR	Real Options Reasoning
UCF	University of Central Florida
WES	Work Environment Scale

CHAPTER 1 INTRODUCTION

1.1 Background Discussion

Many high tech organizations compete with other organizations, so it is in their interest to figure out how to can propel themselves ahead of the competition, even to the extent of leading a technological revolution. There are differing motivations for this, and they can come in the forms of the quest for market dominance, extended life expectancy and higher quality of life via better health care diagnosis and treatment equipment, the prestige of being recognized as the premier technological research organization, or, in the case of governments, the need to attain military dominance for the purpose of security. Is there a way that they can, consistently, be at the forefront of new product designs? They are not interested in creating new designs for the sake of creating new designs, or for the sake of exercising their engineering 'muscle'. Rather, these organizations often have a mission to help individuals, organizations, or governments achieve their full potential. Creating products that are at the edge of the limit of how far we can take technology towards solving a problem can go a long way towards achieving their mission.

It is not for an organization to create a single product, take its collective breath, sit back and admire the work that it did, wait for others to catch up, and watch them do so. Rather, there are organizations that utilize forward-thinking, create and maintain a culture that is conducive to excelling and leading in new engineering designs, testing, and production of revolutionary products. They, then, build on that momentum and sense of accomplishment, reevaluate the new or most current economic or business environment, or governmental posture, and move on with the goal of remaining at the forefront of leveraging more solutions from even more advanced technologies. A modern day example of this is Google, as described in Section 2.11.1.

1.2 Makeup of Technology

Technology is created competence. It is expressed in technological entities consisting of devices, procedures, and acquired human skills; there are four ideas about this definition that are important (Clarke, 2005):

- *Created* describes the artificial nature of technology. It is created and does not spontaneously occur in nature.
- *Competence* emphasizes that technology is concerned with the ways and means for taking actions. Technology is not concerned with the final ends of doing so.
- *Technological entity* can be described as a repository of competencies.
- *Devices, procedures, and acquired human skills* reflect the constituent elements of a technological entity. Within this category, the implied hardware and software components are quite easily imagined. However, the term *skill* needs a clarification. Within the confines of technology, certain types of human skills are included, humans are not. Humans are not technological entities, and are not part of the definition of technology.

Or, as another author defines it: technology denotes the broad area of purposeful application of the contents of the physical, life, and behavioral sciences. It comprises the entire notion of technics as well as the medical, agricultural, management and other fields with their total hardware and software contents (Jantsch, 1967).

High tech vs. low tech – high tech refers to any technology requiring the most sophisticated scientific equipment and advanced engineering techniques, as microelectronics, data processing, genetic engineering, or telecommunications (Collins English Dictionary).

Technological is a subjective term that is used to qualify operations, activities, situation, or phenomena that involve technology to a significant extent.

Technology Forecasting contains two components: (1) "exploratory forecasting" which is the attempt to predict the technological state-of-the-art that will or might be in the future or a prediction with a level of confidence of a technical achievement in a given time frame with a specified level of support; and (2) "normative forecasting" which includes the organized attempts to allocate on a rational basis the money, manpower, and other resources that might affect the creation of tomorrow's technological state-of-the-art (Roberts, 1969).

Technology Mapping is the process that an agency, region or government adopts to determine the technology assets that are relevant to future businesses (GDP12).

1.3 Definition of Success within the Context of Technology

Success is a term that is abstract, and as such, cannot be defined absolutely. According to the Merriam-Webster dictionary, success is a favorable or desired outcome; also: the attainment of wealth, favor, or eminence. Within the literature review chapter of this document, a discussion exists of various factors, by which one could arguably use to define success within the context of technology organizations. Then the Methodology section, Chapter

3, develops a scientific, quantitative approach towards declaration of “success”, as it relates to a technology organization.

Until such time as this ideal is developed, more thoroughly in Chapter 3, the reader should know that the term “success”, within the context of this study of technology organizations, encapsulates the following components:

1. Revenue growth
2. New job creation

As will be shown later, a success ranking metric is calculated in order to better assess each factor’s impact on individual organizational success.

1.4 Research Intent

This research will investigate engineering management methodologies that create organizational environments which, not only foster creativeness and success within technological organizations, but also have a track record to show it. It will seek to identify examples of consistent and repeated success in technology, and explore the common threads linking their respective organizational postures, if you will, and success. The knowledge of the components needed within an organizational culture to promote this revolutionary, forward thinking approach is of supreme interest to everyone, from the astute engineering team leader to the CEO of the organization, itself.

At the other end of the spectrum, i.e. the non-technical world, there has been much work and research done in the area of organizational culture and its impact on business, business practices, and business management. The intent of this research is to, not only, link successful technology management practices and ideologies to organizational success, but also to ascertain the links between the most common impediments to those same successes.

We will seek to identify, quantify, document, and explain the underlying organizational cultures that have resulted in the most prolific and most frequent of success in technology development. This will be done, by, first, defining success within these organizations, and establishing some metric(s) to measure the same. Then, we will postulate a set of contributing factors and environments ranked according to their believed relevance and importance. Then, the establishment of those factors and their ranking will come from empirical research of industry.

1.5 Research Premise

The basis for this research is the belief that there are certain styles of management that have a propensity to stifle creativeness and innovation, and, on the opposite end of the spectrum, are those styles that foster creativeness and engineering success. Indeed, the sustained superior performance of many firms is believed to be linked, at least partly, to their organizational cultures; in fact, a firm's culture can be a source of sustainable competitive advantage if that culture is valuable, rare, and imperfectly imitable (Ocasio, 1986). It is not just the knowledge of the factors needed to succeed that are of interest, but also the knowledge of those items that would suppress the percolating upwards of ideas from the minds "in the trenches" of the design work.

When we look at the high-tech industry, there are a specific set of challenges that arise, and that need to be overcome in order to maximize an organization's success rate. For example, in an industry where the ultimate metric of success is quantified by the number of units produced, it may be in the organizations' best interest to focus on things that would help promote productivity, such as the timing and frequency of breaks, whereas a technologically focused organization may wish to focus on creating environments which stimulate thought processes that may be regarded in other circles as unreasonable, ridiculous, or unattainable.

It is the blanket case that for-profit companies strive for success. Generally speaking, most companies strive to maximize the financial returns of investments and capital for greater profits. Whether expressly documented or not, it is reasonable to assume that every firm, in existence, has a common goal of excelling. At this most basic level, the goals and motivators of many high tech firms mirror those of industry, in general, in that they both seek to leverage their own particular assets in such a way as to produce the maximum benefit to the company and its owners/shareholders.

1.6 Impetus

Technological and business process innovations have accounted for 45% of productivity gains between 1987 and 2007 (Mandel, 2008). This despite the fact that employment in most technologically advanced industries has stagnated or even fallen in recent years. Between the years 2003 and 2008, the industry category that includes Google has only added 15,000 jobs. Furthermore, (Mandel, 2008) found that there is a new field of innovation economics concerned with studying how companies can maximize return from expenditures on Research and Development and higher education. Indeed, approximately one out of three thousand raw ideas reach substantial commercial success across most industries (Stevens, et al., 1997).

Some technology organizations have shown repeated dominance in the areas of success. This poses certain questions. What is the environment in which their key personnel worked? Is it due to their, respective, Human Relations' departments work in recruiting brilliant individuals, or is credit more, aptly, given to the organizational stance? If it is that the organization's stance is the stimulus, what are the contributing factors? Is it creativeness, autonomy, a system of rewards/recognition, compensation, or some other factor(s)?

To borrow the common colloquialism, "it doesn't take a rocket scientist to know" that successful engineering practices must strike a delicate balance between multiple competing interests. In fact, some researchers have diagrammed some of the key competing interests for a good design, as referenced in Figure 1.

Figure 1 - Competing Design Interests (Petersen, et al., 2011)

1.7 Assumptions

Assumptions for this research are:

- Factors influencing technological success in the U.S.A. are very likely different from those influencing the same in other countries
    - Applicability of this research is limited to U.S. organizations and firms
- Key high tech employees such as engineers, scientists, and, to some degree, technicians are intellectual beings that are influenced and respond to certain stimuli
- Influences on technology and its advancement are, often, competing
- Influences can be reasonably grouped under two main categories:
    - Organizational: ideological, cultural, and posture
        - Ideological influences are the core belief system established by leadership within an organization
        - Cultural factors are the establishment of the "norm" or modus operandi within the organization
        - Organizational posture is the organization's stance toward future engineering endeavors
    - Individual: internal, external, and the engineers themselves
        - Internal factors are those that stem from influences from within the workplace, such as co-workers
        - External influences are those that come from acquaintances outside the work place, such as friends and relatives
        - Influences on the engineers, themselves, are things such as individual motivation to see a project succeed, education, and goals

- There may not be a unique answers to the research questions
- No one organization maintains the ideal balance of factors
- Engineering is the branch of an organization that is charged with applying science for the design, development, or improvement of products, services, or processes

1.8 Limitations

1.8.1 Domain Limitations

Often it is difficult to ascertain the distinctions between ideals and concepts. Every effort has been made within this document to retain categorization of ideals and concepts; however, sometimes the ideals are so, invariably, linked that one section may indeed traverse into another section's formal area. For example, in the Organizational Strategy section of the literature review is a discussion of strategies as it applies to research and development, despite the fact that there is a Research and Development section. The reason is that the strategies discussed in this context were overarching into multiple domains.

1.8.2 Organizational Limitations

This research has no interest in any particular organization. It is critical to remember that in the investigation and analysis of the organizations; they, themselves, are not the subject. Rather, we're examining various organizations as the 'laboratory', of sorts, of proving out the propensity of success or failure of various organizational ideologies as it relates to success in engineering.

1.8.3 Metrics Limitations

Success, arguably, the most prevalent factor/metric for most organizations and organizational decisions, can be measured by any number of metrics. Organizational success comes in various forms and its associated metrics quantified, accordingly. Furthermore, success is in the eye of the beholder. So, for example, the manager of an organization would, likely, view net profit from a particular product as the primary metric of success, whereas, the design engineers of that particular product would, likely, measure its success by high reliability and degree of usefulness of the product to accomplish some task. It is these metrics of success that may afford some level of limitation on the research, itself, as the establishment of these metrics will be somewhat subjective and may be difficult to quantify.

1.8.4 Holistic Limitations

This research assumes that technological success or failure happens at the organizational level. There may be cases in which sub-organizational level departments enjoy success while the organization itself does not, or vice versa.

1.9 Research Question

1. What are the key factors influencing prolific success within technology organizations?
    - How can they most effectively be influenced?

1.10 Pre-Research High-Level Methodology

This research will attempt to follow a well-reasoned approach to answering the questions posed in the previous section. In establishing a simplistic guide for conducting the research, the following iterative case study research methodology will be used as outlined by Eisenhardt (1989):

1. Identify and describe the problem or research goal
2. Formulate the basic research questions
3. State known constructs
4. Create a research model
   - Select cases
   - Identify data collection methods and collect data
   - Analyze the data
     i. Overlap data collection with analysis (aids in determining needed adjustments)
5. Shape the hypotheses by iterative tabulation of evidence
6. Conclude research when iterative process yields marginal improvement
7. Summarize findings

1.11 Definitions

Absorptive Capacity is an individual's or organization's ability to recognize the value of new information, assimilate it, and utilize it to productive ends (Cohen, et al., 1990).

Case study is a research strategy which focuses on understanding the dynamics present within single settings (Eisenhardt, 1989).

Contingency Theory is a class of behavioral theory that claims that there is no best way to organization a corporation, to lead a company, or to make decision. Instead, the optimal course of action is contingent upon the internal and external situations.

Creativity is the generation of original and useful ideas concerning products, procedures and processes (Amabile, 1988; Oldham, et al., 1996).

Engineering is the creative application of scientific principles to design or develop structures, machines, apparatus, or manufacturing processes, or works utilizing them singly or in combination; or to construct or operate the same with full cognizance of their design; or to forecast their behavior under specific operating conditions; all as respects an intended function, economics of operation and safety to life and property (ECPD).

External Focus emphasizes an organization's ability to function well within its environment (Quinn, et al., 1983).

High tech or *high technology:* see Section 1.2

Innovation is 'any idea, practice, or material artifact perceived to be new by the relevant unit of adoption' (Zaltman, et al., 1973). There are differing ideas as to the various types of innovation. (Damanpour, et al., 1984) distinguish between technical innovation and administrative innovation. Technical innovation is that that pertains to the product or process, whereas administrative innovation is organizational or social in nature.

(Amabile, et al., 1996) define innovation as the successful implementation of creative ideas with an organization.

Intellectual Stimulation in the context of leadership is the result of a leader aids his followers become more innovative and creative (Bass, 1999).

Internal Focus emphasizes factors internal to the organization (Quinn, et al., 1983).

Intrinsic Motivation is feelings or emotions of competence and self determination to perform a particular task or to achieve a particular outcome (Amabile, et al., 1987; Amabile, 1988; Shalley, 1991).

Multicolinearity is a reference to the situation within a multiple regression model, in which more than one explanatory variable are highly linearly related.

Open Innovation is the use of purposive inflows and outflows of knowledge to accelerate internal innovation, and expand the markets for external use of innovation, respectively (Chesbrough, 2006)

Organizational Culture is defined as a set of beliefs, values, and assumptions that are shared by members of an organization (Schein, 1985). It is the set of underlying values that influences the behavior of the organizational members, and is the core principles that that guide their decisions and behaviors (Schein, 1985).

Organizational Motivation to Innovate is a basic orientation of the organization toward innovation, as well as supports for creativity and innovation throughout the organization (Amabile, et al., 1996).

Real Options Reasoning (ROR) is a conceptual approach to strategic investment that takes into account the value of preserving the right to make future choices under uncertain conditions (McGrath, et al., 2004).

Tailored Design is the development of survey procedures that work together to form the survey request and motivate various types of people to respond to the survey by establishing trust and increasing the perceived benefits of completing the survey while decreasing the expected costs of participation (Dillman, et al., 2008).

Technology: see Section 1.2

Triangulation is the combination of two or more data sources, methods, or investigators in one study of a single phenomenon to converge on a single construct (Krippendorff, 2004).

CHAPTER 2 LITERATURE REVIEW

2.1 Introduction

Sir Isaac Newton's famous quote can be used to describe the base intent of this literature review when he stated "If I have seen further it is only by standing on the shoulders of giants." That is to leverage the hard work of others within academia and industry to establish a foundation or spring board from which to launch the research necessary to discover the ideals, concepts, and interrelations that are believed to exist, and be so, fundamentally, essential to engineering success. In this literature review, the intent is not to "reinvent the wheel", rather it is to carefully seek out the relevant knowledge that exists, study and understand the "invention of the wheel", and then use that information as a guide in developing the hypotheses mentioned above.

2.2 Metrics of Success

The basis for this research is the establishment of metrics whereby to draw conclusions. Without this basis, this research becomes pointless.

There are many elements to identifying a potential metric for success by which to judge an organization's propensity to enjoy substantial technological successes. While reviewing various metrics of success, it is important to keep in mind several factors. Among those factors, is that there will always be a time lag between any product's conception/production and its ability to be declared a success (Balachandra, et al., 1997). Indeed, success in technology is a very challenging and difficult ideal to be able to ascertain, as it is comprised of so many different components. The following is a listing of the components that will go into the consideration of success of technology organizations.

2.2.1 Profitability

Financial success could be used to gauge success of an organization. It does, however, carry many difficulties that must be overcome. There is such a disparity between the costs of technology products. For example, if company A is selling a group of high-tech products whose average price is X amount, whereas company B is selling a category of engineering products whose average price is Y amount, how would one declare one company's sales a better success than the others? Would it be the scale of the profit margins? What if the market landscape was such that customers put a higher premium on a lower level of technological innovation or engineering product?

Additionally, after laying out the capital for technological products and/or services, those products or services may be successful by any standard, but it could be that this is not yet reflected in the financial stance/profitability considerations of the organizations. Often, after investing in technology, it can take an organization time to recoup those initial investments even if the product is a resounding success. These limitations do not bode well for using financial success as a metric of engineering success within the context of this document. However, financial success could be a very useful indicator of success when combined with other organizational attributes such as new job creation, level of technology, etc.

The consideration of financial posture of a technology organization, as a metric for success, may be problematic in some areas.

- If the particular organization is not a publicly traded company, their financial reports may not be accessible.
- Despite having successful products and practices, a technological organization's finances may not have caught up with and accurately represent that success. In other words, the organization's financial reports may show that its products are failures simply because it hasn't recouped its R&D and manufacturing development costs.

2.2.2 Annual Revenue Growth

Unlike profitability which may take years to reflect growth and success, sustained annual revenue growth is an immediate indicator of organizational success. Therefore, it will be one part of the tool used to quantify organizational success and to qualify factor impacts.

2.2.3 New Job Creation

Prolonged new job creation is something that is immediately indicative of new organizational growth. New job creation will be an important factor within this research. It will be combined with multiple other factors.

2.2.4 Patent Creation

Patent data has been used many times in research to assess attributes such as R&D knowledge (Ahuja, 2000; Henderson, et al., 1994; Silverman, 1999) and the propensity to make R&D investments by firms (McGrath, et al., 2004). Additionally, it has been used, increasingly, as an indicator of corporate technological capabilities in management research (Jaffe, 1986; Mowery, et al., 1996; Patel, et al., 1997).

The use of patent data has both positive and negative connotations associated with using it as a means of assessing technology organization status. Obviously, detailed information exists concerning every patented innovation whether it originated in the private or public sector; furthermore, the data includes a classification code that identifies the type of technology embodied in the patent (Silverman, 1999). Subsequently, patents would offer richer information regarding specific technological strengths of an organization, as opposed to R&D or other organizational expenditures. The use of patent data, however, is not without limitations. One such limitation is that there is no guarantee that an organization possessing patentable technology will act on this ability, and procure a patent (Silverman, 1999). In fact, some studies have concluded that in industries where new product development is very important, organizations don't even bother to patent their technological advances (Levin, et al., 1988).

So, in terms of findings or conclusions, one would need to consider these negatives, and try to assess the likelihood that they did or did not have a substantial impact their findings. It has been shown that other measures of technological aptitude such as peer review judgments have been shown to yield similar results to those of patent data (Narin, et al., 1987). There are those that argue that patented knowledge and non-patented knowledge are very complementary, and although patent data would not portend to directly measure an organizations' non patentable knowledge, it should serve as a rough indicator of the same (Patel, et al., 1997).

2.2.5 Perception

Individual and/or community perceptions are a very subjective metric to consider. However, perceptions are important and can be of benefit when used in conjunction with other metrics. Some technology organizations are of such stature and reputation such that few would dispute that the organization has enjoyed prolific success, even though those same individuals may not be able to back this idea up with any meaningful data. The perception that Google, Facebook, or Microsoft has been successful may not pass the scientific rigor test; however, it is enough to provide a very meaningful hunch that these organizations should be looked at. Therefore, perceptions are of benefit to this research. Furthermore, since perception will, occasionally, provide the basis that a particular organization is in the mix for consideration, it is important that this factor be represented within the criteria.

2.2.6 Conclusion

For this research, two different aspects of success will be used in this study as described in Chapter 3. As a way of assessing organizational success prior to the organization's inclusion in the study, four factors will be consolidated into a weighted scoring including: revenue growth; new job creation; patent creation; and perception of success. However, because of the weaknesses mentioned above, the null hypotheses will be tested against an organization's success as defined by revenue growth and new job creation only. This research will use a quantitative and well defined methodology to develop a formula for calculating a level of success metric.

2.3 Data Collection

With respect to data collection, there are special considerations that are important when conducting case study research.

One method used by many researchers who struggle to obtain quantitative data regarding organizations of interest is reliance on data from individuals with knowledge of the organization's inner workings. These sources can be classified in two ways: (1) Informants; (2) respondents. Either of these categories could be working class employees, professionals such as engineers, or managers.

The normal problems consisting of informant biases are, of course, potential problems in any research of this nature. Information about a dependent variable can, itself, influence the possible causes (March, et al., 1997). So, there is the potential for the problem of the 'self-fulfilling prophecy' whereby successful engineering or Research and Development (R&D) organizations tending to overestimate the explanatory success factors, and those same success factors being influenced by multicolinearity (Rese, et al., 2011).

In the event triangulation of data collection is desired, other data collection methods may be used too. For example, either online or paper questionnaires may be used. Many of the problems discussed in Sections 2.3.1 and 2.3.2apply to this type of data collection. However, there are many other considerations when it comes to achieving good response rates and accurate data. In the event this data collection methodology is used, care will be taken to follow the Tailored Design Method (Dillman, et al., 2008) which incorporates special considerations regarding response rates and information gathering. For example, in conducting these surveys, paper questionnaires are more likely to get a response than email questionnaires, and email pre-notices are more effective at boosting response rates than are paper pre-notices (Kaplowitz, et al., 2004). Emailed pre-notices are more effective, even when used to precede a paper questionnaire.

2.3.1 Informants

With the use of key informants as a source of information, comes with associated risks. Informants generalize about patterns of behavior, after summarizing either observed or expected organizational relations (Seidler, 1974). Informants are usually chosen on the basis of their formal role within the organization, and the response errors are likely to be higher for informants that are not closely associated with the phenomena under study (Kumar, et al., 1993). Information from sources of this nature is subject to knowledge and perceptions of the informant (Golden, 1992). Informant bias and random error can taint informant reports (Kumar, et al., 1993), and is something that this research must take into account. Of particular concern are that, often, informants are individual who were affiliated with the organization or who had connection within the organization, but no longer are. Therefore, their recounting of events can suffer from memory failures or inaccurate recollection of happenings (Golden, 1992).

2.3.2 Respondents

As with any other thing, there are risks to data collection when dealing with respondents. Respondents describe their personal feelings, opinions, and behaviors (Seidler, 1974). Data from respondents, in many ways, carry the same types of risks known to affect informant driven sampling.

Within the category of respondent sampling is a type of sampling known as Research Driven Sampling (RDS), and it is where researchers rely on respondents for suggestion of individuals who, also, could be respondents. Research driven sampling relies on two things: (1) long referral chains- that is, if the chain-referral process consists of enough cycles of recruitment or waves; and (2) the composition of the final sample as it relates to whether critical characteristics and behaviors will become independent of the seeds from which it began (Wejnert, et al., 2008).

2.4 Work Environments

Organizations cannot aim to insulate themselves from their environments (Thompson, 1967); therefore, a synopsis of the literature addressing this topic is pertinent to this discussion. There has been considerable research into the topic of organizational environments, in general, which resulted in tools by which to assess an organizational environment. For example, the Organization Assessment Instrument (OAI) (Van de Ven, et al., 1980) provides a comprehensive assessment of an organization's structures, functions and design (Drazin, et al., 1985).

Organizations are, invariably, composed of many individuals who carry various responsibilities within them, and any particular work group may have varying work environments within the organization. Furthermore, it has been shown that within a given organization, subgroups can vary, substantially, in the effectiveness, daily functioning, and in their individual responses to particular problems (Van de Ven, et al., 1980). Contributing to this are the infinite possibilities of organizational structures. Indeed, some parts of an organization's environment can be considered homogeneous, whereas other parts differ considerably across subgroups within the organization (Sackman, 1992).

The Work Environment Scale (WES) was created to assess employee perceptions across multiple high level dimensions of their daily work environments (Insel, et al., 1975). Neither of these tools, however, provided environmental assessments with respect to creativity and/or innovation. As well, the Siegel Scale of Support of Innovation was created to address perceptions of key factors within the educational/academic community (Siegel, et al., 1978). Since this Scale was set up, specifically, to address the environmental factors with the educational community, it's relevance as it relates to the context of this research (business/engineering organizations) is uncertain.

2.5 Creativity

Creativity is the generation of original and useful ideas concerning products, procedures and processes (Amabile, 1988; Oldham, et al., 1996). It is a very complex phenomenon (Ford, 1996), and his assessment of this complexity is reflected in Figure 2. It is a process that is quite often kept in check by practical restraints or goals, and provoked by challenges and problems that arise from the pursuit of a goal (Shalley, 1991). Creativity, after being allowed to conceptualize can result in Invention (Sears, et al., 2011). When an individual exhibits creativity, they produce novel, useful ideas about products, practices, services or procedures (Shalley, et al., 2004). It has been shown that organizational performance and survival are linked to organizational creativity and innovation (Nystrom, 1990). Furthermore, individual creativity is the foundation for organizational creativity (Amabile, 1988). Research has shown that some level of creativity is required for almost any job (Shalley, et al., 2000). However, in the case where creativity is a required element for optimum success, the question becomes: what can an organization do to maximize creativity? It stands to reason that in order to maximize creativity, one must first fully understand it and its subcomponents.

2.5.1 Factors Effecting Creativity

A general framework describing a variety of influential factors has been established (Amabile, 1988; Amabile, et al., 1996; Woodman, et al., 1993), and served as the basic model used by (Shalley, et al., 2004) to compile a comprehensive listing of factors effecting creativity, which we will discuss here. In compiling this listing, the authors broke the significant components into four major categories: (1) individual factors; (2) job factors; (3) group or team factors; and (4) organizational factors. In the following sections, each of these components is discussed in greater detail.

Individual Factors

It is easily intuited that some individuals are more creative, by nature, than others. This should provoke the question of why. Well, there are personality traits that are conducive to creative performance, and they are broad interests, independence of judgment, autonomy, and a sense of one's self as creative (Barron, et al., 1981). Quite possibly one of the most important individual factors for individual creativity is individual motivation to see one's self and the project succeed (Shalley, et al., 2004). There is, also, a contextual element to the relevance of the personal motivation and ambition. For example, researchers have found that within R&D circles, intrinsic motivation is absolutely imperative for creativity (Amabile, et al., 1987).

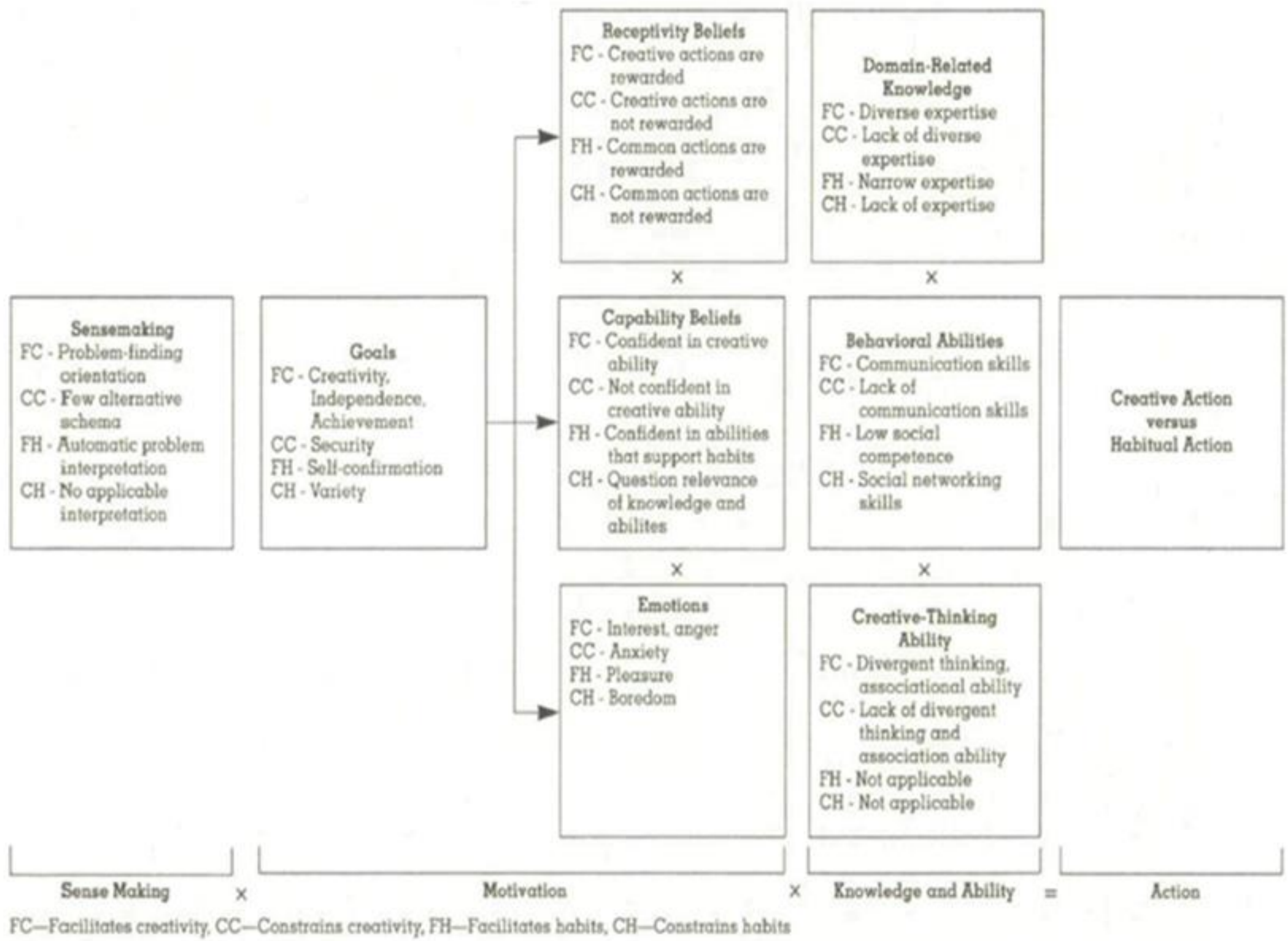


Figure 2 – A Theory of Creative Individual Action

When individuals have access to multiple alternatives, possible solutions, or potentially related ideas, they are more likely to make connections that lead them to be creative (Amabile, et al., 1996). Creative performance results from a skill set specific to creativity; this skill set is referred to as creativity relevant skills (Amabile, 1988). These skills can be defined as the ability to think creatively, spawn alternatives, engage in divergent thinking, or defer judgment (Shalley, et al., 2004).

Other pertinent factors, related to individualism, that influence creativity are related to knowledge. This includes domain-specific knowledge, which reflects an individual's level of: (1) education; (2) training; (3) experience; and (4) knowledge within a specific context (Gardner, 1993). Education allows an individual the advantage of exposure to experiences, viewpoints, and knowledge bases (Perkins, 1986). It develops the practice of divergent problem solving skills, and develops individuals cognitively such that they are capable of and more likely to use multiple diverse perspectives and more complicated schemas (Perkins, 1986). Practical knowledge and expertise can enhance creative thinking and problem solving skills by providing individuals with indispensable training and familiarization with original idea generation practices (Feldhusen, et al., 1995). This can contribute such that creative thinking becomes the norm for individuals, rather than the exception; furthermore, it forces individuals to be more comfortable in going outside their comfort zones, also very important for creativity (Shalley, et al., 2004).

Experience is important because it brings in the element of familiarity, and some level of familiarity is a prerequisite to being able to be creative (Weisberg, 1999). In other words, it is very difficult to be creative without some knowledge of what the norm or status quo for the particular project is (Shalley, et al., 2004). There is, however, risk associated with familiarity. It is that in some cases, familiarity can lead to routine task performance, whereas that is not what is needed for the sake of creativity (Ford, 1996). Knowledge, as mentioned above as item (4), is really a conglomeration of the first three items. Education, training, and experience all combine to create the knowledge base.

Job Factors

Job characteristics are an important component within the job factors category, and have definite effects on creativity (Shalley, et al., 2004). When a job is complex and demanding, individuals are far more likely to focus all of their attention and effort on their job; subsequently, this lends itself to the employee being more persistent, and more likely to consider different alternatives, ultimately resulting in a greater degree of creativity. It is widely recognized that autonomy is one of the key components of creativity. However, complete autonomy may not be necessary in order to achieve optimum creativity among employees. In fact, one study found that R&D professionals expect to have boundaries on their autonomy, and were satisfied with being able to determine their own approach in researching a solution, after management set the agenda (Bailyn, 1988).

As a subset of the job factors category is a grouping of factors that are directly attributable to managerial responsibilities under the prerogative of the project's organizational structure, itself. In other words, there are several job related factors, the tone of which is set by upper level management, and which trickle down to the supervisory level. The first, of which, is role expectations and goals (Shalley, et al., 2004). It is the influence that supervisory figures have on their employees, and the expectations/goals that they impart on those employees. Goals are ways of letting the employees know what is important to the organization, and what the organization is expecting of them. In so doing, it regulates action directly by affecting what people are paying attention to, how hard they work, and how long they persist on a task (Shalley, et al., 2004). Individuals who have been assigned a creativity goal perform more creatively than those not assigned a creativity goal (Carson, et al., 1993).

Supervisory support is important, as well, and is, in some ways, similar to goal setting. Creativity is enhanced by open interactions with supervisors and receipt of encouragement and support (Tierney, et al., 1999). Role models serve an important influence on creativity, as well. Highly creative individuals have often worked or studied under, or otherwise been influenced by highly creative people (Simonton, 1984). So, with the right selection of a supervisor, an organization can make great strides toward influencing the creativity of its employees.

When informational feedback is provided to an individual in a free and positive atmosphere, higher creative performance soon follows (Zhou, 1998); this as opposed to the same feedback being delivered to the employee in a controlling or punitive manner. However, agreement is lacking in regards to whether evaluation always has a positive impact on creative performance. Some research has suggested that it can potentially harm creative performance (Amabile, 1979).

Finally, common knowledge may lead one to believe that rewards for creativity would have a positive effect on creativity and tend to spawn more creativity. Research has shown, however, that this is not necessarily the case. In fact, some suggest that rewards imply good performance on past behavior, whereas new practices, process or outcomes are desired (Kerr, 1975). It is personal motivation rather than the promise rewards that spur creativity (Amabile, 1979). Ultimately, rewards can be a positive factor, because they can show that an organization places high value on creativity. It's just that an organization must be careful in establishing an award system.

Group or Team Factors

Creativity can be affected by synergistic elements, and, as such, it is usually more pronounced in a group setting. Creativity can occur in isolation, but usually thrives in an environment where there is an interactive process between individuals, such as the social interactions that take place between coworkers and/or team members (Agrell, et al., 1994; Taggar, 2002). Researchers have found that interactions with diverse others are a prerequisite to an organization's attaining of creative performance by its employees (Amabile, 1988; Woodman, et al., 1993). It is known that there is correlation between group and organizational creativity, adaptability and innovation and heterogeneity among members of a group with respect to age, tenure, education, and functional area (Hoffman, et al., 1961; Pelz, et al., 1966). This idea was taken further by (McLeod, et al., 1996), who found that this idea extends even further to, specifically; include diversity with respect to ethnicity. Consequently, the components comprising groups or teams must be considered within the context of creativity.

Researchers have found that creativity is very much influenced by perceptions of capacities toward creative efficacy. Creativity is not only impacted by work place environments, but also by personal interactions outside the work place. Indeed, there is a positive correlation between employees' creativity and the support provided to an employee from individuals such as coworkers and supervisors from within the organization, and from individuals from outside the organization such as friends and family (Madjar, et al., 2002). This was taken farther by (Ford, 1996), who found that employees rely on cues from others within their environments to form attitudes about their own capacities to be creative.

Organizational Factors

Creativity requires expertise, and, as such, one of the most prolific traits of creative individuals is that they have a substantial investment in expertise and ongoing development of expertise (Mumford, et al., 2002). Consequently, philosophically, it would behoove an organization, desiring to influence creative output, to put considerable thought and effort into assimilating teams with strong and diverse expertise.

(Shalley, et al., 2004) summarized that, although, overall organizational climate is difficult to change, there are multiple components of organizational climate that are reasonably manageable and conducive to creativity. The first element is that of creating a climate where risk taking and constructive task conflict are supported, encouraged, and promoted by the organization's management. Essentially, if employees feel that affecting change is something that is a hassle, as evidenced by stiff organizational policies, then they will be less likely to be creative in thinking and problem solving. Additionally, it is important that employees understand their organization's procedural justice system. When employees clearly understand how, when and for what they will be rewarded, promoted, or even fired, they will have a stronger sense of fairness, organizational commitment, loyalty, and increased levels of citizenship behavior (Shalley, et al., 2004). And, this leads to attitudes that foster creativity.

2.5.2 Assessing the Organizational Stance towards Creativity

Literature regarding quantitative assessments of work environments for creativity is scant prior to the development of an instrument called KEYS (Amabile, et al., 1996). The goal was to provide an assessment of perceived stimulants and obstacles to creativity in organizational work environments. Amabile and colleagues state that previous creativity research had been conducted on the social-environmental influences in organizations that revealed aspects of the work environment at the level of the organization, project management, and the level of the work group, itself. But, Amabile and colleagues' focus was to evaluate individual perceptions of the environment and the influence of those perceptions on the creativity of their work. They believed that the impacts of the individual perceptions were more important than the source and level of the influences that caused those perceptions.

The conceptual model underlying KEYS includes conceptual factors of the model, reference Figure 3. The model breaks down these primary factors into five categories:

Encouragement of Creativity

The authors found that this category was the broadest and most frequently mentioned in the literature. Within this category, there were three major levels: (1) organizational encouragement; (2) supervisory encouragement; (3) work group supports. Of these, the first was the most prominent, and frequently mentioned. These levels are further broken down into major elements.

Within the Organizational Encouragement level there are four elements: (1a) The encouragement of risk taking and idea generation coming from all levels of management (Hage, et al., 1973); (1b) Fair and supportive evaluation of new ideas (Cummings, 1965); (1c) Reward and recognition of creativity (Cummings, 1965); (1e) A collaborative idea flow across an organization and participative management and decision making (Allen, et al., 1980).

The second level is Supervisory Encouragement, and was broken down into two elements: (2a) Goal clarity; (2b) Open interaction between supervisor and subordinates; (2c) Support of a team's work and ideas from the supervisory level. A substantial driver of this factor is the finding that an environment is needed that provides circumstances where people are less likely to experience the fear of negative criticism (Amabile, 1979). Essentially, this driver is addressed with concept of positive supervisorial encouragement.

The third level is Work Group Encouragement which is not as large a contributor to the broader category. This support can come from within the work group, itself, by way of work group member experience diversity, mutual openness to ideas, constructive challenging of ideas, and a shared commitment to the particular project (Delbecq, et al., 1985).

Autonomy or Freedom

There has been substantial research that has shown that creativity can flourish at its best when individuals they have autonomy while performing their daily duties, and when they feel a sense of ownership and control over their own work (Paolillo, et al., 1978). Taking this concept even further, it has been shown in studies of creativity, not only can creativity flourish, but also individuals do, indeed, produce more creative work when they feel this freedom to choose how they go about their work (Amabile, et al., 1984).

Resources

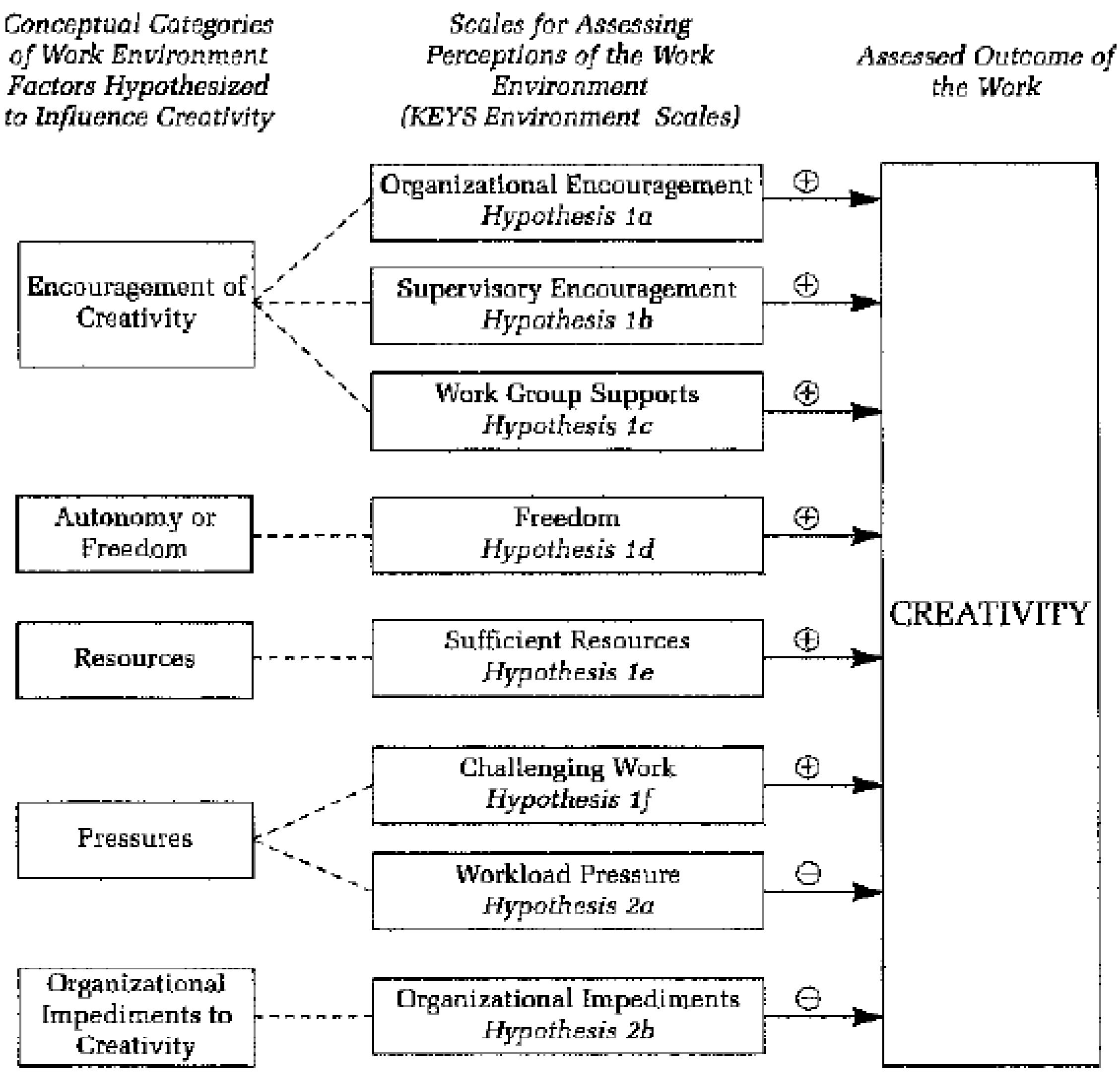
The perception of supply or lack of resources to accomplish the task at hand may be influence, psychology, individuals by leading to beliefs about the intrinsic value of the projects that they are assigned to (Amabile, et al., 1996).

Pressures

There have been conflicting conclusions regarding the influences of pressure onto creativity. On the one hand, some research has shown that an inordinate amount of workload pressures can undermine creativity. Yet, other research has concluded that some amount of pressure could stimulate creativity, if the pressure was perceived as being urgent and challenging and as arising from the nature of the problem, itself (Amabile, 1988). However, the KEYS model breaks down the category of Pressures into two distinct components: (1) excessive workload pressure; and (2) challenge. It stipulates that excessive workload pressure will adversely impact creativity, while pressure from the challenges of the problem will have a positive influence on creativity (Amabile, et al., 1996).

Organizational Impediments to Creativity

Although, to date, most research into factors influencing creativity has focused on organizational creativity supports as opposed to impediments to creativity (Amabile, et al., 1996), there is evidence to suggest that there are certain identifiable factors that will impede creativity (Kimberley, 1981). Specifically, those factors could include ridged management practices, conservatism and internal strife.



[a] The scales predicted to be positively related to creativity are referred to as "stimulant scales" and those predicted to be negatively related are referred to as "obstacle scales."

Figure 3 - Concept Model Underlying Assessment of Perceptions of the Work Environment for Creativity (Amabile, et al., 1996)

2.6 Innovation

Innovation consists of two parts: (1) generation of an idea or invention; and (2) the conversion of that invention into a business or other useful applications (Roberts, 1988). Furthermore, an invention could be seen as the phase that bridges the generation and adoption stages of the innovation process (Sears, et al., 2011). This view is slightly different from the viewpoint offered by (Damanpour, 1996), who states that the adoption of innovation can be thought of as a process that includes the generation, development, and implementation of new ideas and behaviors; furthermore, it is conceived as a way of changing an organization, either as a response to changes in the external environment or as a preemptive action to influence the environment.

As a precursor to this discussion, it is important to note that there are distinctions to be made between different types of innovation, e.g., administrative versus process; radical versus incremental (Dewar, et al., 1986). Subsequently, the search for a universalistic theory on innovation may be inappropriate given the differences between innovation types (Downs, et al., 1976). For purposes of this discussion, the focus will be on technological innovations. With this focus, the prevailing innovative contrasting types are radical versus incremental. Radical innovation is an innovation that satisfies a formerly unsatisfied need for the first time (Gemunden, et al., 2007). It consists of fundamental changes that represent revolutionary changes in technology (Dewar, et al., 1986), and represent distinct departures from existing practice (Dushesneau, et al., 1979). ---Incremental innovation, on the other hand, is minor improvements or simple adjustments in current technology (Munson, et al., 1979). Based on this discussion, it is easy to intuit that the distinction between radical versus incremental is subjective, and that there may be innovations that could easily be classified as either or both.

Different innovation types are affected differently by the same sets of factors. When discussing radical innovation, it is very difficult, if not impossible, to forecast and perform early analyses on elements relevant to the organization and innovation, whereas, with incremental innovation, the information surrounding those same elements may be known, already, or easily attainable (Balachandra, et al., 1997). Furthermore, an organization desiring to perform a type of incremental organization may need to consider or evaluate the current environment prior to making a decision to proceed with the innovation. Quite often in the case of radical innovation, the product design may be based solely on the creative instincts of the designer by understanding user needs through empathy with the user world (Balachandra, et al., 1997). The influences of the designer and his frame of reference on a design, in this manner, are referred to empathic design (Leonard-Barton, et al., 1994).

2.6.1 Factors Affecting Innovation

Individual capacities to create and innovate are not only dependent on their individual characteristics, but also on their work environment (Mumford, et al., 2002; Woodman, et al., 1993). The management of innovation requires a commitment of individuals who are enthusiastic and self-motivated for the new project or product (Gemunden, et al., 2007). These individuals may or may not have been assigned to the innovation, itself, but they do exhibit a very high degree of personal involvement and are willing to foster and nurture the project through the various phases of design and implementation. As mentioned, innovation is, not only, affected by characteristics, but also on a host of other factors, as well. Of significant importance is the organization's posture toward innovation.

Additionally, innovation coupled with other ideals such as learning can raise competence levels that in turn improve business performance (Martinsons, et al., 1999). A diagram of how this process works is shown in Figure 4.

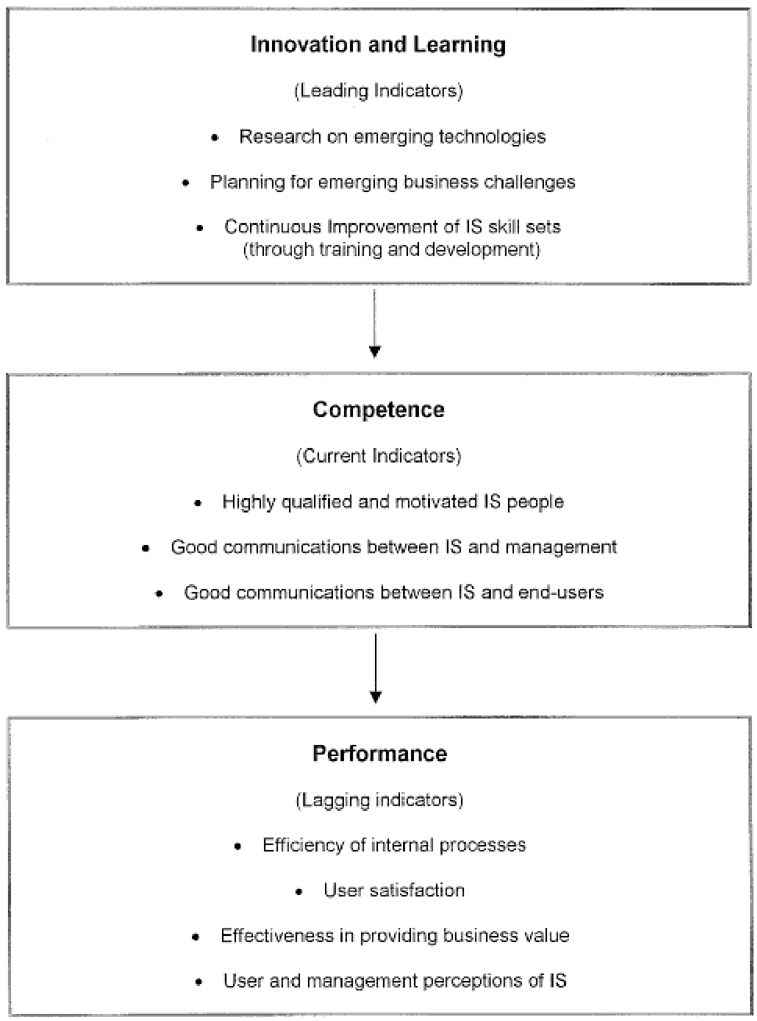


Figure 4 – Performance as a Function of Innovation and Learning (Martinsons, et al., 1999)

G. van der Panne Model for Innovation Success

In reviewing 43 recent papers about factors influencing success and failure of innovative projects, (van der Panne, et al., 2003) found that there was fairly broad consensus among researchers regarding the ten highest-ranking success factors. So, ideals were somewhat consistent regarding positive impacts on innovation success as a result of factors such as firm culture, experience with innovation, the multidisciplinary character of the R&D teams and explicit recognition of the collective character of the innovation process or the advantages of the matrix organization. However, there was little similarity among lower ranking factors among researchers whose papers they reviewed. The studies were either inconsistent or inclusive regarding the influence of factors such as strength of competition, R&D intensity, the degree to which a project is “innovative” or “technologically advanced” and top management support.

Research has shown that there are many variables influencing the adopting of innovation. In their review of 43 relevant papers, (van der Panne, et al., 2003) broke all of the variables down into four major categories: (1) firm related factors; (2) project related factors; (3) product related factors; and (4) market related factors. They, further, linked them together as shown in Figure 5 below:

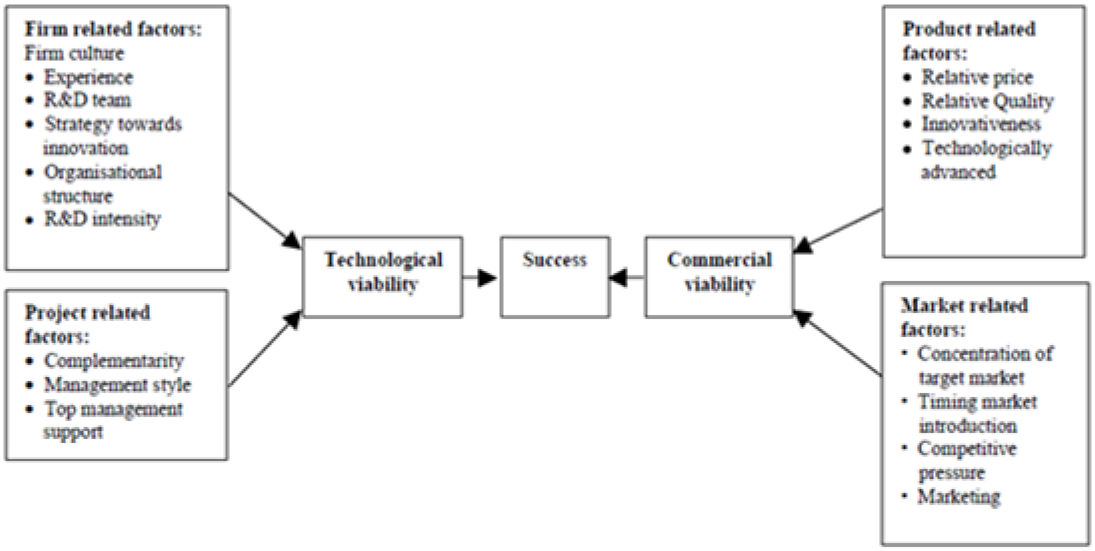


Figure 5 - Critical factors for innovative success (van der Panne, et al., 2003)

Firm Related Factors

From Figure 5, above, we see that firm related factors and project related factors, all feed into the technological viability side of this particular factors for innovation success matrix. Firm related factors are those organizational culture elements that, invariably, influence innovation. As shown in above, (van der Panne, et al., 2003) broke this category down into five subcomponents: experience; R&D team; strategy towards innovation; organizational structure; and R&D intensity.

Experience

Previous experience with similar innovative projects hone the technological, production, and marketing skills necessary to be able to successfully innovate in the future. It is reasonable to take this a step further, and conclude that firms should engage in innovation that is, at least, similar to previous projects taken up by the same firm (Bessant, 1993).

R&D Team

Influences on the R&D team affect its technical ability to innovate. There are three primary categories here, according to (van der Panne, et al., 2003). They are that the R&D team must contain the following three elements: (1) a product champion; (2) interdisciplinarity, in terms of varied technical backgrounds; and (3) balance between both technical and marketing skills. These categories are summarized as follows.

First, a product champion is someone who committed to the project, optimistic about the success of the project, and is very willing to face opposition and defend the project when the need arises. The champion concept has, for many years, been a mono-personal concept where the success or failure of the innovation is attributable to a single individual (Gemunden, et al., 2007). The champion must be willing to put his personal reputation on the line for an idea of doubtful success, and, although he is willing to fail, he is capable of using any and every means available in order to achieve success (Schon, 1963). This idea was, recently, taken even further with research that showed that the existence of a product champion provided a significant positive influence, and that the most effective product champions displayed behaviors exemplified by three important traits: (1) enthusiasm and confidence; (2) persistence; and (3) the capacity to bring the right people together (Howell, et al., 2005). Some researchers have noted that care must be taken in the selection of a product champion. In fact, there are several potential risks associated with selection and appointment of an R&D product champion. One of those risks is that the official nomination of an enthusiastic product champion can disrupt or interfere with his enthusiasm and dedication (Rothwell, 1992).

Second, inter-disciplinarity is the existence of experts, on the team, with a wide breadth of educational and experience backgrounds.

Third, although, (van der Panne, et al., 2003) state that technological skills are a prerequisite for this type of team, it is vitally important that the team have marketing representation, too.

Depth of knowledge resources was important in a fashion comparable to organizational size. An aggressive technological policy, defined as "a preemptive, long-range strategy for technological innovation" tends to promote an organizational structure consisting of a concentration of technical specialists (Ettlie, et al., 1984). This concentration of technical specialists tends to promote the existence of innovation champions, and creates the perception of increased economic connection between an innovation and the organization adopting it. Although, depth of knowledge resources was a factor, it does not appear to be as important as the organizational size. In fact, in many ways an organization's size can address the depth of knowledge resources question as a result of making available more engineers and technical personnel to address innovation.

Strategy towards Innovation

Formulating a technological strategy based on an organization's technological profile can provide the leader of an organization with a way of assessing and capitalizing on the organization's technological commitment (Ansoff, et al., 1967). An explicit innovation strategy (firm strategy towards innovation) was found to be an important factor. There are many different interpretations and approaches towards innovation strategy; however, the consensus among the research summarized by (van der Panne, et al., 2003) is that there exists within the organization an innovation strategy. Despite this consensus, fewer than half of all innovating firms have an explicit innovation strategy (Page, 1993). The most common strategies of this nature within the literature are classified as either proactive or reactive. Proactive strategies are those that guide the organization to innovate in order to attain market position, whereas reactive strategies call for innovation as a means of defending against competition for existing innovations.

Organizational structure

Organizational structure and R&D intensity were the two firm related factors with which there was very little agreement. Within the heading, organizational structure, there are multiple differing ideologies as to what structure is the most effective for an innovation based firm. The only consensus was that functional or fixed organizational structures seemed to hamper innovation (van der Panne, et al., 2003). Innovators tend to resist functional structure, and for good reason (Larson, et al., 1988), as those more fixed structures are dichotomies to the very trial and error nature of innovation (Calantone, et al., 1993). Alternately, an organic (i.e. a more flexible and adaptive) structure is preferred, and, in fact, the preference was unanimous among the studies reviewed by (van der Panne, et al., 2003). There are two strong arguments in the literature in favor of organic organizational structures. First, the non-rigid nature of these structures tends to produce more individual diversity and expression. This, subsequently, translates into more product champions being 'born' within the particular project. Secondly, as an innovation matures from idea to development to production, the organizational structure status evolves, as well, from a more flexible (organic) structure to a more formal structure (Bart, 1993). This organizational evolution is better supported with an organic structure. This ideology is not without its detractors, though. There are many examples within the literature reviewed by (van der Panne, et al., 2003), where the researchers concluded that there is a negative correlation between "organicity" and a firm's innovative capabilities.

R&D intensity

R&D intensity is R&D expenditures as a percentage of sales. Some would argue that the more a firm invests in innovation the more innovation it will see come to fruition (Page, 1993); furthermore, it is well known that R&D intensive firms do, generally, obtain higher commercial success rates (Gemunden, et al., 1992). A lack of financial backing is a preponderate factor for failure of innovation to succeed (Rubenstein, et al., 1976). There have, also, been relationships established linking the interaction of R&D intensity and innovative output, with other factors such as regional knowledge spillovers, demand pull effects, and differences in technological opportunity (Brouwer, et al., 1999).

Project Related Factors

As discussed, the category of factors labeled as project related factors, all feed into the technological viability side of the model put forth by (van der Panne, et al., 2003).

Complementarity

The next category that feeds into the technological viability side of the innovation success diagram is that of the project related factors. The author coined the phrase complementarity to represent the quantification of a project's compatibility with the firm's resources in broad terms (i.e. management and market research skills, sales, distribution, R&D and production facilities). Complementarity, in some ways, refers to the synergy that originates from compatible meshing of things such as marketing activities and innovation activities. Energies of this nature can also come from or be linked to the current project's similarity to a previous project, especially, if that previous project was deemed a success. This kind of synergy is generated from phenomena such as learning-by-doing, etc. (Zirger, 1997).

Management Style

Management style was, quite possibly, the factor that was easiest to obtain a consensus on, as to the mere fact that it is a key factor influencing the success of innovation. A basic assumption to this category is that innovation task management requires a different style than other task management; otherwise, there'd be no need to break this category out as something unique (Gemunden, et al., 2007). According to one study, most innovators break projects into constituent phases (Crawford, 1987). The most commonly identified of those phases are: (1) planning; (2) brainstorming; (2) screening; (3) evaluation; (5) development; and (6) market research. The reason that it is important that a project be broken up into phases is that it is much easier to influence individual factors, crucial for success, after the project has been broken into phases (Calantone, et al., 1993). The closer a project follows these predetermined phases and trajectory, the more successful it will be (Cooper, et al., 1987). Furthermore, omitting phases is a major cause for project failures (Wind, et al., 1988).

(van der Panne, et al., 2003) state that the two phases of the trajectory that are of most importance to the success of the project are planning and evaluation phases. An effective planning phase incorporates major milestones for the project, and this, effectively, converts uncertainties into clear tasks and responsibilities (Madique, et al., 1984). The evaluation phase is important because it helps discriminate the more viable projects from the less viable ones, thereby reducing associated uncertainties (Mansfield, et al., 1975).

Top Management Support

Within the project related factors category of the model shown in Figure 5, top management support was the only factor which lacked consensus among researchers. There was agreement among the literature within (van der Panne, et al., 2003)'s study that top level management support empowers a project and serves as a driving force for major initiatives and efforts. The project manager is an institutionalized role model to foster innovative projects, and is a formal assignment of responsibility for an innovative task (Gemunden, et al., 2007). Furthermore, it not only includes leadership of the team, formally assigned to the innovative project, but also includes planning and controlling the cooperation with various stakeholders, including project sponsors, clients and suppliers.

Some researchers have found that radical innovations tend to achieve higher success rates than incremental innovations, and that this is a result of radical innovations tending to receive more support from top level management (Gobeli, et al., 1987). Based on this, it seems that these researchers would conclude that top level management support is a critical factor for the success of innovation. However, other research has shown that top management support adds to failure as often as it does to success (Kleinschmidt, et al., 1995), for a variety of reasons.

Product Related Factors

The right side of the model indicates that those factors feed only into the commercial viability aspect of innovation success. Since, the subject and focus of this document is engineering success, by and large, the side of this model that is of relevance herein is the left. However, although this model doesn't reflect it, some of the factors on the right are, indeed, related to the innovation of the project, itself.

Relative Price

Although, few studies in this synopsis acknowledged or discussed a product's price relative to competition pricing, it remained undisputed that relative pricing of an innovative product to competition products or substitutes was an important factor (van der Panne, et al., 2003). Some would say that successful innovations meet customer needs on a number of levels, simultaneously. These levels can include quality, relative price, total-costs-of-use, convenience, after-sales service, and backward compatibility (Madique, et al., 1984), whereas less successful innovations primarily excel in a reduction of total-costs-of-use, only (Roy, et al., 1997).

Quality

Quality is listed, unanimously, as a prerequisite to successful innovation. And, one researcher even asserted that it was the only real determinant of success (Roure, et al., 1990).

Innovativeness

The degree of innovativeness was a highly disputed category when looking at factors influencing innovation success. Some researchers found that highly innovative products had a success rate of 80%, whereas products falling into the classification of medium innovation had a success rate of 50% (Kleinschmidt, et al., 1991). However, this factor of innovativeness is, in some ways, related to some of the previously discussed factors such as synergy and likelihood of having the highest qualified product champion on board. In other words, it seems more likely that highly innovative products would have the benefit of more excitement and synergy, perhaps even as a result of having better, more dynamic product champions on the particular team. From this standpoint, some researchers have concluded that higher innovative projects are, inherently, at a lower risk than lower innovation projects (Kleinschmidt, et al., 1991).

Technologically Advanced

Literature reviewed was, absolutely, inconclusive as it relates to the relationship between how technologically advanced a project/product is and the success that it will enjoy (van der Panne, et al., 2003).

Market Related Factors

There were four market related factors which play into this particular model: concentration of target market; market timing; competitive pressure; and marketing.

Concentration of Target Market

This is the extent to which the potential customers for a product are concentrated within a single market. Higher concentration corresponds to easier communication with the customer base (van der Panne, et al., 2003). However, there is at least one study that found that not only is there an increase in product viability when the concentration of buyers is higher, but also, when the concentration of buyers is lower (Roure, et al., 1990).

Timing Market Introduction

The timing of market introduction for an innovative product is absolutely crucial in many instances for success of innovative products. Obviously, the product should be introduced ahead of competing products, and this is, in fact, an enormous competitive advantage (Madique, et al., 1984). This interest can, however, compete with other interests within the technological viabilities side. For example, attempting to speed up the time-to-market period for a product can prove troublesome for the R&D team, and can have a negative impact on quality and/or innovativeness.

Competitive Pressure

This is another area that lacked any consensus, whatsoever. There were found to be wildly varying ideals about the effects of competitive pressure. Some suggest that innovative firms should target smaller, growth oriented markets, and that these markets are by nature, less competitive. Furthermore, with less competition, they believe that any innovation is more likely to succeed, as opposed to a market where potential customers have more options (Stuart, et al., 1987). (Link, 1987) takes it further, saying that fierce competition is a main factor of failure. Whereas, other researchers conclude that since radical innovations are less likely to face fierce competition, this is an argument in favor of innovative firms pursuing radical innovations as opposed to incremental innovation (Roure, et al., 1990).

Marketing

(van der Panne, et al., 2003) found that, although, it was unanimous that adequate market research plays a key role in successful innovation, they could not ascertain from the literature whether or not it was beneficial to involve consumers in the innovation process. Frequently cited marketing blunders resulting in innovation failures are: overestimated forecasts of demand, problematic translation of engineers' desires into customer's needs, and the tempting romance of the innovation-adventures (Hopkins, 1981). According to several researchers, most successful ideas originate within marketing, not from within the firm (Johne, et al., 1988; Madique, et al., 1984). Furthermore, innovators involving customers, historically, attain higher success rates than those who don't (Gemunden, et al., 2007). However, there are huge pitfalls related to this strategy, as well. Too much involvement of the customer can serve to limit the innovators' creativity, and result in an innovator neglecting technology driven ideas or, essentially, 'chasing' customer immediate needs (van der Panne, et al., 2003). It is likely that many customers don't, necessarily, understand or express their future preferences. Furthermore, those customers, often, don't have the advantage of knowing and understanding current technological capacities. So, ideas should be allowed to evolve within the organization's R&D department, and then be integrated with the customer via the firm's marketing strategy (van der Panne, et al., 2003).

G. van der Panne Synopsis

In conclusion of (van der Panne, et al., 2003)'s study, the authors concluded that there was broad and strong consensus among researchers that the following factors would enhance success:

- An organizational culture dedicated to innovation that explicitly recognizes the collective nature of innovation efforts
- Prior experience, by the organization, with innovation projects (learning-by-doing; learning-by-failing)
- An R&D team characterized by multidisciplinary character; with a particular emphasis on the balancing of technological and marketing skills, along with the presence of a product champion
- A clearly articulated innovation strategy, along with a management style that complements the strategy
- Comparability of an innovation's product quality and price to those of existing products
- Good market introduction timing

2.6.2 Strategic Influences on Innovation

It is readily apparent that an organization's posture has a direct impact on its ability to effect innovation. In fact, it makes perfect sense to formulate contingency strategies that not only effect innovation, but also establish the innovative goal for the organization. (Ansoff, et al., 1967) states that when the environment is such that technology is changing rapidly, organizations are well advised to focus their efforts on research and development rather than process improvements, because during this phase, process improvements may well be rendered obsolete as a result of the ‘state of the art’ (technology) maturing. Contrasting this to the times when the rate of change of the ‘state of the art’ is low, it makes sense to adapt the contingency ideology of focusing on improving processes for existing technology. During times when technology is changing at a rapid pace, managerial decisions are rendered obsolescent quickly (Ansoff, et al., 1967). In this case, he states that planning assumptions are more quickly superseded by events; furthermore, this can tend towards rendering managers who do not keep up with new developments obsolete, as well. Technological improvements are rarely monolithic in nature. In fact, often they are the result of the accumulation of many smaller advances by different organizations over time. Therefore, an organization that wishes to be innovative must ensure that their managers are abreast of external technological advances.

2.6.3 Open Innovation

Open innovation can be defined as ‘the use of purposive inflows and outflows of knowledge to accelerate internal innovation, and expand the markets for external use of innovation, respectively’ (Chesbrough, 2006). It is a very powerful methodology which encompasses the generation, capture, and employment of intellectual property at the firm level (West, et al., 2006). The internally focused, centralized approach towards R&D is becoming obsolete in many industries (Chesbrough, 2003). He and other researchers have concluded that in order for an organization to stay relevant, it must widely disseminate knowledge, and use ideas; else they must be sold to other organizations. This is, in part, a result of Research and

Development (R&D) becoming more and more costly, while returns on the same are dwindling due to increased competition in markets and shorter life cycles. It is the case that a firm, depending on its business model, elects whether or not external and internal knowledge is valuable enough to be further developed and commercialized into a new business. However, when the venture is determined not to be profitable enough or when it doesn't fit the organization's business model, the firm will not simply abandon the project (as in the case of the closed business model), rather it will seek to license or sell the technology to other organizations who can use the innovation successfully, because they have different business models, i.e. one that is compatible with this particular technology or ideal (Vanhaverbeke, et al., 2008).

There are three fundamental challenges with the concept of open innovation, and they are: (1) finding creative ways to exploit internal innovation; (2) incorporating external innovation into internal development; and (3) motivating outsiders to supply an ongoing stream of external innovations (West, et al., 2006). These challenges are linked together according to the following diagram.

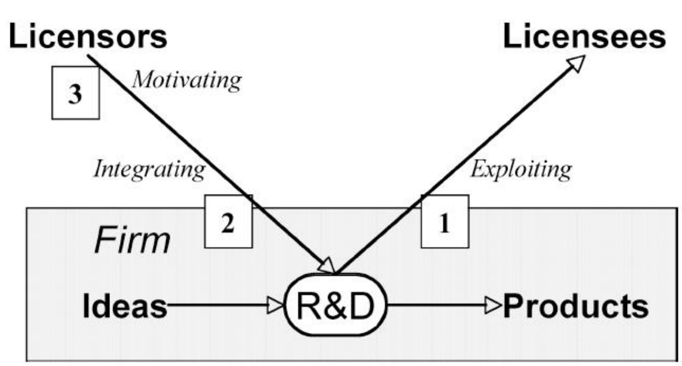


Figure 6 - Motivating, Integrating and Exploiting Innovation (West, et al., 2006)

First, (West, et al., 2006) ascertain that innovating companies need to find ways to maximize the return on their own internal innovations, not just adding to the company's products, but outbound licensing of intellectual property, patent pooling and even giving away technology in order to stimulate demand for other products. Second, they must find ways to incorporate relevant technologies into their own products and services. Organizations must be proficient at identifying potential technologies, absorbing them, and putting them to good use. In order for this to happen, there must exist with the organization, a general attitude of acceptance toward bringing in outside technology. Third, is the challenge and assumption that there will, indeed, be sources of outside innovation available. Why would an organization, for example, continue to make available technologies that cost money to develop? Well, there are, according to (West, et al., 2006) two categories of these types of innovators. One is that innovation benefits the innovator, and there is no cost by sharing the benefit. The other category is the case where there is spillover which directly benefits a competitor, and subsequently, harms the innovator. In many cases, however, organizations within a particular industry complement other organizations by creating markets, but then compete in dividing up those markets (Brandenburger, et al., 1996).

2.6.4 Organizational Size

Organizational size can be an important factor for innovation (Dewar, et al., 1986; Ettlie, 1983). Larger organization will have more engineers. Although, large numbers of engineers may not be particularly creative, but they facilitate technical innovation because they have easy access to state of the art ideas, and have the ability to readily test these ideas and variations of these ideas. Additionally, more engineers, invariably, leads to more research equipment, larger labs, and more slack within the organization to tolerate failures. The element of an organization's tolerance for failure with respect to innovation is very important, because as the numbers of failures increases so do the numbers of experiments and successes (March, 1981). This allows for more risk taking which is a fundamental condition when attempting to implement radical innovation. Organizational size has been identified by multiple researchers as one of the most important factors affecting the structure and processes of an organization (Damanpour, 1996); (Blau, 1970); (Kimberly, 1976). Financially, a larger organization can absorb unsuccessful technological innovations without any significant impact. As alluded to previously, large organizations employ more professional and skilled employees, thereby giving them the potential to have more technical knowledge and technical potential. However, these influences are not all positive; for example, with larger organizations there is, often, more bureaucratic 'red tape' and less flexibility. Management in larger organizations is, often, more formalized, and managerial behavior is more standardized, inertia is higher, and managerial commitment to innovation is lower (Hitt, et al., 1990); (Damanpour, 1996). Furthermore, they tend towards inflexibility and adaptation in a timely manner. This has led some to conclude that smaller organizations have an advantage with respect to innovation in that they are more flexible, have a greater ability to adapt and improve, and are more prone to accept and implement change. (Nord, et al., 1987)

2.7 Factors and Effects on R&D

This section, in many ways, ties to the heart of this dissertation. There are two core areas of R&D: new product development and commercial R&D. The former is an organization's attempt to broaden its product line, while the latter is an organization's attempt to increase its competitiveness in a particular market by way of streamlining processes on existing product lines (Balachandra, et al., 1997). Although, commercial R&D is a vital component to any organization's long term well-being, it is not the primary concern of this document. So, the focus here will be, largely, limited to the case of new product development.

In thorough review of studies evaluating factors contributing to R&D projects and New Product Development (NPD), (Balachandra, et al., 1997) reviewed 19 studies to try and discover whether or not there was agreement within the community of the factors effecting new product design and R&D projects. They used a very selective approach in selecting studies of which to review. In the preamble to the findings, and while discussing factors for success in R&D projects, (Balachandra, et al., 1997) lists four primary categories influencing the same: (1) market; (2) technology; (3) environment; (4) organization. These four primary categories were later broken down into individual factors. At the top level, the four factors were outlined, as follows.

First, a metric that incorporated assessments for the potential size of the market, expected market share, and the profitability of the new product was called the "strength of market" (Cooper, 1979). This strength of market metric was given the status ranking of "high importance" when used as a tool in assessing a new product's predisposition to succeed. Some authors take this ideal even further in stating that there must be more than just an expectation for a market, rather, they say, there must be an existing market in order for a new product to have the highest probability of succeeding (Balachandra, et al., 1984). There seems to be a correlation between the new product success rates and the expected growth rate of the market (Merrifield, 1981). The rate of new product introduction within a given product category is representative of the stage of life cycle of the product category. For example, a high rate of new product introduction implies a product category life cycle that is in the growth stage. Several studies touched on this, but there was no consensus as to the impacts that this has on the success of a new product. Some studies indicated that introduction of a new product into a market considered to be in the growth stage have a higher chance of success; whereas, other authors concluded that a market considered to be in the growth stage would, inevitably, imply stronger competition for market share, thereby being a negative factor for new product introduction. (Balachandra, et al., 1997) concluded that there was broad consensus that the market for both new product development and R&D projects is an important category; however, there is disagreement as to the individual factors and the extent of their impacts. A summary accounting for these disagreements is provided in a table at the end of this section.

The second identified factor was technology. Here, (Balachandra, et al., 1997) found that there were conflicting findings regarding the role, in success of new products, of technology. Some studies found that products utilizing higher levels of innovation were more likely to succeed (Mahajan, et al., 1992), while others concluded that the same category of products were more prone to failure (Mansfield, 1981). In fact, one study found that the relationship between innovativeness and new product success was not even a linear one, but rather it was a U-shaped relationship (Kleinschmidt, et al., 1991). Demand pull was deemed a more important factor for success than technology push by several studies. (Balachandra, et al., 1997) concluded that the influence of new factors on the success of new product development is dependent on other contextual factors, and that of those, the primary one is the innovativeness of the technology.

Third, when it came to environmental factors such as political and social factors, public interest in the product and social acceptability of the product, the authors found that a supportive environment is a prerequisite to new product success. However, there was broad disagreement on the importance of environmental factors in this context. Furthermore, it was found that study authors could not even agree on which factors to analyze, much less which ones were significant to new product design and R&D projects. It is obvious from Table 2, that the environmental category had the least impact of the four categories, on the success of product innovations.

Finally, an organization's posture was identified as a major factor. Indeed, the authors concluded that irrespective of markets, technology, or environment, if the organization is not capable of getting a new product to market, then the product will fail. In their review, (Balachandra, et al., 1997) found that every study reviewed focused on some issues of organization. The importance of the source of a potential new product idea was contentious among researchers, as well. Some believe that an organization's marketing department is closer to the needs of the customers, and, therefore, should be the source for new product ideas

(Wheelwright, et al., 1992). Whereas, other researchers concluded that R&D departments were more in tune with the capabilities of the organization and current technologies, and were, subsequently, better equipped to hatch new product ideas. And, although, some studies found that it was imperative that a new product receive strong support from marketing, at least one study concluded that it was a hindrance rather than an aid to receive help from the marketing function. In fact, several studies found that organizations with strong R&D capacities actually possessed weak or no marketing skills.

Before, providing a summary highlighting the factors identified, we note from the previous discussion that there was considerable disagreement among researchers as to the factors and their impacts on success of new product innovation and R&D projects. A table showing contradictory results in major findings is shown as follows:

Table 1 - Contradictory Results in Major Findings (Balachandra, et al., 1997)

No.	Factor	No. of Studies Citing Positive Effect	No. of Studies Citing Negative Effect
	Market Related		
1	Potential market/existing market	3	5
2	Market analysis	4	7
3	High growth	5	1
4	Early to market	2	3
5	Rate of product introduction	2	4
	Technology Related		
1	Innovative product	4	4
2	Perceived value	5	1
3	Patentability	4	3
4	Demand pull/Technology push	4	1
	Environment Related		
1	Important/Not important	4	1
	Organization Related		
1	Support from marketing	6	3
2	Use of quantitative techniques	1	2
3	Source of ideas from marketing	3	3

Of the nineteen studies reviewed by (Balachandra, et al., 1997), in Table 2 a synopsis is provided in as to how many times each of these particular factors was identified as being of vital importance. In this table, the highlighted category is of particular importance in the context of this dissertation document. This, because one of the basic ideals on which this dissertation research is based, is the belief that there are factors at the organizational level which are critically important to technological success within an organization. We see that of the nine studies selected for review, focusing on R&D projects, there were thirty-six organizational factors identified as being of significant importance, and this averaged a total of four organizational factors per study. Of the ten new product development studies, there were also thirty-six organizational factors identified. So, among new product development studies, there was an average of 3.6 organizational factors identified per study as being of significant importance.

Table 2 - Average Number of Factors per Study (Balachandra, et al., 1997)

Factor Type	R&D Studies (9)			New Product Development Studies (10)		
	No.	Avg.	%	No.	Avg.	%
Environment	11	1.2	13.1%	0	0	0.0%
Market	24	2.6	28.6%	16	1.6	26.7%
Organization	36	4	42.9%	36	3.6	60.0%
Technology	13	1.44	15.5%	8	0.8	13.3%
Total	84	9.24	100%	60	6	100%

Additionally, (Balachandra, et al., 1997) lists a summary of the factors cited by four or more studies as follows:

Table 3 - Factors Cited by Four or More Studies (Balachandra, et al., 1997)

No.	Factor	No. of Studies Citing R&D	No. of Studies Citing NPD	Total
	Predominantly R&D project studies			
1	High level of technical success	5	1	6
2	Probability of technical success	5	0	5
3	Market existence	4	0	4
4	Availability of raw materials	4	0	4
5	Need to lower cost	3	1	4
6	Timing	3	1	4
7	Commitment	3	0	3
	Predominantly New Product Development			
1	Emphasize marketing	1	5	6
2	Marketing and technology are strengths	1	4	5
3	Competitive environment	1	3	4
4	Technology strategy tied to business strategy	0	3	3
	Evenly cited by both types of studies			
1	R&D process well planned	3	3	6
2	Create, make, market interphase	2	2	4
3	Training and experience of own people	2	2	4

2.7.1 Real Options and its Role in R&D

In an atmosphere of increased competition and razor thin profit margins, it has become far more incumbent upon high-tech organizations to do all they can to minimize risk and cost while maximizing the likelihood of success in engineering and R&D. A tool that greatly helps an organization accomplish this is known as real options. The theory behind real options, in which the options are a real asset, was derived, originally, from theories developed in finance to account for the value of financial options (Black, et al., 1973). In fact, (Vanhaverbeke, et al., 2008) advocate that the alleged benefits of open innovation can be explained, in part, utilizing the real option approach. Real option is 'the right, but not the obligation, to take an action in the future' (Amram, et al., 1999). Real Options Reasoning (ROR) is a conceptual approach to strategic investment that takes into account the value of preserving the right to make future choices under uncertain conditions (McGrath, et al., 2004).

The real option gives a firm the ability to participate in technologies and explore ideas for some period of time without, necessarily, having to fully commit to the development of the same until it has had a chance to carefully evaluate the technology and/or idea with minimal resource commitment. Following the topology of real options provided by (Janney, et al.), (Vanhaverbeke, et al., 2008) lay out four specific areas where high-tech firms benefit from applying the methodology of real options to the concept of open innovation, and they are as follows:

First, early involvement in new technologies and business opportunities is a boon to any organization whose focus is on innovation. Open innovation allows organizations to sense developments in a broad range of externally developed inventions by buying minority stakes in high-tech startups , participating in venture capital funds, or by providing and participating in educational investments in promising projects at universities or research labs. As previously alluded to, this allows a company to learn about new technologies at a stage when investments are small, and commitments are reversible. So, in terms of real options, open innovation allows an organization to review and access a much larger range of available technologies and ideas. This can be an advantage not only because, oftentimes, these technologies and ideas are different that those that the organization has come up with internally. This results in higher returns and higher diversification, and allows a company to broaden its “horizons” by attaining a wider portfolio of products that are more resistant to problems in any single area of the business.

Second, organizations benefit from delayed entry or delayed financial commitment to a technology or idea. In a closed innovation scenario, an organization must elect whether or not to ‘pull the idea through the funnel’ of developing it further or not, and it often has a very limited window of opportunity of which to make the decision because the idea has come from within the organization. Often, it must either be capitalized on and developed immediately, or forgotten about due to the circumstances surrounding its conception. Whereas, with open innovation, a company may start the exploring commercial possibilities of a technology outside initially, via relationships with universities, etc. The ability to delay a decision to commit offers a much larger array of entry options, and supports ways of developing growth opportunities from a technology. It, essentially, gives the firm more leverage in terms of differentiating innovation strategies.

Third, it offers firms the benefit of early exit, with the benefit of some smaller value even though the project did not materialize, internally. These smaller values come in the form of selling the technologies or spin off ventures, or licensing the technology. So, initiatives can be pursued with input/investments from multiple organizations, rather than the firm being required to provide the entire investment. Essentially, there are two positives here: (1) the organization receives more ‘bang for the buck’, i.e. it is required to spend less capital, yet it can still see the benefits; (2) the organization is able to pursue the same degree of innovative exploration with a lesser budget. However, these possible benefits don’t come without a price. For example, the organization may have to sacrifice some of its own intellectual property rights in hopes of receiving more of the same.

Fourth, open innovation allows organizations to benefit from delaying exit from a given product development. This is good because it allows the organization to form ventures with other institutions, thereby, allowing the ventures to take place outside the organization. This allows the firm the ability to monitor a venture while delaying the exit decision. This is important because it allows the venture to grow and mature while allowing the firm time to decide whether to take on the technology, develop, and sell it in a product. Or, whether to ‘bail out’, and sell or license the technology to venture capitalists and the like.

A word of caution is needed here, though (Vanhaverbeke, et al., 2008). That is that technological intensive firms cannot and should not arbitrarily attempt to learn, acquire, and implement new technologies without a systematic methodology for doing so. Adoption of new technologies, often, requires new competencies and routines in order to effectively exploit the real options presented by the open innovation ideology. These organizations must develop the ability to scan, efficiently, trends in research and technology; furthermore, they must adapt to tapping into and receiving external sources of knowledge. This is something that requires a high level of expertise and experience, and requires years of practice and experience to perfect.

It is, also, noted that an important tool that can, potentially, serve as an enabler for the effective use of real options is that of the patent. The taking of a patent does not commit the firm to commercialization of a particular option, rather it allows the firm to control potential downside losses, while retaining the ability to make a decision later (McGrath, et al., 2004).

2.7.2 Knowledge Capacities

In an attempt to reconcile knowledge management, absorptive capacities, and dynamic capabilities in order to arrive at an integrative perspective which merges knowledge exploration, retention, and exploitation both from within an organization and from without, (Lichtenthaler, et al., 2009) put forth the framework shown in Figure 7

	Knowledge exploration	Knowledge retention	Knowledge exploitation
Internal (Intrafirm)	Inventive capacity	Transformative capacity	Innovative capacity
External (Interfirm)	Absorptive capacity	Connective capacity	Desorptive capacity

	Knowledge exploration	Knowledge retention	Knowledge exploitation
Internal (Intrafirm)	Inventive capacity	Transformative capacity	Innovative capacity
External (Interfirm)	Absorptive capacity	Connective capacity	Desorptive capacity

Figure 7 - Knowledge Management Framework (Lichtenthaler, et al., 2009)

Here, another rather complicated ideal comes into play, specifically, interorganizational absorptive capacity (Lane, et al., 1998). It is incumbent upon an organization to purposively investigate and absorb relevant technologies and ideas, and then to learn from them. Indeed, it has been shown that real options approach in open innovation leads to organizations, over time, improving their knowledge absorptive capacities (Vanhaverbeke, et al., 2008). The process of remaining open to external technologies and ideals, gleaning information from those external sources, and then finding relevant uses for a particular technology, by definition is knowledge absorption. This is a learned skill, and organizations become more adept with experience in doing the same. Indeed, real options reasoning is a dynamic methodology that can build a firm's ability to identify, assimilate and exploit external knowledge (Teece, et al., 1997).

2.7.3 Leadership and Contextual Contingencies

Leadership is embedded in its context (Osborn, et al., 2002). In fact, (Osborn, et al., 2002) argue that it is socially created in and from a context where patterns over time must be considered and where the past matters. They say that leadership is the collective incremental influence of leaders in and around the system, as opposed to the mere incremental influence of a boss on subordinates.

Specific Case

In a study, (Zheng, et al., 2010) examined the impacts of the interactions of leadership and contextual factors in R&D innovation within four highly innovative and highly successful teams residing in two national laboratories in the United States, and concluded that common themes of leadership were:

- A dual focus on the internal and external domains of the teams
- Steering rather than managing
- Hands-off
- Individual focus
- Buffering
- Rain-making

They found that within the confines of these four successful teams, all four leaders focused on building internal solidarity while, simultaneously, reaching out for knowledge and collaboration.

The doctrine of steering rather than managing consists of three primary components: (1) communicating the vision or priorities to the team members (‘have people understand the bigger picture’); (2) helping team members make the connection between the team vision and their own work tasks (‘it’s not just a piece of metal that you are putting together’); and (3) energizing and exciting people with the prospect of reaching their objectives (‘He shares his excitement with you, the excitement of the possibility if this works’) (Zheng, et al., 2010).

The team leaders utilized a hands-off approach in contrast to micro-management. It encompassed three elements: (1) allowing individuals to select their own research/ technological agenda; (2) exerting minimum oversight on how members conduct their work; and (3) maintaining flexibility in making plans.

These R&D focused teams' leaders focused on non-competitive individual successes. They believed that innovation stems from individual success, and this led to their efforts to understand each member and to build appreciation and recognition for individuals rather than to stimulate internal competition. Leadership flowed, with these leaders, both inside and outside the boundaries of the teams.

Two practices were observed as being salient in each of the four teams: (1) buffering between the team and the outside environment; and (2) rainmaking for the team. Nearly every interviewee expressed frustration regarding the ever increasing amount of oversight of national laboratories. Budgetary constraints, inefficient procurement procedures, and the like, all resulted in increased oversight. In an attempt to foster creative and productive environments, each of the four leaders felt that it was part of their responsibility to provide a buffer between the team and these external pressures. They did this to filter out unnecessary administrative duties to protect staff time, while ensuring communication between the lab and the members.

As well, leaders expended substantial energies towards promoting their teams both inside and outside the laboratories. This promoting is what was referred to as rainmaking. This concept originated from the belief that 'there are more smart people outside this fence that inside', and that 'very little of the work was wholly conceived, wholly executed here'. In fact, the belief was that the organizations were enabling and leveraging work from elsewhere.

Contextual Contingencies

Continuing the discussion of the previous section; despite that leadership ideologies were consistent across all four teams, the intensity of the various characteristics varied according to three contexts: (1) funding model; (2) nature of tasks; and (3) team structure (Zheng, et al., 2010). The funding model was that which described the main source of funding for the particular team. Since, the funding model is not, particularly, important in the context of this dissertation, we shall gloss over it in favor of the later contextual contingencies.

The nature of the tasks, also, was a key factor in the involvement extent of the leaders of the four teams. The key innovative tasks of the teams differed to the extent of their focus on scientific, technological, and application work. Teams that focused on scientific experimentation and discovery were found to be utilizing a more complex model, because that focus required scientists and engineers to transform existing knowledge. In contrast, technological innovation involved less complex tasks because the innovations involve, primarily, incremental modifications of existing technology. It was found in this study that the more complex the tasks, the less control the leaders exhibited over the tasks and the task outcomes.

Additionally, the more uncertain the tasks the more external information was sought after by the particular leader. With highly uncertain and complex tasks a larger external network of contacts was sought after in order to expose the various team members to more divergent ideas. In cases where larger external orientations weren't desired so much, rain-making behaviors often occurred inside the organizations. For example, some teams went to great efforts to include technicians and other support personnel within their discussions. It was a way of obtaining a "buy-in" from all the participants, and some of the leaders observed that this "buy-in" was the source of dedication from those folks when it was needed. So, when the team needed something such as time or other resources from those personnel, those participants were observed to be far more able, capable, and willing to convince their own superiors to contribute those resources.

Finally, the contextual contingency of team structure came into play. It is the extent to which established structures and patterns of collaborations exist among team members. It is the element of the team that governs the teams' task differentiation and communications patterns. How much focus leaders placed on individuals was determined by the team structures. Where more fluid structures were in place, the leaders interacted with every member of the team, and there was less differentiation based on position. In this environment, more personalized approaches were adopted. In contrast, one of the four teams' leaders interacted with group leaders, who, in turn, interacted with the group members directly. This leader maintained an open door policy which allowed every team member to interact with him at any time, but there were no formal meetings for the whole team.

2.8 Organizational Conceptualization

Organizational culture comprises the fundamental values, assumptions, and beliefs held in common by members of an organization (Ostroff, et al., 2003), has a direct impact on employee attitudes, and those attitudes, in turn, influence organizational effectiveness (Siehl, et al., 1990). Furthermore, for the long term stability and viability of an organization, it is imperative that it maintain somewhat of a long-term orientation. From this standpoint, an engineering organization must be somewhat open to periodic change, because there will times that change is warranted, otherwise, it risks losing its edge (Hamel, 2002).

2.8.1 Change

Organizations whose short term orientations keep them intently focused on quarterly results may find it very difficult to extend their vision to the organization's longer horizons (Detert, et al., 2000). That said; it is imperative that an organization remain open to the fact that the technical world is an ever evolving place, and that organizations wishing to remain at the forefront of their industry must be prepared and open for change (Hamel, 2002). When it is discovered that in order to either maintain or acquire a particular viability, a change is needed; it is incumbent upon the professionals leading the organization to fully understand the culture that they're dealing with (Goodman, et al., 2001). Only then, can we adequately define a process for transforming the current culture into the desired new culture (Goodman, et al., 2001).

2.8.2 Competing Values Framework

Originally, developed to explain differences in the values beneath various organizational effectiveness models is the metathoery known as the Competing Values Framework (CVF) (Quinn, et al., 1981). The idea of a competing values framework attempts to rationalize the ideals of having competing values within an organization with the stated purpose of integrating them together in a best fit scenario in order to attain an organization that is open to growth and collaboration. For the purpose of reconciling competing interests, effectiveness and effectiveness improvement should be the guiding principle (Quinn, et al., 1983). This, however, possess its own set of problems in that effectiveness and effectiveness improvement are both very subjective terms that are very difficult to quantify and/or prioritize. As it relates to effectiveness, different organizations adhere to different models, and there is no single correct way to choose effectiveness criteria (Campbell, 1977). Perhaps, as a result of the subjectivity of analyzing effectiveness criteria, literature reflects vastly differing points of view on the topic. For example, the value of organizational effectiveness has been questioned (Steers, 1975), while others have criticized it (Hannan, et al., 1977).

The competing values framework is a multi-dimensional framework for assessing culture and organizational effectiveness across two dimensions: structure and focus (Gregory, et al., 2009). Structure ranges from control on the one extreme and that of flexibility or autonomy on the other. It is this dimension that captures the difference between organizations that attempt to allow their employees to dictate their own behaviors and those that that strive for consistent patterns of behaviors (Quinn, et al., 1983). The focus dimension pits internal focused and external focused ideologies against each other. An internal focus emphasizes elements and factors internal to the organization, while an external focus emphasizes the organization's ability to function well in its environment. By attempting to capture these competing interests, the creators of the CVF model tried to compile it in such a way that one could use the model to conceptualize different organizational postures such as transformation versus equilibrium. They, also, wanted to be able to use the model to analyze paradoxical and logical organizational influences (Denison, et al., 1991).

There are multiple variants of this CVF culture domain model. (Denison, et al., 1991) proposed four competing cultures: Group Culture, Developmental Culture, Rational Culture, and Hierarchical Culture. These cultures are linked in a peculiar manner, reference Figure 8. The first axis shows the competing demands of stability and change, whereas the second axis illustrates the competing ideologies of internal organizational focus as opposed to an externally focused organization.

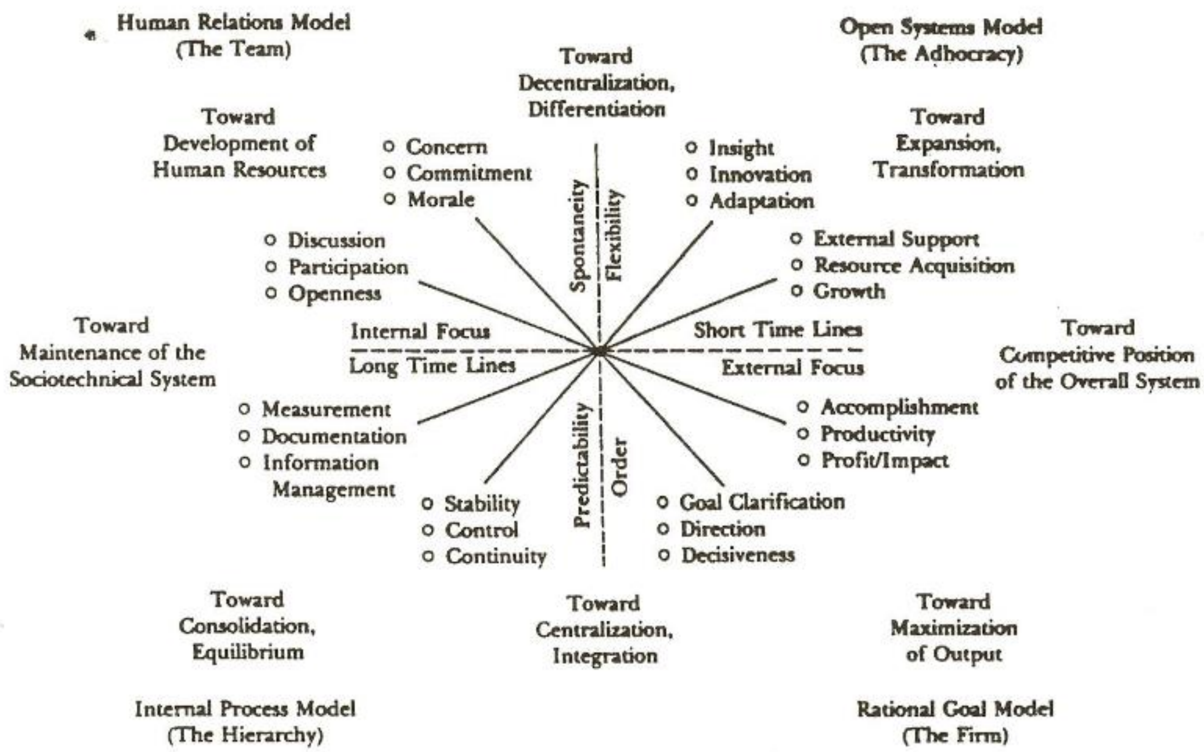


Figure 8 - Competing Values Culture Framework (Denison, et al., 1991)

Group Culture

The group culture is characterized by the value that its members believe exists as a result of a team or group mentality. Value that can only be attained by cohesiveness as a unit, and that is why, here, members of the group work very hard to reach consensus on decision making. It is a characteristic that, also, ranks highly among management, and is, therefore, something that management attempts to promote through mentoring, support, and enabling. On the Competing Values Culture Framework (Denison, et al., 1991) graph, reference Figure 8, the group culture is in the upper left quadrant. The group culture emphasizes the team mentality by way of its members placing their primary focus on the internal organization, and, more specifically, they focus on human relations and flexibility. The well-being of the group, itself is very important, such that group maintenance, is a priority. Core values are comprised of belonging, trust, and participation; motivators for those values are attachment, cohesiveness, and membership. Leadership within the group culture tends to be participative, respectful/considerate, and supportive, and it encourages interaction through teamwork. Success is measured by how well it members achieve development of human potential and member commitment.

(Denison, et al., 1991) assert that any culture orientation has a polar opposite, and that these opposites are very important. So, as discussed below, the developmental culture which emphasizes flexibility and external focus can be contrasted with the hierarchical culture, which stresses control and internal focus. As well, parallels between various orientations are very important. For example, group and developmental cultures share an emphasis on flexibility. They go on to say that the four culture types should be viewed as ideal types, and that organizations are very unlikely to represent one type of culture. Rather, different organizations will reflect varying combinations of the various culture types. Furthermore, this type of variation is postulated to be a healthy combination for organizations.

Developmental Culture

The developmental culture is in the upper right quadrant of the Competing Values Culture Framework diagram, reference Figure 8. It is characterized by its emphasis on flexibility and change, but maintains as its primary focus the external environment. According to (Denison, et al., 1991), this cultural alignment emphasizes growth, resource acquisition, creativity, and adaption to the external environment. Key motivators for this culture are creativity, growth stimulation, and variety. Leadership is entrepreneurial and idealistic, and willing to assume risk in both developing and fulfilling their vision for the organization's future. As well, these leaders focus on acquiring additional resources, acquiring visibility, legitimacy among peers, and external support. Effectiveness criteria include growth, development of new markets, and resource acquisition.

Rational Culture

This ideology is in the lower right quadrant of the Competing Values Culture Framework diagram, reference Figure 8, and emphasizes productivity, performance, goal fulfillment, and achievement. Organizational purpose tends toward pursuit and acquisition of well-defined objectives, while its members are motivated by competition and the desire to achieve predetermined ends. Leadership takes on a directive, goal orientated, instrumental, and functional role, and is always strives to provide structure, while keeping the teams focused on productivity. Criteria for effectiveness include planning, productivity, and efficiency.

Hierarchical Culture

The hierarchal culture is located in the lower left quadrant of the Competing Values Culture Framework diagram, reference Figure 8, and emphasizes internal efficiency, uniformity, coordination, and evaluation. It focuses on the logic and structure of the internal organization and emphasizes stability. An organizational purpose with emphasis on hierarchical culture tends to be the execution of regulations, while motivating factors include security, order, rules, and regulations. Leaders are, generally, conservative and cautious, paying close attention to technical matters, and not, readily, willing to assume risk. Effectiveness criteria include control, stability, and efficiency.

2.8.3 Cultural Balance

(Quinn, 1988) proposed that balanced cultures are the preferred culture type due to all organizations benefitting, to some extent, from all the values associated with each CVF culture domain. This idea is taken even further in postulating that employees, like the organization as a whole, benefits from a culture that values all four CVF culture domains (Gregory, et al., 2009). They believe that the supportive and cognitive frameworks created for individuals as a result of organizations' culture providing behavioral expectancies related to all four CVF domains (James, et al., 1978), employees develop more positive attitudes about the organization. Additionally, a balanced approach is inherently paradoxical, and, subsequently, organizations succeeding at balance are likely more sophisticated and perceived as more supportive (Gregory, et al., 2009). Furthermore, there are long term downsides for organizations and individuals alike when particular cultural dimensions are prevalent. Evidence suggests that cultural balance can be directly correlated to employee satisfaction as put forth by (Denison, et al., 1995).

2.8.4 Contingency Theory

Contingency theory can provide a systematic methodology for creating strategy as a result of particular environmental factors.

The ideals that form the backbone of contingency theory are (Morgan, 1996):

- Organizations are open systems that need to balance internal needs and to adapt to environmental circumstances.
- There is no single best way of organizing; rather it depends on the task or environment that is being dealt with.
- Management's top priority must be achieving good fits and alignments.
- Different organizational types are needed in different types of environments.

There are varying ideals about corporate contingency strategies and what they mean for organizations. Most contingency theory research to date has focused on its application with an organization's balance sheets as its primary metric, whereas the focus of this dissertation is the factors, specifically, influencing the success of engineering. There appears to have been little in the way of research into the impacts of corporate strategy based on contingency theory within engineering focused organizations; however, most researchers believe a strategy incorporating some form of contingency theory is necessary in order to maintain a healthy balanced approach (Hofer, 1975) within any organization. Indeed, (Ansoff, et al., 1967) believed that businesses should adapt continent business strategies for their research and development efforts as follows: When an organization experiences a high rate of change in the 'state of the art', it should focus its research and development efforts on new product designs and product improvements. But, when this rate is low, it should focus on process improvements, because this is, likely, where innovation would have the most impact.

2.8.5 Balanced Scorecard

Relying on such measures as traditional financial accounting provides an incomplete picture and hinders the creation of future business value (Kaplan, et al., 1992). A balanced scorecard is a formalized mechanism for allowing managers to influence business assessments by supplementing (1) financial measures with ones that reflect (2) customer satisfaction, (3) internal business processes, and (4) the ability to learn and grow (Kaplan, et al., 1996). This process is diagramed in Figure 9. It facilitates the linking of long-term strategic objectives with short-term actions. It is a decision support tool at the strategic management level (Martinsons, et al., 1999).

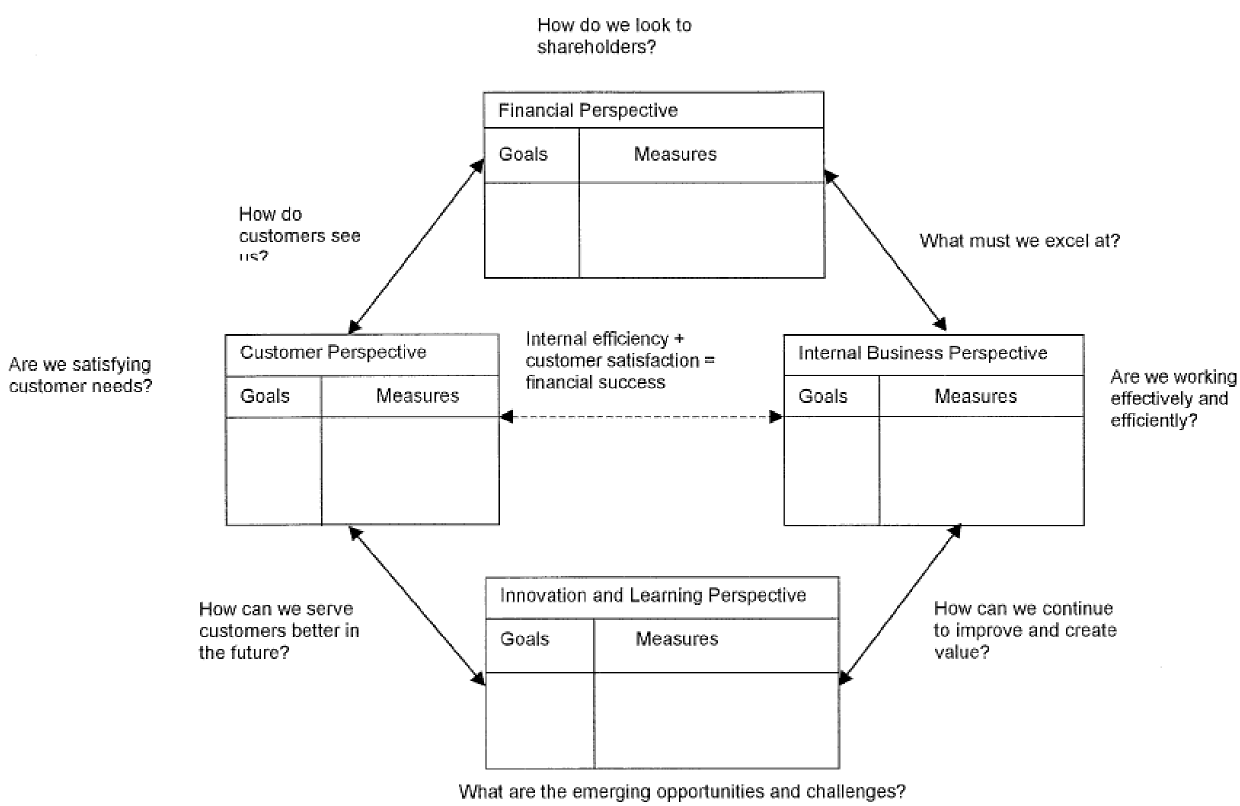


Figure 9 - Balanced Scoredcard Diagram (Martinsons, et al., 1999)

2.9 Roles of Leadership

There has been much research done into the impacts of leadership, in general, within the context of organizational cultures. (Burns, 1978) introduced the concepts of transformational and transactional leadership. Transformational leadership is a style that is characterized by uplifting the morale, motivation and morals of the individuals that fall under their direction. Transactional leaders, on the other hand, are those that cater to their followers' immediate self-interests. Essentially, transformational leaders would emphasize what you can do for your organization, whereas transactional leaders would emphasize what your organization can do for you (Bass, 1985).

Often, however, these proposed leadership styles are invoked in a prescriptive manner, or they are believed to be universalistic; however, this is not the case (Khanin, 2007). This author states that leaders must be aware that there are merits and shortcomings and specific organizational contexts in which they may be relevant, but there are other contexts in which they are not relevant. Therefore, the effective organizational structure will analyze, closely, the philosophical approaches, and select the elements that best fit their goals.

2.9.1 Transactional Leadership

There has not been as much research done into transactional leadership theory or the Leader-Member Exchange Model (LMX) of leadership as there has been done into transformational leadership styles. Transactional leadership is characterized by the advent of an individual taking initiative in making contact with others for the purpose of an exchange of something valued (Kuhnert, et al., 1987). This exchange, typically, takes place between a leader and a subordinate. There is, however, another similar type of exchange that takes place; it is known as Perceived Organization Support (POS), and occurs when an exchange takes place between an employee and the employing organization (Wayne, et al., 1997) . In many ways, one could argue that transactional leadership hearkens back to a more traditional leadership style than does the transformational leadership style. Essentially, transactional leaders engage in a sort of barter arrangement whereby both the superior and subordinate influence each other, reciprocally, such that each derives some benefit from the transaction (Burns, 1978). In his book, (Bass, 1985) expounded on this concept, and stated that transactional leaders focus on marginally improving and maintaining the status quo of performance, manipulating goals, minimizing resistance to actions, and on how to implement decisions. In all cases, transactional leadership can be summarized as the exchange of valued outcomes (Kuhnert, et al., 1987). It is a social exchange that entails some unspecified obligations; when one person does another a favor, there is an anticipation of some future return of the favor (Blau, 1964). Despite this anticipation, there is, usually, no specified timetable of the return, and, in many cases, what form the return will come in is unclear (Gouldner, 1960). Employees often take a long-term approach to these social exchange relationships, and the pattern of the returns over time help determine the perceived balance of the exchanges (Rousseau, 1989).

Despite this exchange there is evidence to show that not all of these exchanges are of equal value (Graen, et al., 1982). In fact, these authors state that there are two levels of transactions, and they classify them as: (1) Low quality; and (2) High quality. They found that employees who were involved in high quality transactions such as experiencing relationships that involved support and the exchange of emotional resources were less likely to leave an organization than employees who were involved in low quality transactions such as eight hours of pay in exchange for eight hours of work. They concluded that low quality transactions are based on the transaction of goods or rights, whereas high quality transactions incorporate some type of interpersonal relationship/bond (Landy, 1985).

Indeed, transactional leaders will utilize trade-offs in countless areas in exchange for some perceived benefit. For example, the kinds of transactions can range from the obvious such as new office furniture for increased productivity or promises of higher wages in exchange for successful implementation of a system, to the not so obvious transactional elements such as respect or commitment in exchange for increase productivity (Burns, 1978). These later elements of the promises or commitments that are based on exchangeable values such as respect and trust are referred to as modal values, and they, in some ways, link leaders to followers in an attempt to actualize the needs of both parties.

These exchanges were provided another basis by (Gouldner, 1960), who said that the norm for reciprocity is based on two assumptions: (1) Individuals should help those that have helped them; and (2) Individuals should not injure those that have helped them. (Gouldner, 1960), also, stated that the norm for reciprocity has benefits beyond the exchanges, themselves, in that it provides stability in social relationships, because the social roles require compliance by all who hold a particular role. These transactions, obviously, are linked to the leaders' ability to control resources such as pay increases, bonuses, and the like (Dienesch, et al., 1986) Furthermore, as a result of this, the authors conclude that there remain substantial shortcomings in the theory itself. They believe that more work needs to be done to explore whether leader-member exchanges may: (1) develop in a number of different ways; (2) differ in character based on which dimension (i.e. affect, loyalty, and contribution) is prominent; and (3) lead to different outcomes depending upon the nature of the developmental process and the resulting characteristics of the relationship.

In studying the impacts, possible links and idiosyncrasies of Perceived Organizational Support and Leader-Member Exchanges, (Wayne, et al., 1997), concluded that both were very important elements, and that the quality of the leader member exchange has a strong effect on perceived organizational support. They found significant support for the following hypotheses:

1. Numbers of developmental experiences (formal training, etc.) and promotions are positively related to perceived organizational support
2. Leader liking and expectations of an employee will be positively related to leader-member exchange quality
3. There will be a positive, reciprocal relationship between leader-member exchange and perceived organizational support
4. There will be a direct link between perceived organizational support and organizational citizenship behavior (employees helping others when they’re not required to, such as teaching a new employee something, or helping another catch up after they’ve been absent), but perceived organizational support will not be linked to performance ratings

5. There will be a positive correlation between leader-member exchange and performance ratings, and the same will exist between leader-member exchange and organizational citizenship behavior

6. Perceived organizational support will be positively related to affective commitment and negatively related to intentions to quit

7. Leader-member exchange will be positively related to the member's doing favors for the leader

While it is apparent that transactional leadership plays varying roles in organizational structures and compositions, it may not be the primary style of leadership that would offer the most contribution to the focus of this document which is success in technology organizations.

2.9.2 Transformational Leadership

Transformational leadership is characterized by someone attempting and succeeding in raising colleagues, subordinates, followers, clients, or constituencies to a greater awareness about the issues of consequence (Kuhnert, et al., 1987). (House, 1977) ascertains that charismatic leadership theories are a hybrid approach to leadership and that they include elements of many other theoretical approaches, such as behaviors, traits, attributions, and situations to leadership.

2.10 Literature Synopsis

As a direct result of the tedious task of reviewing relevant literature, there has been significant evolution in the author's opinion and foundational assumptions for approaching the research for this dissertation. It is readily apparent to the reader from the Makeup of

Technology section that: *Technology* is created competence. It is expressed in technological entities consisting of devices, procedures, and acquired human skills (Clarke, 2005). There are four ideas about this definition that are important:

- Created describes the artificial nature of technology. It is created, and does not spontaneously occur in nature.
- Competence emphasizes that technology is concerned with the ways and means for taking actions. Technology is not concerned with the final ends of doing so.
- Technological entity can be described as a repository of competencies.
- Devices, procedures, and acquired human skills reflect the constituent elements of a technological entity. Within this category, the implied hardware and software components are quite easily imagined. However, the term skill needs a clarification. Within the confines of technology, certain types of human skills are included, humans are not. Humans are not technological entities, and are not part of the definition of technology.

High tech or *high technology* is technology that is at the cutting edge: the most advanced technology currently available (Wikipedia).

Technological is a term that is used to qualify operations, activities, situation, or phenomena that involve technology to a significant extent.

2.10.1 Definition of Success within the Context of Technology

From the literature review, we concluded that term success, within the context of this research, encapsulates the following components:

1. Perception

2. New job creation
3. Patent creation
4. Financial stance/profitability

2.10.2 Influences on Creativity

Key factors influencing creativity were broken down into five broad categories:

1. Encouragement of creativity
2. Autonomy or freedom
3. Availability of resources
4. Pressures
5. Organizational impediments to creativity

Two of those categories were broken down further: first, encouragement of creativity was separated further down into organizational encouragement, supervisory encouragement, and work group supports; and secondly, pressures were separated into challenging work and workload pressures. Challenging work was a promoter of creativity, while workload pressures were impediment to creativity.

2.10.3 Influences on Innovation

The literature showed that the factors having the greatest impact on innovation were separated into six broad categories:

1. Organization culture dedicated to innovation
    - One that explicitly recognizes the collective nature of innovation efforts

2. Prior organizational experience with innovation

3. R&D teams with multidimensionality with respect to members' education, experience, and balancing of technological and marketing skills

- Clearly articulated organizational strategy towards innovation

4. Includes a management style that complements the strategy

5. Comparability of an innovation's product quality and price to those of existing products

6. Good market introduction timing

Other considerations included strategic influences which are to say the current rate of change in the 'state of the art' with respect to introducing new innovation into the market. Finally, although the concept of open innovation wasn't something that influenced innovation, per se; it was noted that open innovation is an ideological approach towards innovation that has gained significant momentum among technology organizations in recent years.

2.10.4 Influences on R&D

In a synopsis across multiple studies, researchers found that R&D organizations place emphasis on factor types as follows, and in order of most significant to least significant.

1. Organizational factors were cited as being the most impactful on R&D. This, despite the fact that there was considerable disagreement regarding the impacts of the individual factors.

2. Strength of market metric that encompasses several components, including whether there is an existing market for a given technology and what phase market is in (growth or other)

3. Technology factors included considerations as to what 'level' of innovativeness a given R&D effort would yield.

4. Environment, it was determined, was the least impactful. It was something that should be considered though.

As well, it was ascertained that knowledge capacities of any particular R&D organization do influence its success rates.

2.10.5 Significance of Organizational Conceptualization

Literature review regarding organizational conceptualization focused on cultural balance and contingency theory, and linked those items together using metatheory known as the competing values framework. This framework seeks to systematically balance competing values and ideals such as structure versus focus in optimal scenarios for the benefit of the organization's effectiveness.

2.10.6 Significance of Leadership

Leadership was shown to be a significant within any organizational culture. The two types of leadership most relevant to success within technology organizations were transactional and transformational.

2.11 Modern Approach to Technological Revolution

2.11.1 Google

Google, an online search engine provider, has been very successful by any definition, and has become well known as one of the most innovative organizations ever. As of 2008, the only company to rival them in terms of Information Technology (IT) and business architecture, experimentation, improvisation, analytical decision making, participative product development, and other relatively unusual forms of innovation was Microsoft (Iyer, et al., 2008). Although, the company has embarked on a wide variety of business ventures, from radio and television advertising to mobile phone operating systems, its core are the online search and advertising industry. These core business ventures, in many ways, have enabled the extension into other business ventures. A key contributing factor to Google's success is the emphasis placed on their individual engineers, the esteem and respect for their ideas. Everyone has a voice, anyone can be heard, and every employee is very much aware of this.

Despite a track record of innovation, their philosophy remains a simplistic one. In the words of co-founder, Larry Page, "The perfect search engine would understand exactly what you mean and give back exactly what you want." (Google, 2009). As well, a mission statement that is as simple as it is insightful, namely: "To organize the world's information and make it universally accessible and useful." Their ten core principles are summarized as (Google, 2009):

- Focus on the user and all else will follow
- It's best to do one thing really, really well
- Fast is better than slow

- Democracy on the web works
- You don’t need to be at your desk to need an answer
- You can make money without doing evil
- There’s always more information out there
- The need for information crosses all borders
- You can be serious without a suit
- Great just isn’t good enough

It is a culture that attracts the brightest technical talent, so much so, that for every open position, Google receives 100 applicants (Iyer, et al., 2008). The authors of this paper, state that based on information obtained through different venues (to include Google searches), there are seven key concepts that have affected the organization’s success in innovation and implementation, and they are: (1) practice strategic patience; (2) exploit an infrastructure “built to build”; (3) rule your own ecosystem; (4) exercise architecture control; (5) build innovation into organization design; (6) support inspiration with data; and (7) create a culture built to build. These concepts are summarized, as follows.

Practice Strategic Patience.

In a world where companies and their executives tend to be focused on the present, immediate and near term future, Google has shown great patience in setting its sights on a time frame for achieving its goals. Indeed, CEO Eric Schmidt has stated that he believes it will take the company three hundred years to achieve its mission of organizing the world’s information. Despite their willingness to stay focused on a long term goal, the company recognizes that not everything will take three hundred years. An unexpressed, secondary, yet very important commercial mission is to monetize consumers' intentions, as evidenced by their searches and other online activities (Iyer, et al., 2008).

Exploit an Infrastructure "Built to Build"

The second part of Google's organizational strategy calls for creating an infrastructure that, essentially, outpaces the competition both in its ability to provide services, now, and one that is easily adaptable to new ideas, markets, and products. To do this, the infrastructure must incorporate scalability, the ability provide accelerated product-development life cycles, and support for third-party development and mashups. In 2007, Google's infrastructure consisted of approximately one million computers. Scalability allows this very complex network to, easily, incorporate additions and changes. So, their technicians can add new computer clusters as dictated by market demand, and the clusters will be instantaneously recognized and available for use on the network. Additionally, the company has created a proprietary database than can efficiently and quickly handle growing volumes of data.

Their scalability is complemented by the capacity to facilitate accelerated product-development life cycles. When any new product is developed is can be placed on the network for immediate availability and use. It becomes a test bed for the product. If customers respond enthusiastically, the infrastructure immediately recognizes it, and makes room to accommodate the application's computing needs. This system basically bonds the testing functions and marketing functions into a single efficient operation.

Finally, Google has worked to create an infrastructure that is more efficient and reliable than the internet; thereby, providing a better user experience for the consumer. Additionally, the organization wanted to make their infrastructure such that it was easily adapted to third-party applications. Indeed, the intent was to set up their network in a way that developers would build products that incorporate Google's own proprietary products. An example is that the real estate company Zillow.com could focus on obtaining and presenting real estate sale and value date, and leave the mapping and display elements to Google.

Rule Your Own Ecosystem

In the discussion above, an ecosystem has, essentially, been described. In this sense, Google is the owner and operator of the ecosystem, and, as such, can claim a disproportionate percentage of the value created within it. In other words, with every transaction that takes place on this platform, Google stands to benefit from it. A pictorial diagram of this ecosystem is shown in Figure 10.

Exercise Architectural Control

Obviously, Google has the capability to, and does exercise complete architectural control. It does this, in many ways, without raising "red flags" from potential partners. The success of most new partnering business ventures are purely speculative, and will not be clear until after the product has been unveiled. Google can allow third parties to innovate and test the application prior to engaging in contract or revenue-sharing negotiations. Although, the third party benefits from exploring whether or not the application will be a success,

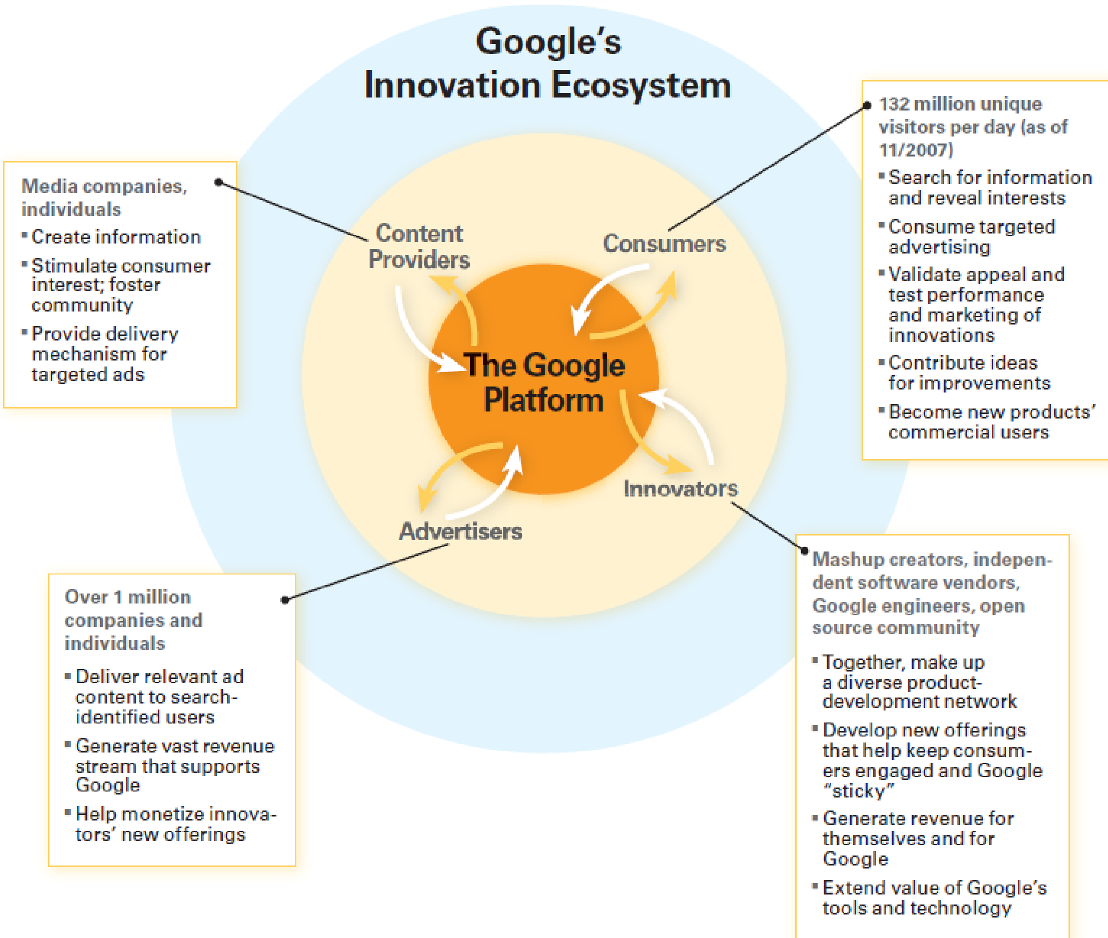


Figure 10 - Google Ecosystem (Iyer, et al., 2008)

Google still retains architectural control, subsequently, it can choose whether to carry the product or not.

Build Innovation into Organizational Design

The Google organizational culture is such that innovation is built in. There are four key elements of this: (1) budget innovation into job descriptions; (2) eliminate friction at every turn; (3) let the market choose; and (4) cultivate a taste for failure and chaos. At Google, employees are required to spend 80% of their time on the core search and advertising businesses and 20%

of their time on technical project of their own choosing. Managers are required to dedicate 70% of their time on the core business, 20% to related but different projects, and 10% on entirely new products and services. Secondly, engineers are expected to effect change, and the organization is set up such that when a change is proposed, it is reviewed, perfected, and implemented in very short order. In other words, eliminate friction or barriers to progress. Thirdly, Google doesn't try to tell consumers what they need, or what will work best for them. Rather, the philosophy is to innovate, and allow consumers dictate the product's evolution and progression. Finally, Google expects ideas and projects to fail. They recognize that innovation carries risk, and that success cannot happen without failure. Employees are encouraged to take risk, and realize that they may fail.

Support Inspiration with Data

Senior leadership at Google expect, when presented with ideas about new business, projects, etc., to have available to them substantial data regarding the viability of the project or product. Employees are expected to not only think and come up with new ideas, but to research those ideas. Essentially, they should discover whether or not there is reason to believe that the idea could be a success, and if so, compile data to support this opinion.

Create a Culture Built to Build

All of these components combine for what (Iyer, et al., 2008) call a culture built to build. The organizational culture places high value on great ideas, and even goes so far as to link employees' compensation to the quantity of quality ideas. To provide further intellectual stimuli to employees, the company does a host of things. One of which is to have "Tech Talks" regularly at company headquarters from industry titans and leaders. All these things have combined to make one of the most prolific and successful innovative companies in the history of the world.

CHAPTER 3 METHODOLOGY

3.1 Introduction

As was documented in chapter two, definitive information on the subject of success within technology organizations is sparse, and information regarding similar constructs such as innovation and R&D is somewhat contradictory and inconclusive.

The purpose of this dissertation is to ascertain from the perspective of the CTOs of a population of very successful technology organizations which factors are key to success within technology organizations, and the factors that are the largest impediments of the same. Furthermore, it is to extend this idea to include a basic construct that states than an innovator can have a profound impact on an organization.

Arguably, no organization exhibits the ideal mix of cultures and influences in the ideal way for the true optimum organizational efficiency and creativity. One difficult task in researching success factors within technology organizations is to identify and link the ideal management of technology organizations to the real world management. So, for this study one of the challenges becomes delineating the impacts of the imperfect aspects of management on the organizations' performance from those positive impacts that we wish to evaluate.

3.1.1 Methodology Outline

Data collected from a few select technology organizations will be used to build the desired theory by using case study research (Eisenhardt, 1989). Formally, case study is a research strategy which focuses on understanding the dynamics present within single settings

(Eisenhardt, 1989). A benefit of using the case study approach is that the examination of data is often conducted within the context of its use (Yin, 1994). However, there is more to protocol than the instrument; Yin (1994) reminds researchers that the development of rules and procedures contained within a methodology like case study research enhance its reliability.

It has been postulated that the four most common methodological areas of weakness within research of this type are: (1) quality of data; (2) definition of new product; (3) factor selection and definition; and (4) measurement of factors (Balachandra, et al., 1997). So, particular attention will be paid to ensure that these areas either are not problems here, or that they are adequately mitigated.

The methodology used to conduct this research will follow Eisenhardt's (1989) process for building theory from case study research as outlined on in Table 4.

Table 4 - Process of Building Theory from Case Study Research (Eisenhardt, 1989)

Step	Activity	Reason
Getting Started	Definition of research question Possibly a priori constructs Neither theory nor hypotheses	Focuses efforts Provides better grounding of construct measures Retains theoretical flexibility
Selecting Cases	Specified population Theoretical, not random, sampling	Constrains extraneous variation and sharpens external validity Focuses efforts on theoretically useful cases – i.e. those that replicate or extend theory by filling conceptual categories
Crafting Instruments and Protocols	Multiple data collection methods Qualitative and quantitative data combined	Strengthens grounding of theory by triangulation of evidence Synergistic view of evidence Fosters divergent perspectives and

Step	Activity	Reason
	Multiple investigators	strengthens grounding
Entering the Field	Overlap data collection and analysis, including field notes Flexible and opportunistic data collection methods	Speeds analyses and reveals helpful adjustments to data collection Allows investigators to take advantage of emergent themes and unique ideas
Analyzing Data	Within case analysis Cross-case pattern search using divergent techniques	Gains familiarity with data and preliminary theory generation Forces investigators to look beyond initial impressions and see evidence thru multiple lenses
Shaping Hypotheses	Iterative tabulation of evidence for each construct Replication, not sampling, logic across cases Search evidence for “why” behind relationships	Sharpens construct definition validity, and measurability Confirms, extends, and sharpens theory Builds internal validity
Enfolding Literature	Comparison with conflicting literature Comparison with similar literature	Builds internal validity, raiser theoretical level, and sharpens construct definitions Sharpens generalizability, improves construct definition, and raises theoretical level
Reaching Closure	Theoretical saturation when possible	Ends process when marginal improvement becomes small

In researching success factors in technology organizations, the methodology will be broken into three top level categories: (1) Conceptualization; (2) Operationalization; and (3) Conclusion. These categories and their individual components flow according the diagram in Figure 11.

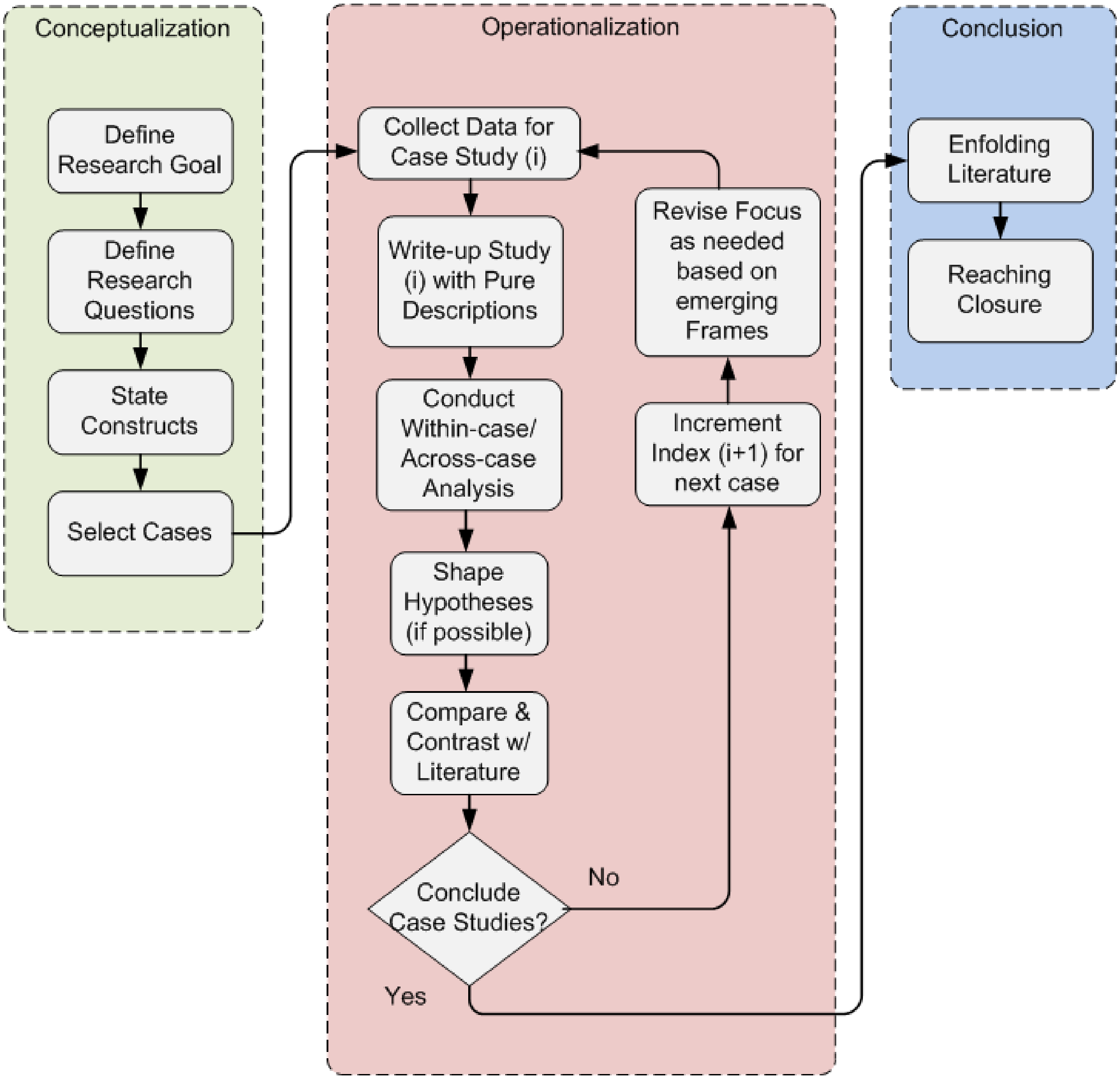


Figure 11 – Methodology Phases and Flow

3.2 Conceptualization

This section includes the research goals and questions, followed by the establishment of the constructs that are requisite to the operationalization of the research. From Table 4 above, this section incorporates Steps: (1) Getting Started; (2) Selecting Cases; and (3) Crafting

Instruments and Protocols. That is, this section covers every part of the process prior to Entering the Field.

3.2.1 Research Goal

The goal of this research is to develop, test, and validate a framework for assessing technology organizations' propensity for success. The long term goal is to use this research to build a foundation from which I influence technology organizations for the better. It is to facilitate the expansion of my own knowledge and capacity to influence this community.

3.2.2 Research Questions

The result of this research will be the refinement of our knowledge and understanding of what factors lead to success or failure, as defined later in this chapter, within technology organizations. To ascertain this, the following questions will be answered.

- What are the key elements that foster success within a technology based organization?
    - How can those elements, most effectively, be influenced?
- What are the key organizational cultural components that will impede a technology based organization's quest for success?
    - How can those components, most effectively, be influenced?

3.2.3 Defining Success

A prerequisite to researching factors influencing success is to establish a meaningful way to assess technology organization successfulness. Using a single criterion to assess success is problematic, because it may not accurately represent the level of success of the organization; furthermore, it does not facilitate a robust level of organization success ranking scheme.

Two different interpretations of success will be applied as outlined in Sections 3.3.1 and 4.5.1. Prior to an organization being invited to participate in the study and to obtain a general feel for the organization's success, companies will be scored according to a combination of quantitative metrics (revenue growth, new job creation, and patent creation) and un-scientific qualitative metric (public perception of success). Since these factors play a role in the population selection for the study, they will be more fully discussed in the operationalization section. After data has been collected, it will be compared to the equally weighted purely quantitative metrics of revenue growth and new job creation.

3.2.4 Constructs

The foundation for this research is the belief and understanding that technological organizational success is influenced by certain factors; furthermore, an extrapolation of the ideas and findings of similar research discussed in Chapter 2 is evidence that the same sort of relationship exists with technology organizations. Each of those previously discussed studies found that there were factors that had either positive or negative impacts on the particular subject of their respective research, be it creativity, innovation, R&D, or otherwise.

The basic constructs for this research are:

1. Technology and technology organizations are essential components of the effective evolution of society.

2. Successful technology organizations lead to greater and more efficient technological advancements.

3. Innovators have a profound impact on technology organizations.

4. Organizational and cultural environmental factors influence the success rates of technology organizations.

5. Basic human relations ideas and principles influence every element of society, including technology organizations (Carnegie, 2009).

Innovators and Innovation as Components

A cornerstone of this research is the third construct. It is the belief that innovators play a key role in the success of technology organizations. This construct will guide the tone of the questionnaires and interviews. It is to explore and establish the correlation of the impact that a vision, innovative ideology, and innovator has on an organization's success.

3.2.5 Case Selection

Case study research relies on theoretical sampling (Eisenhardt, 1989); in other words, cases are chose for theoretical reasons, not statistical (Glaser, et al., 1967). Indeed, cases need not be chosen randomly; furthermore, random selection is neither necessary nor preferable (Eisenhardt, 1989). For this type of study, the goal for sampling is to achieve accurate statistical evidence on the distributions of variables within the population (Eisenhardt, 1989).

So, cases for this research will be chosen based on the desire to examine a cross section of technology organizations. Once the basic population is defined, the level-of-success criteria discussed in section 3.2.3 will be calculated and applied to narrow the field. A consideration at the forefront, specifically, is whether or not the case is one of innovative leadership and key players profoundly impacting the organization's success.

This study will focus on technology organization with annual revenues of less than $300 million per year. Broad representation within the study of technology organizations from varying financial positions will be achieved by selecting organizations with a broad spectrum of annual revenues. Cases will be selected from across the spectrum of technologies within the population, so selections will include diversity of organizational technology focus with the desired diversity including defense industry, manufacturing, engineering/technology support, and technology based service providers.

Each participant will be offered the guarantee of anonymity and in the end provided a synopsis of the findings.

3.3 Operationalization

This section describes those practical activities necessary to answer the research questions and build the desired theory; it is the operationalization of the research. From (Eisenhardt, 1989)'s Table 4, this section comprises Steps: (4) Entering the Field; (5) Analyzing Data; and (6) Shaping Hypotheses.

In keeping with the process of building theory with case studies outlined by (Eisenhardt, 1989), an iterative method will be used. So, as data is collected and as data collection progresses, feedback will be provided to interviewees. As prominent factors begin to emerge, further exploration of those factors will be incorporated as questions within subsequent research and interviews.

3.3.1 Candidate Organization Success Assessment

The following procedure will provide the basis for assessing the level of success of prospective participant organizations. A high level of success score is not a prerequisite to inclusion in the study, but it will provide a relative early indication of organizational success. This metric will incorporate the indicators of company x as follows: (1) revenue growth in 2011 as A_x; (2) job creation in 2011 as B_x; (3) patent creation in 2011 as C_x; and (4) perception of success in 2011 as D_x.

Each metric's minimum individual score is zero, and its maximum individual score is ten. Higher scoring organizations indicate the organizations are enjoying more success than lower scoring ones. A metric score of zero indicates an approximate status of equilibrium where there is neither growth nor recession. Since, organizations experiencing recession were of no interest to this study, it was not necessary to incorporate a metric that accounts for negative growth.

Metric Weights

The success scoring will be a weighted combination of the above factors, and the sum of the individual weights will equal one. Where α, β, γ, and δ are the weights applied to individual metrics, the equation is:

$$\boldsymbol{S_x = \alpha(A_x) + \beta(B_x) + \gamma(C_x) + \delta(D_x),} \tag{3.1}$$

Revenue Growth in 2011

Revenue growth (A_x) is an important indicator of growth oriented successful technology organizations. Therefore, its weight, α, is assigned a value of 0.4 in this pre-research success assessment and its scoring will be as follows:

Table 5 - Revenue Growth Scoring

Score	Profitability Ratio (Net income/Revenue)
0	Revenue growth as a percentage of revenue: 0.0 - 07.9%
1	Revenue growth as a percentage of revenue: 08.0 - 15.9%
2	Revenue growth as a percentage of revenue: 16.0 - 23.9%
3	Revenue growth as a percentage of revenue: 24.0 - 31.9%
4	Revenue growth as a percentage of revenue: 32.0 - 39.9%
5	Revenue growth as a percentage of revenue: 40.0 - 47.9%
6	Revenue growth as a percentage of revenue: 48.0 - 55.9%
7	Revenue growth as a percentage of revenue: 56.0 - 63.9%
8	Revenue growth as a percentage of revenue: 64.0 - 71.9%
9	Revenue growth as a percentage of revenue: 72.0 - 79.9%
10	Revenue growth as a percentage of revenue: 80% or greater

Job creation in 2011

Although, new job creation (B_x) is not a universal indicator of success of a technology organization within the context of this research, it is an important indicator. As such, its weight, β, is assigned a value 0.3. For the purpose of scaling new job creation, each organization's new job creation score will be the ratio of new jobs to existing jobs, within a given year. The scoring will be as follows:

Table 6 - New Job Creation Scoring

Score	Description
0	New jobs as a percentage of total jobs: 0.0 - 07.9%
1	New jobs as a percentage of total jobs: 08.0 - 15.9%
2	New jobs as a percentage of total jobs: 16.0 - 23.9%
3	New jobs as a percentage of total jobs: 24.0 - 31.9%
4	New jobs as a percentage of total jobs: 32.0 - 39.9%
5	New jobs as a percentage of total jobs: 40.0 - 47.9%
6	New jobs as a percentage of total jobs: 48.0 - 55.9%
7	New jobs as a percentage of total jobs: 56.0 - 63.9%
8	New jobs as a percentage of total jobs: 64.0 - 71.9%
9	New jobs as a percentage of total jobs: 72.0 - 79.9%
10	New jobs as a percentage of total jobs: 80% or greater

Patent Creation in 2011

Patent creation (C_x) is an indicator of success within technology organizations; however, it has substantial shortfalls. As discussed in Chapter 2, patent creation as a metric is inconsistent because studies have shown that some organizations make patenting innovation a priority, while others do not (Silverman, 1999). As a result, patent creation's weight, γ, is given a value of 0.2.

This indicator will need to be scaled in order to achieve a meaningful relative scoring. It will be scored according to the ratio of new patents per year per 100 employees. The scoring will be as follows:

Table 7 - Patent Creation Scoring

Score	Ratio of Patents per year to Every 100 Employees
0	0.0 - 0.07 patents created per 100 employees
1	0.08 - 0.15 patents created per 100 employees
2	0.16 - 0.23 patents created per 100 employees
3	0.24 - 0.31 patents created per 100 employees
4	0.32 - 0.39 patents created per 100 employees
5	0.40 - 0.47 patents created per 100 employees
6	0.48 - 0.55 patents created per 100 employees
7	0.56 - 0.63 patents created per 100 employees
8	0.64 - 0.71 patents created per 100 employees
9	0.72 - 0.79 patents created per 100 employees
10	0.8 or more patents created per 100 employees

Perception of Success in 2011

Public perception (D_x) as an indicator of growth and success is very subjective and may seem to be too vague within the scientific community; however, it can provide some level of insight into selecting organizations. Since its contribution is the most subjective, its weight, δ, is assigned a value of 0.1.

On a scale of 0 to 10, it will be assigned a value based on the subjective assessment of public perception as a result of reports from media outlets. The lack of a scientific basis for this factor is accounted for in its meager weight in this assessment. A score of zero indicates the company is perceived as unsuccessful, and a score of 10 shows it’s perceived as very successful.

Scaling Synopsis

With respect to pre-research assessment of technology organization success of candidate organizations, obviously, higher scores indicate more successful companies.

Although, a scoring of less than five will not provide conclusive evidence that the organization is a failure, it will show that the organization is not as successful as higher scoring organizations.

3.3.2 Data Collection

This research will adhere to three core principles of data collection: (1) Use multiple sources of data; (2) Create a case study database; and (3) Maintain a chain of evidence (Yin, 1994). These principles allow for establishing a robust foundation from which to draw conclusions. As well, the use of multiple-source data will aid in validating the findings (Iverson, et al., 2006).

Multiple data collection methods will be used so as to allow for triangulation of the evidence (Tellis, 1997). Triangulation is the combination of two or more data sources, methods, or investigators to converge on a single construct (Krippendorff, 2004). There are four types of triangulation: (1) data source triangulation where the researcher looks for the same pattern within different contexts; (2) investigator triangulation where multiple researchers examine the same phenomenon; (3) theory triangulation where investigators with different points of view look for the same results; and (4) Methodological triangulation when one approach is followed by another in search of the same results (Denzin, 1984). This research will work to achieve the first two items: data source triangulation and investigator triangulation.

These sources will be in the following forms:

- Publicly available data such as that derived from web sites, SEC filings, etc.
- Interviews
- Surveys/questionnaires

These listed sources are a subset of and consistent with the six established primary sources of evidence for case study research. Those six primary sources of evidence are: (1) documentation; (2) archival records; (3) interviews; (4) direct observation; (5) participant observation; and (6) physical artifacts (Yin, 1994). The table shown below summarizes the types of evidence according to their strengths and weaknesses (Tellis, 1997):

Table 8 - Types of Evidence (Tellis, 1997)

Source of Evidence	Strengths	Weaknesses
Documentation	Stable - repeated review	Retrievability - difficult
	Unobtrusive - exist prior to case study	Biased selectivity
	Exact - names, etc.	Reporting bias - reflects author bias
	Broad coverage - extended time span	Access - may be blocked
Archival Records	Same as Documentation	Same as Documentation
	Precise and quantitative	Privacy might inhibit access
Interviews	Targeted - focuses on case study topic	Bias due to poor questions
		Response bias
	Insightful - provides perceived causal inferences	Incomplete recollection
		Reflexivity - interviewee expresses what interviewer wants to hear
Direct Observation	Reality - covers events in real time	Time-consuming
	Contextual - covers event context	Selectivity - might miss facts
		Reflexivity - observer's presence might cause change
		Cost - observers need time
Participant Observation	Same as Direct Observation	Same as Direct Observation
	Insightful into interpersonal behavior	Bias due to investigator's actions
Physical Artifacts	Insightful into cultural features	Selectivity
	Insightful into technical operations	Availability

The Tailored Design Method (Dillman, et al., 2008) will be used as a guide for all data collection of this research. Consistent with this methodology will be that some of the initial questions will be asked in such a way as to influence the surveyed's opinion on such things as the definitions of technology, success, and innovators. This is important because it will help establish a baseline for every participant in the study.

From a top level point of view, data will be collected in a systematic manner.

1. Publicly available data will be scoured to identify organizations of interest and to gain as much insight as possible about those organizations.

2. Level-of-success will be calculated according to the previously established process.

3. Interviews, as the preferred method, will be sought out and conducted with key players within organizations of interest. Interviews will be conducted according to the Tailored Design Method.

4. Electronic surveys will be sent to organizations that are not available for interviews but are willing to respond to surveys. Those surveys will utilize a Tailored Design Method.

Publicly Available Data

Publicly available data includes multiple sources: websites, news outlets, research institution publications, etc. This portion of the data collection will play an important role, especially in the beginning stages of the research. Specifically, publicly available data will serve to:

- Provide the basis for initial case study selection by providing an initial indication of technology organization success
- Provide alternative sources and points of view of data collected elsewhere

Interviews

It is intended that interviews will be the primary data source for this research. The intent of these interviews is to explore key factors of technology organization success. Interview questions will be structured to try and get the subject to open up and reveal information to which the interviewer was not only, not privy, but also had no inkling or basis for attempted discovery (Zainal, 2007). To this end, interviews will include two distinct segments: (1) a structured format where the interviewee is asked to respond to particular questions from the interviewer; and (2) an open-ended format whereby the interviewee is provided the opportunity to postulate his ideas of the factors success. The factors presented for ranking and discussion will be those identified as potentially influential, from the literature review with respect to other topics, including work environments, creativity, innovation, R&D, organizational conceptualization, and leadership roles. A listing of the salient factors as it relates to the aforementioned topics is as follows:

- Organizational (work environment, individual autonomy, resource availability, pressure, strategy, organizational structure, organizational size, knowledge capacities, and open or closed innovation style)
    - Individualism (creativity, and experience)
    - Group/Team (synergy and attitudes)

- Job or Project (complexity, challenge, management tone and style, supervisory support, and senior management support,)

- Product (quality, innovativeness, degree of technicality, patentability, and perceived value)
- Market (competitive pressures, market timing, and support from marketing personnel)

As well, a key focus of the interviews will be to ascertain if the success of the organization can be attributed in large part to a single or select group of innovators. If so and if the innovator is not the interviewed, a request for an interview with the innovator will be made. This purpose of this will be to hone in on what that innovator's keys to success are.

Surveys/Questionnaires

Surveys will be used to obtain input from a few select organizations which are not readily available for interviews. This data will be used as a cross check of that attained from publicly available data and interviews.

Surveys will be designed utilizing the Tailored Design Method (Dillman, et al., 2008). Many of the survey questions will utilize a Likert scale and will be the same as the questions asked in the interviews. A likert item is a ranked scaling method which provides a way of measuring either positive or negative responses. In addition, there will be open ended questions within the questionnaires, and these questions will be structured in such a way so as to encourage the participant to share more information.

In conducting these surveys, the literature review revealed that paper questionnaires are more likely to get a response than email questionnaires, and email pre-notices are more effective at boosting response rates than are paper pre-notices (Kaplowitz, et al., 2004). Emailed pre-notices are more effective, even when used to precede a paper questionnaire.

As a result of limited resources, electronic surveys will be used as opposed to paper questionnaires, and they will be preceded by emailed pre-notices.

Field Notes and Case Study Database

Field notes will be kept, which are an ongoing stream-of-consciousness commentary about what is happening within the research. The field notes will include any and all specific impressions that occur, as it will be difficult to know at any time whether a particular detail or impression will be useful in the future (Eisenhardt, 1989).

A case study database will be maintained that provides a brief synopsis of all the participants' selection criteria scoring and a descriptive write-up of each case study.

3.3.3 Data Analysis

Analyzing data is a central component of any research. Data analysis is both the most difficult and least codified part of the process, and more so, in the case of case studies, because the research problem is often open ended (Eisenhardt, 1989). Eisenhardt states that it is desirable to force the researcher to go beyond initial impressions by utilizing structured and diverse analysis methods. A pitfall of case study research is that the amount of data can be overwhelming, so much so, that there is the danger of the research being terminated due to the lack of ability to manage the data (Mintzberg, et al., 1985). This is the basis for conducting within-case analysis as outlined as follows.

Within-case Analysis

A detailed case study write-up will be made of each site, and these write-ups will consist of simple pure descriptions of the observations. These descriptions are important because they facilitate the researcher coping with the large amount of data (Pettigrew, 1990). These write-ups will include tabular displays, graphs, etc., and a comprehensive descriptive discussion of each case study; the overall goal is to become intimately familiar with each case as a stand-alone entity (Eisenhardt, 1989). This write-up will be written immediately after having conducted an interview or having received a survey/questionnaire.

Across-case Pattern Analysis

Across-case pattern searching will complement the within-case analysis. The intent here is to circumvent the trap of prematurely leaping to conclusions as a result of information-processing biases (Kahneman, et al., 1973). When something is observed within a single case study, it may not be significant; however, if the same phenomenon is observed across multiple cases, it is more likely to be indicative of a pattern. There are tools to aid in accomplishing cross-pattern analysis. One is for the researcher to select or choose categories or dimensions, and then evaluate the data across those categories or dimensions (Eisenhardt, 1989). An alternative is to select pairs of cases and list the differences and similarities across the pairings. Both of these methods will be used in conducting across-case pattern analysis.

3.3.4 Shaping Hypothesis

At this point and from the analysis, impressions, tentative themes, concepts and possibly even relationships will begin to emerge. Here, the emerging frames will be systematically compared with the evidence from each case for the purpose of evaluating how well it agrees with the case data. This research will make use of an iterative approach towards establishing theory that fits the data. This iterative approach dictates that, as the research progresses, the incremental discoveries and findings are wrapped back into the research such that future activities incorporate and explore those areas.

As the process begins to unfolds, it will become important to begin sharpening the constructs, and that this will be a two part process: (1) refining the definition of the construct; and (2) building evidence which measure the construct in each case (Eisenhardt, 1989). This will occur when evidence from observed and diverse sources begin to converge into a single well-defined construct.

Replication across case studies which confirm emergent relationships will enhance confidence in the validity of the relationships, whereas contradiction across case studies will be used as an opportunity to refine the theory, itself. Here, the data provides keen insight into why or how a relationship holds.

As the research progresses and factors effecting success in technology organizations begin to emerge, a thorough evaluation of technology organizations' understanding and interpretation of the definitions and measures of those factors will be performed. If these organizational interpretations vary significantly, this research will attempt to develop meaningful definitions and measures of those same factors.

The shaping hypotheses processes within theory-building research are very similar to traditional hypothesis-testing; however, theory-building research processes are more judgmental because traditional statistical tests cannot, generally, be applied (Eisenhardt, 1989); therefore, the data will be evaluated to see if statistical tests are appropriate. If they are, then the tests will be performed.

3.4 Case Study Synopsis

This section represents the final aspects of the research. It is where the findings are contrasted with existing literature, and the point where closure is attained.

3.4.1 Enfolding Literature

The final stages of building theory from case study research includes contrasting existing literature to the relationships and constructs established within the data analysis phase. The literature comparison is an essential component of this process. It is to answer the questions: what are similarities between the literature and observed relationships and constructs; what are the contradictions; and why? The reconciliation of agreement and contradiction between the research and literature are vitally important. Legitimate agreement can serve to boost confidence in the overall conclusions; while contradictions may provide meaningful insight. In either case, the comparisons will be carefully analyzed and explored. As well, the literature comparison will serve to tie together underlying similarities that would not otherwise be linked.

Eisenhardt (1989) concludes that linking emergent theory to existing literature enhances validity, generalizability, and theoretical level of theory building from case study research. Furthermore, it is critically important within the context of case study research because of the very limited number of cases.

3.4.2 Reaching Closure

Two considerations here are prominent: (1) when to stop adding cases; and (2) when to stop iterating between theory and data. Ideally, researchers should stop both activities when they have reached theoretical saturation (Eisenhardt, 1989). Theoretical saturation occurs when incremental learning is minimal because the researcher has previously observed the phenomena (Glaser, et al., 1967).

There are, however, other pragmatic considerations that influence the cessation of data collection, and those considerations are things such as time and budgetary limitations. Those limitations will dictate that this research will be limited to five case studies.

3.4.3 Summarize the Findings

A thorough synopsis of the studies, analyses, literature review comparison, and findings will be written.

3.5 Mid-Research Methodology Complications and Solutions

Every effort was made to execute the planned and approved case study methodology described thus far in this chapter; however, as documented in Chapter 4, multiple problems were encountered with data collection. Therefore, as planned and approved the research scope and methodology could not coexist in unison. There were two options, as described in Section 4.2.1: (1) retain the research scope and adapt the methodology; or (2) adapt the research scope and keep the methodology.

The doctoral committee charged with oversight of this research agreed with the first option. Therefore, the methodology was allowed to evolve as detailed in Chapter 4.

The adapted data collection methodology was accompanied by an opportunity to strengthen the research. As detailed in Section 4.2.1, rather than conduct two interviews with each of five participants, online questionnaires were used to better facilitate participant schedule constraints. With the shift to online questionnaires, came the opportunity to acquire more than five responses. If enough data points could be acquired, traditional inferential statistics and hypothesis testing could be used instead of descriptive statistics and case studies. Since, this is a more robust approach; it became the objective and was implemented. Although, it took multiple iterations of contacting prospective participants and sending out invitations, the goal of a more participants and the subsequent goal of a more robust methodology was accomplished.

CHAPTER 4 RESULTS AND DATA ANALYSIS

4.1 Introduction

The hypotheses are laid out in this chapter, as well as the research and methodology (data collection and analysis) used to confirm them.

The preferred method of data collection was to be 30-60 minute interviews with each participant organizations' Chief Technology Officers (CTOs) or equivalent and use an iterative approach for theory building. As a result of data collection problems resulting from prospective participants' schedules, an innovative adaption towards data collection was required. This adaptation, data collection and analysis are discussed as follows.

The methodology outlined in Chapter 3 was to utilize descriptive statistical analysis. However, as discussed in the next section of this chapter, there were significant problems collecting data according to this methodology. So much so, the research could not be completed as designed. Therefore, the methodology was allowed to evolve in favor of completing the original mission of studying the most successful technology organizations.

As discussed below, the methodology evolved such that the adapted data and hypotheses were more robust and technically sound. This was the result of transitioning to inferential statistical analysis rather than descriptive analysis and case studies. This chapter describes this process evolution, develops the research model, and concludes with the hypotheses testing results.

4.2 Data Collection Challenges

The work-flow of identifying, selecting, and contacting the initial 14 prospective participants included:

1. Use multiple sources to compile a list of candidate organizations.
2. Use the criteria outlined in chapter 3 to down-select 14 organizations.
3. Identify the CTO or equivalent and his contact information.
4. Corroborate the CTOs title via independent sources such as state corporate filings or independent websites. – It became readily apparent the smaller growth-oriented technology organizations do not make updating position descriptions and titles on their websites a priority. It was critical to get the title correct in the address line of the cover letter sent with the Explanations of Research.
5. If there were title contradictions, then find a third source that agreed with one other.
6. Prepare the pre-notices which included customized cover letters and Explanations of Research approved by the UCF Institutional Review Board.
7. Print the envelopes, cover letters, and Explanations of Research.
8. Mail the pre-notices.
9. Follow up approximately 10 days later with phone calls to prospects.
10. More often than not, the initial call required another follow-up call because the prospect wasn't available.

As well, University of Central Florida (UCF) Institutional Review Board (IRB) approval was a required prerequisite to conducting any research in which there were human participants. This was to ensure that there that there were no unacceptable risks to participants. In addition to initial approval, UCF IRB required a review and re-approval of any revised research approach and/or documentation used to provide information to or request information from candidate participants. So, with methodology and process evolution came multiple iterations UCF IRB submittals, reviews, and adjustments as directed to obtain approval.

The proposed data collection methodology proved very problematic early on in the process. Step 9 above most often resulted in my talking to an assistant who did not have immediate access to the prospective participant or declined my request to speak with him or her about the research interview scheduling. Except one, all assistants took my information, and either agreed to speak with the CTO or declined interviewing on the basis of extremely busy schedules. Upon a follow-up phone call approximately five business days later, I was not able to secure any more interviews.

One interview was scheduled with the CTO of the one organization whose assistant allowed me to speak with him directly. However, when I called a few days later at the appointed time, the CTO advised via his assistant that he could not participate due to schedule conflicts. Every one of the administrative staff members advised that their superiors were very interested in the study and would like to participate; however, their busy schedules simply precluded participation.

This process resulted in a commit from one of 14 contacts or a 7.1 % commitment response rate. However, as stated above no one actually participated; this resulted in a 0.0 % participation response rate.

4.2.1 Process Evolution

At this point, it was apparent that the proposed methodology was not a viable option for research focused on prolifically successful technology organizations facing such intense innovative and competitive pressures. Recalling the methodology from Chapter 3, the scope of the research included very successful technology organizations, and the methodology called for data collection via interviews with technology organizations' Chief Technology Officers.

So, given the constraints on available resources (time, finances, etc.); therefore, there were two options:

1. Retain the original scope of the research scope (evaluating prolifically successful technology organizations) and adapt the methodology (interviewing participants twice) to something more compatible with participant schedules.
2. Adapt the original scope to include marginally successful technology organizations and retain the original methodology (interviewing participants twice).

After much deliberation and discussion with the Doctoral Committee Chair, Dr. Elshennawy, the first option was chosen.

Data Collection

In order to achieve better response rates, an online questionnaire format was chosen as the preferred medium for acquiring data. The benefits and advantages of an online questionnaire were deemed multifaceted:

1. Participants could do so at their convenience and without incorporating specific appointment times into their respective schedules.
2. Participation did not require participants' undivided attention. So, the questionnaire could be started, continued, and finished at the participant's convenience.
3. Participants would be asked the same questions that had been planned for the interviews.

Obviously, not all impacts of the inquisition could be deemed beneficial. There were some disadvantages to the adapted data collection methodology. The primary disadvantages were:

1. Online questionnaires would not facilitate the investigator queuing on verbal or other emphases used by participants to further explore peculiarities, etcetera.
2. If writing open-ended responses as opposed to verbally discussing them with an interviewer, participants were not as likely to offer as much detail.
3. A single online questionnaire would not facilitate an incremental theory building methodology.

Ultimately, the benefits outweighed the costs and the online questionnaire was determined to be the better alternative.

Prospect Contact Constraint

As the research progressed, the process continually evolved for efficiency and improved response rates. As a result of the constraint imposed by the limitation of resources (one researcher conducting all aspects of the research), certain factors presented nearly insurmountable obstacles that created an impetus to improvise.

In the beginning phases, an inordinate amount of time was spent contacting organizations to obtain addresses and contact information as no organizational representative volunteered their CTO's direct contact information without first discussing it with the CTO. This proved very time consuming because it necessitated multiple call-backs. So, to improve efficiency the following elements were used to narrow the field of candidate participants prior to contacting them:

1. Whether prospective participant's direct mail address could be obtained prior to contacting the organization for the purpose of mailing pre-notices directly.
2. Whether prospective participant's direct email address could be obtained prior to contacting the organization for the purpose of emailing the questionnaire invitation and questionnaire link directly.

To accomplish this, online resources were used including a website (http://www.lead411.com) to obtain each CTO's direct contact information before selecting an organization. If his or her contact information could not be readily obtained, the organization was not selected as a potential participant.

Population and Candidate Organization Success Assessment Constraint

It was too time intensive to conduct the pre-research assessment outlined in Section 3.3.1., identify the CTO, obtain direct contact information, and proceed with the invitation only to have the candidate decline the invitation. It was noted that already low response rates were even lower among larger publicly traded companies. It seemed the smaller growth oriented technology companies were more sensitive to the need to understand success factors in technology organizations and, therefore, showed greater interest in the study.

This influenced a shift towards focusing on smaller privately held organizations. But, this shift presented another set of problems. Once a candidate organization was identified, the methodology of Section 3.3.1 stipulated that a pre-research success assessment be performed by scoring each company's revenue growth, new job growth, patent creation, and public perception. In most cases candidate organizations were privately held as opposed to publicly traded companies, and those privately held companies don't typically make their annual revenues and/or job creation data available to outsiders. Within this smaller company constraint, the pre-research success assessment became nearly impossible to accomplish.

Hence, the need to adapt the methodology to incorporate a source that had compiled a list of very successful technology organizations according to prescribed criteria similar to that of Section 3.3.1 of this document. In identifying and assessing candidate organizations, it was discovered that Inc. Magazine assimilates and publishes the Inc. 5000, a list of the 5,000 fastest growing companies in America. Each of the organizations identified prior to discovering the Inc. 5000 list was, coincidentally, included in this same list.

So, the decision was made to constrain the population for this study to technology organizations on the Inc. 5000 list. Although the list included multiple industry sectors; it was confined to those that organizations that specialize in technology as defined by (Clarke, 2005) in Section 1.11.

Workflow Adjustments

Once, prospective participant organizations were selected, Invitation Letters and Explanations of Research were sent via United States Postal Service (USPS) mail. The early pre-notice invitation letters and Explanations of Research offered participants more detail regarding the research and participation. Then, the initial emailed notices containing the questionnaire links reiterated the importance of participating and benefits such as an offer to provide participants with a copy of the Conclusions and Recommendations. However, some tweaks were made to improve response rates consistent with (Dillman, et al., 2008).

During the data collection process, different approaches were tried for the purpose of increasing either response rates or efficiency or both. This included experimenting with emailing 20 prospective participants directly without sending pre-notices via USPS. Those direct emails were very brief and included digital copies of invitation letters, Explanations of Research, and links to the online questionnaires. Consistent with the literature, invitations without pre-notices resulted in extremely low response rates even when paired with small incentives such as $5 Starbucks egift cards (Dillman, et al., 2008).

The impacts of each change could not be fully assessed because the tweaks were not necessarily made one at a time. The impact(s) of any given set of changes could therefore have been attributed entirely to one change as opposed to partially attributed to each change. Those changes and their perceived impacts included the following:

1. Mailing pre-notices with the invitation letters and Explanations of Research as opposed to emailed electronic copies of everything in a single letter
    - Dramatic positive impact on response rates was observed with the mailing of pre-notices
2. Altering the pre-notice invitation letters and Explanations of Research to be more succinct and direct
    - Positive impact on response rates was observed
3. Including a small incentive such as $5 Starbucks egift cards as tokens of appreciation for each participant's time
    - Positive impact on response rates was observed
4. Altering the timing of the mailed pre-notices and emailed questionnaire links with respect to day of the week received
    - Positive impact on response rates was observed when pre-notices and emailed questionnaire links were received on Tuesdays, Wednesdays, and Thursdays
5. Modifying the timing of the follow-up emailed questionnaire links

- Positive impact on response rates was observed when pre-notices and emailed questionnaire links were received about ten business days apart

The changes and affected response rates were very consistent with the literature (Dillman, et al., 2008); these adaptations resulted in the best balance of the trade-off between efficiency and response rates.

4.3 Research Design

The literature review of Chapter 2 documented existing knowledge and established many interrelationships between certain factors and ideals of importance to technology organizations such as creativity, innovation, R&D, etcetera. The argument is made that if those factors influence ideals which in turn are essential to success in technology organizations, then many of those same factors likely have a direct and positive impact on success within those technology organizations. Furthermore, it seems an immediate corollary is that higher levels of implementation of those ideals would affect higher levels of technology organization success.

4.3.1 Conceptual Model

So, a conceptual model towards technology organization success that incorporates many of the factors and ideals identified as relevant within similar contexts in the literature review is proposed in Figure 12 and described below.

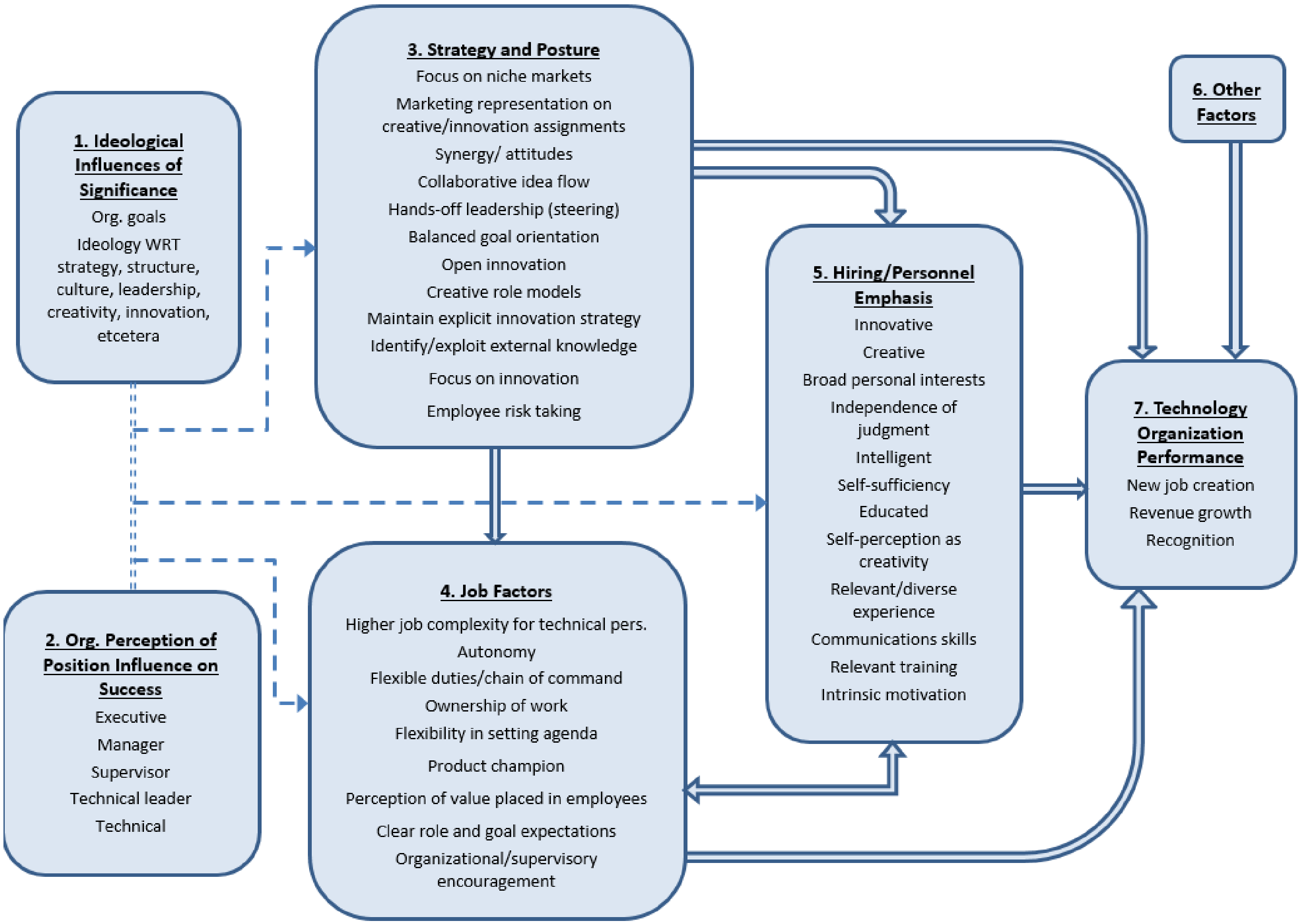


Figure 12 – Technology Organization Success Factors Conceptual Model

4.3.2 Hypotheses and Data Correlation

A null hypothesis cannot be proven true; it can only be shown to be implausible (Hayter, 2007). Therefore, to prove or establish that $\mu < \mu_o$ it is necessary to take it as the alternative hypothesis. By demonstrating that its opposite ($\mu \geq \mu_o$) taken as the null hypothesis is implausible, the alternative hypothesis is established.

The typical null hypotheses of this research postulate that there is not substantial correlation between each of the named factors/variables and prolific technology organization success. This translates into each of the respective measures of implementation effectiveness (β_i γ_i and δ_i) tending towards zero (0). Rejection of a particular null hypothesis implies that its respective factor is substantially interrelated to prolific technology organization success.

To aid in establishing these interrelationships, each sample correlation coefficient (Pearson product moment correlation coefficient) was calculated and analyzed in order to assist in the assessment of each component's correlation to organizational success. It is noted, however, that a favorable correlation coefficient between a component and organizational success does not establish causality; it does establish a link (Hayter, 2007).

4.4 <u>Data Collection</u>

The process of data collection and assimilation were integrated with data analysis, and the conglomeration was compiled in a single Excel spreadsheet. So, the actual data is shown and discussed in Section 4.5.

In all, 112 invitations were sent to prospective participants and 15 elected to participate in the research. This equates to an average response rate of 13.4%. As previously mentioned, this rate was not consistent throughout. Rather, it fluctuated with variations towards recruitment.

4.4.1 Population

As previously discussed in Section 4.2.1, the decision was made to: (1) identify an existing list of successful technology organizations; and (2) constrain the population to that list. An excellent and existing external source was identified as Inc. Magazine's Inc. 5000, a list of the 5,000 fastest growing companies in America. The population of this study was constrained to those that organizations that specialize in technology as defined by (Clarke, 2005) in Section 1.11 as follows.

The Inc. 5000 list's authors had categorized each of the 5,000 companies into one of 33 industries as shown in Table 9. For this study, a list, as shown in Table 10, was compiled of all 2,738 companies comprising the industries highlighted green in the referenced table. This list included the companies in chronological order according to their respective 3-year revenue growth; the company with the highest revenue growth was the highest ranked. The **Index** column shows each row being indexed from one to 2,738.

Table 9 – Inc. 5000 Industry Categories

Inc 5000 Industry Categories	
Insurance	Business products & services
Financial services	Retail
Real estate	Education
Consumer products & services	Construction
Advertising & marketing	Human resources
Logistics & transportation	Travel
Government services	Environmental services
IT services	Engineering
Software	Computer Hardware
Health	Business services
Food & beverage	Consumer products
Media	Computers & electronics
Security	Logistics
Telecommunications	Transportation
Manufacturing	Defense Contracting
Energy	Consulting

Table 10 - Sample of List and Randomized Selection Calculations

Index	Rank	Company	3-year % growth	Revenue (mil)	St	Selected Index Number	Random Generated number (0.0-1.0)-RAND()
1	2	Astrum Solar	23577%	$26.9 million	MD	-	0.778901344
2	3	Edge Solutions	21036%	$21.8 million	GA	-	0.155245214
3	5	Gold & Silver Buyers	12222%	$55 million	TX	-	0.702986
4	8	Acquia	10461%	$21.8 million	MA	-	0.56416178
5	9	Red Frog Events	10404%	$31.7 million	IL	-	0.82839547
6	10	Cartagz	10237%	$14.2 million	CA	-	0.591168914
~	~	~	~	~	~	~	~
2738	…	…	…	…	…	…	…

The far right column of Table 10 shows how Excel's RAND() function was used to generate random numbers between 0 and 1.0 to nine decimal places. Each entry in the **Random Generated number (0.0-1.0)-RAND()** column was then multiplied by the total number of companies, 2,738, to obtain its **Selected Index Number**. Then the company corresponding to the appropriate index number in the **Index** column was selected. However, not every company in each of the included industry categories fit the definition of a technology organization described in Section 1.11. Therefore, once random selections were made, if the companies' core business was deemed such that it could not be classified as a technology organization, the index number was incremented until the organization was a technology organization. The selected organizations were invited to participate. There were multiple iterations of selections and invitations due to relatively low response rates. Organizations that accepted the invitation were removed from the list for subsequent iterations.

Within the study population, confirmation of random diversity among some characteristics was important. Some of these are listed in Table 11 and documented the following:

1. Level of success in terms of annual revenue growth and direct annual job creation
2. Technology focus (service versus product, software versus hardware, high-tech versus low-tech, etcetera)
3. Geographic location of the organization
4. Organizational size in terms of number of personnel
5. Organizational size in terms of annual revenue

Table 11 – Data Demographics

Pseudonym/ Identifier	Technology Sector	Avg. Annual Revenue Growth '07-'11	Avg. Annual Job Creation '07-'11	Geographic Region	Annual Rev (million) '11	No. Personnel '11
Company A /78120	Utilizes 60,000 professional testers to provide real-world testing of software applications	202 %[1]	58 %[2]	NE	$ 8.6	68
Company B /37831	Installs residential and commercial solar energy systems	26%	27%	NE	$ 10.5	40

Pseudonym/ Identifier	Technology Sector	Avg. Annual Revenue Growth ‘07-‘11	Avg. Annual Job Creation ‘07-‘11	Geographic Region	Annual Rev (million) ‘11	No. Personnel ‘11
Company C /48931	Provides warehouse management, engineering and integrations services for telecommunications industry	170%	55%	SW	$ 214.0	15
Company D /78106	Multilingual website/software services	22%	11%	SE	$ 30.6	131
Company E /78108	Consulting re. strategic management, system architecture, and network infrastructure	46%	59%	S	$ 7.1	70
Company F /771110	Open source data applications in visualization, imaging, and quality	49%	28%	N	$ 27.2	100
Company G /77108	Software development and system integration services	38%	29%	SE	$ 12.4	106
Company H /771054	Provides communications services (trunking/ internet phone calls)	72%	32%	N	$ 3.1	16
Company I /27131	Develops customized software solutions	8%	9%	S	$ 2.4	24
Company J /41662	Provides technical consulting and staffing to the nuclear power industry	29%	22%	S	$ 77.5	383
Company K /73478	Develop & manufacture devices using nanotechnology, materials and ceramics	15%	21%	W	$ 3.7	28
Company L /79150	Provides data storage infrastructure	35%	28%	SW	$ 226.0	425
Company M /79141	Provides solar energy solutions to homeowners	521%	284%	NE	$ 26.9	170

Pseudonym/ Identifier	Technology Sector	Avg. Annual Revenue Growth '07-'11	Avg. Annual Job Creation '07-'11	Geographic Region	Annual Rev (million) '11	No. Personnel '11
Company N /79138	Restores communications equip.	15 %[1]	19 % [2]	SE	$ 18.9	125
Company O /73476	Designs, engineers, and constructs electrical transmission and distribution systems	72%	25%	S	$ 30.1	49
[1] Participant skipped question in questionnaire, estimate obtained for 2008-2011 (Inc. Magazine, 2012) [2] Participant skipped question in questionnaire, estimate obtained for 2008-2011 (Inc. Magazine, 2012)						

4.4.2 Survey

An online survey format was elected because of simplicity and convenience for respondents. After evaluating multiple survey providers and what they could offer, http://www.surveymonkey.com/home/ was chosen because of the cost and results reports analysis/download capabilities. No question required a response; this was done to allow a respondent who was uncomfortable with any particular question to skip it as opposed to deciding to abandon the survey because he could not elect to skip it. The survey in its entirety is shown in APPENDIX E: SURVEY.

Background Questions

Questions one through seven established background information including the respondent's title, year the organization was founded, whether the respondent was the founder, revenue growth and job creation data for the years 2007 and 2011. Question four was a matrix question for establishing the respondent's perception of success metric priority. Questions five and six provided the organization's revenue growth and job creation and how the actual numbers lined up with expectations.

Core Questions

The model discussed in section 4.3.1 was used as the basis for creating the core questions. Questions eight through 37 were core to the study and were mostly multiple choice. Only one question incorporated skip logic; it was question 34: "Does your organization have a single key innovator that has been essential to the organization's success?" If the respondent selected "No", questions 35, 36, and 37 regarding this key innovator's ideology were automatically skipped.

Discussion Questions

Questions 38 through 40 were open ended and were designed to elicit information which could not have been pre-conceived. They asked the respondent to list and rank: (1) the four factors perceived as the most influential to their organization's success; and (2) the four factors perceived as the greatest threats to their organization's continued success. Finally, question 40 asked the participant to describe in his own words his organization's culture.

4.5 Data Analysis

Analysis was performed in order to determine the validity of the model postulated in Section 4.3.1 and illustrated in Figure 12. The model was created to determine the factors correlating to technology organization success and the extent of their respective correlation. The Excel spreadsheet containing the responses includes the statistical analyses.

4.5.1 Dependent Variable

Organizational success rank y was created as a four level discriminant and dependent variable for the analyses. This was done to facilitate stronger correlation analyses of the impacts of each factor on technology organization success, participant organizations were ranked according to where their level of success fell within the participant's grouping of success. Two categories of success were included and equally weighted in the rankings; the categories were: (1) Annualized revenue growth over the period 2007-2011; and (2) Annualized direct new job creation over the period 2007-2011. There was no consideration given to indirect new job creation such as that stemming from trickle-down impacts on suppliers and distributors. Within the groupings of participant organization success, four levels were used with corresponding values of one through four; this where a rank of one corresponded to the highest level of within respondent grouping of organizational success. The success rank scale is shown in Table 12.

Table 12 – Success Ranking Levels

Rank Range within Respondent Grouping of Annual Revenue Growth Range			Corresponding Rank (y)
3rd quartile	72%	100%	1
Upper 1/2 of 2nd quartile	38%	72%	2
Lower 1/2 of 2nd quartile	24%	38%	3
1st quartile	0%	24%	4

Rank Range within Respondent Grouping of Annual Job Growth Range			Corresponding Rank (y)
3rd quartile	43%	100%	1
Upper 1/2 of 2nd quartile	28%	43%	2
Lower 1/2 of 2nd quartile	22%	28%	3
1st quartile	0%	22%	4

The actual organization success rankings were calculated as described above, weighted accordingly, and listed in Table 13. Calculated and included, as well, were the average success rank (y_bar), rank variance (SYY) and standard deviation.

4.5.2 Independent Variables

Survey responses were used as independent variables, and, in some cases, multiple responses were combined into a single composite independent variable. Most survey responses incorporated a four category Likert scale such as: (1) High emphasis; (2) Moderate emphasis; (3) Low emphasis; and (4) No emphasis. Other survey responses that needed less distinction between responses utilized a three category response such as: Yes; No; or Maybe. Not all responses on the survey had a number that corresponded to each response. Numbered responses were the ones associated with matrix questions.

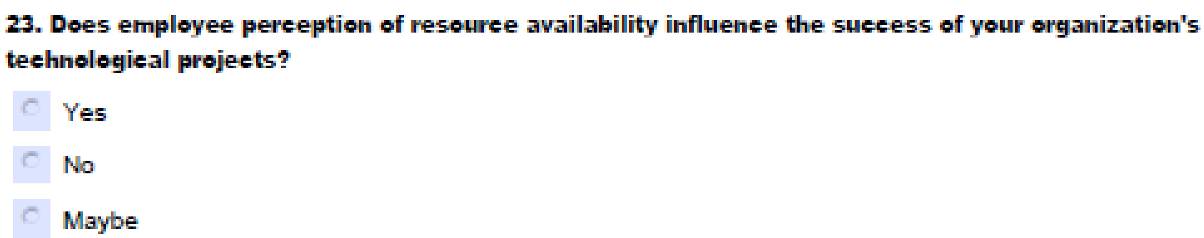
Table 13 – Weighted Participant Organization Success Ranks

Organization	Revenue Growth Annualized	Revenue Growth Actual Rank	Job Growth Annualized	Job Growth Actual Rank	Weighted Success Rank (y)
Company A	337%	1	84%	1	1
Company B	26%	3	27%	3	3
Company C	170%	1	55%	1	1
Company D	22%	4	11%	4	4
Company E	46%	2	59%	1	1.5
Company F	49%	2	28%	3	2.5
Company G	38%	3	29%	2	2.5
Company H	72%	2	32%	2	2
Company I	8%	4	9%	4	4
Company J	29%	3	22%	3	3
Company K	15%	4	21%	4	4
Company L	35%	3	28%	3	3
Company M	521%	1	284%	1	1
Company N	15%	4	19%	4	4
Company O	72%	1	25%	3	2
			Rank Avg (y_bar)		2.5666667
			y Variance SYY		17.933333
			Std Dev		1.2809524

3-year growth vs. 4-year

Generally, a response rank of 1 represented what was deemed to be the likely response from a very successful technology organization. So, for example, responses to the component "Creative role models" of question 25, "How much emphasis does your organization place on addressing each of the following job characteristics?" was expected to trend in the direction of higher emphasis; therefore, the rank of 1 corresponded to High emphasis. This was important from a consistency in analysis perspective because it simplified null hypotheses testing in that it allowed all null hypotheses to be the same.

For the purpose of statistical analysis, there were some cases where the survey's answer selection categories were not ordered in the most logical manner. Figure 13 is an example where there were three ordered responses: Yes; No; or Maybe. Here, for statistical analysis it made more sense to reorder the rank of these responses to: (1) Yes; (2) Maybe; or (3) No. So, throughout the data file and after every response column is a column labeled "Post Survey Rank" that contains the ranking assigned to the corresponding choice to its immediate left as shown in Table 14. Here, Yes responses were ranked 1, Maybe responses were ranked 2, and so on.


23. Does employee perception of resource availability influence the success of your organization's technological projects?

Yes

No

Maybe

Figure 13 - Survey Question 23

Table 14 – Question 23 Re-order and Rank

Question 23. Does employee perception of resource availability influence the success of your organization's technological projects?	
Response	Post Survey Rank
Yes	1
Maybe	2
No	3

4.5.3 Statistical Analyses

The data analyses and synopsis within the Excel spreadsheet was multi-faceted and is discussed as follows.

Prerequisite Construct

It is important to understand a vital and meticulous construct within this research. All but two cases (questions 25 and 30) of four-category response questions were deliberately constructed with the top ranked response containing the adjective *very*. *Very* is defined as *exact or precise* (Merriam-Webster Dictionary). Within these responses, *very* is taken to stipulate absolutely that the factor to which it refers is a necessary component within the context of its use. In most cases its context refers to success within technology organizations.

Correlation of Variables

Since all data collected was ordinal in nature, the Pearson product moment correlation coefficient was calculated for evaluating the strength of the linear association between the dependent and independent variables (Tabachnick, et al., 2001). The closer the calculated correlation coefficient was to ±1, the higher the linear correlation between the dependent and independent variables. Whereas correlation coefficient values approaching 0 indicate no linear association. To better evaluate the correlation of the variables a test of the null hypotheses H_o: $r = 0$ was performed for every value of the Pearson product moment correlation coefficient by calculating its t-statistic and associated p-value

Relevance of Variables/Factors

Next, the null hypotheses were put forward and the corresponding t-statistics and p-values were calculated. In most cases, the null hypotheses were H_o: $\mu \geq 2$.

Where question responses fell into a four category Likert scale, the typical alternative hypothesis became that the particular element was a very (exactly) significant to technology organization success (H_A: $\mu < 2$).

Three category responses were slightly different. Here, H_A: $\mu < 2$ often implied the factor or consideration reflected reality or not. This, because a rank of 1 often corresponded to Yes; 2 often corresponded to Maybe; and 3 often corresponded to No.

P-values with a significance level, α, less than 0.05, were taken to imply that the null hypothesis was not a credible statement and the alternative hypothesis was.

Analysis Concerns and Mitigations

A basic assumption of the t-test is that the data mean assumes the shape of a normal distribution. Responses to many Likert scale questions do not take the form of a normal distribution. This can result in question regarding the credibility of the t-tests inferences. Generally, t-tests provide robust results if three conditions are met: (1) the data distribution is largely unimodal; (2) symmetric; and (3) the variances are moderate to small. This is the case in most of the data contained within this research (Norman, 2010).

Nonetheless, to mitigate concerns and corroborate inferences the specific steps are taken herein, as follows:

1. The Mann-Whitney U-test will be performed on all data using an Evaluation License for OriginPro 9 as shown in Figure 14, Figure 15, and Figure 16. If the findings of significance are the same, then no further analysis and comparison will be performed and documented.

2. Where the t-test results diverge from the Mann-Whitney U-test, the central tendency of the data will be evaluated. The Mann-Whitney U-test results will be the deciding test as long as the data's central tendency metrics such as response mean, median, mode, and variance agree.

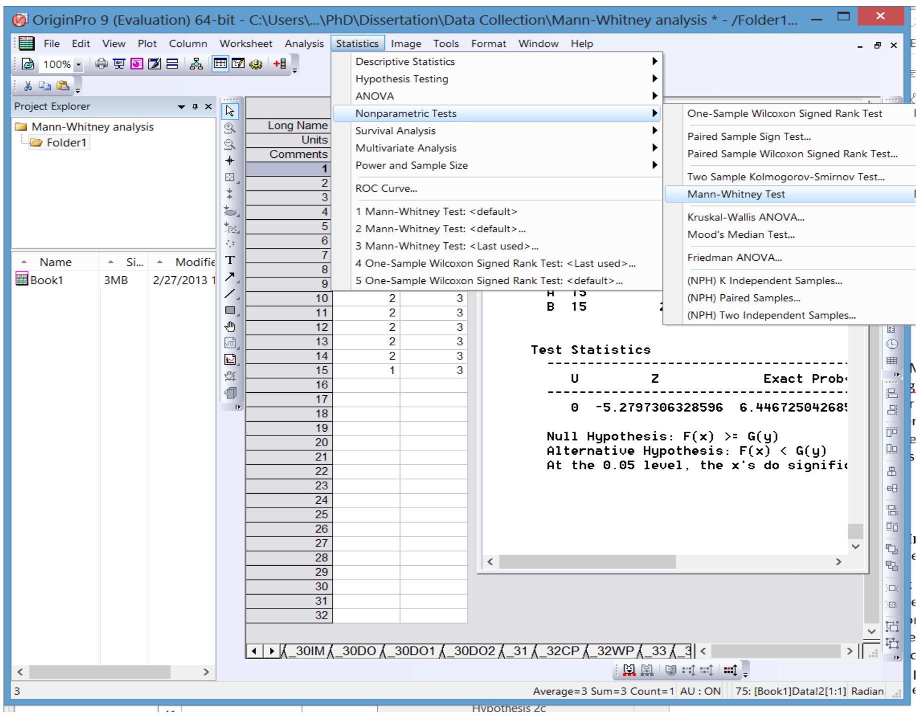


Figure 14 - OriginPro MW Test Selection Screen

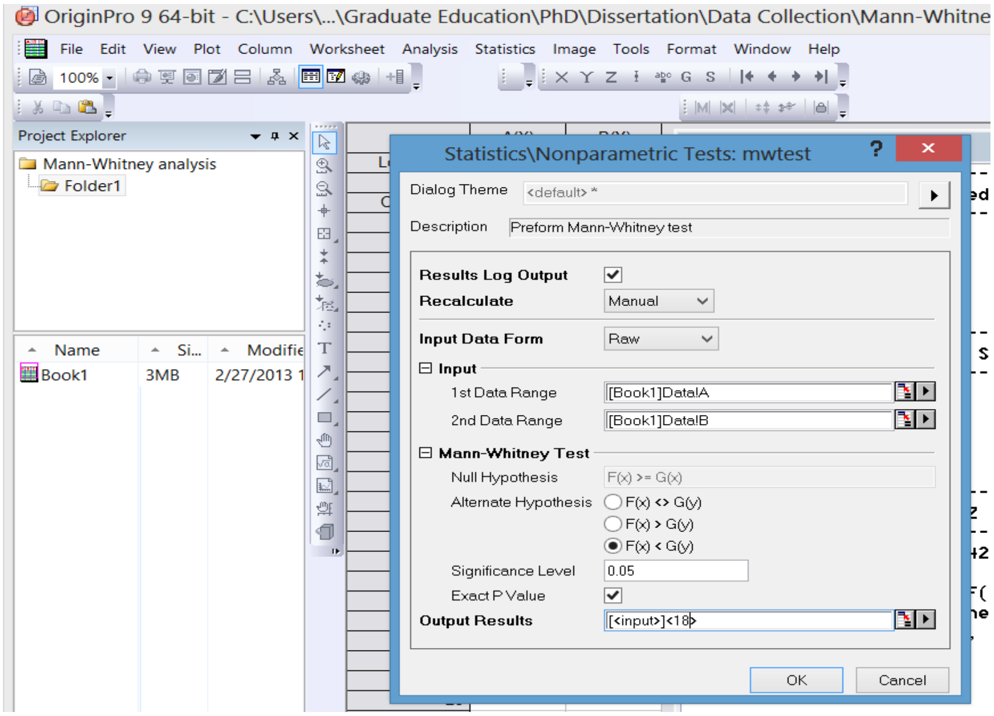


Figure 15 - OriginPro Data Selection and Setup Screen

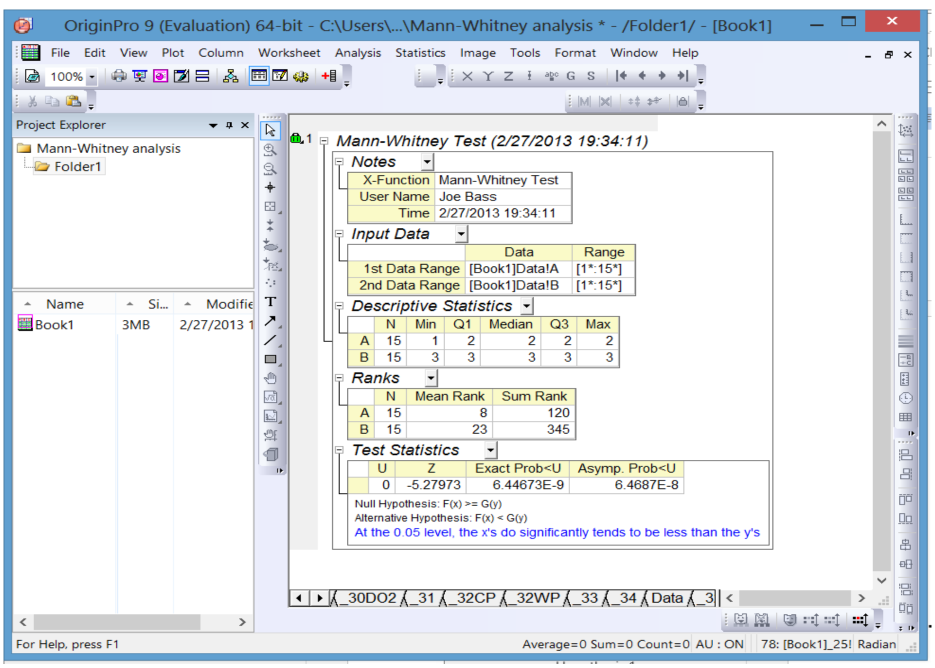


Figure 16- OriginPro MW Output Screen for Question 18

4.5.4 Background Information

Core survey questions were preceded by background information questions.

Respondent Titles

The study scope stipulated that the Chief Technology Officer (CTO) or equivalent of participant organizations would be targeted as respondents. As evidenced by the responses to question 1 of the survey, less than 30% of participant organizations had a position formally titled as Chief Technology Officer. This presumably was the result of these relatively smaller organizations needing personnel to serve in multiple roles such as CTO and Chief Executive Officer (CEO) or President. The distribution of participant titles is shown in Figure 17.

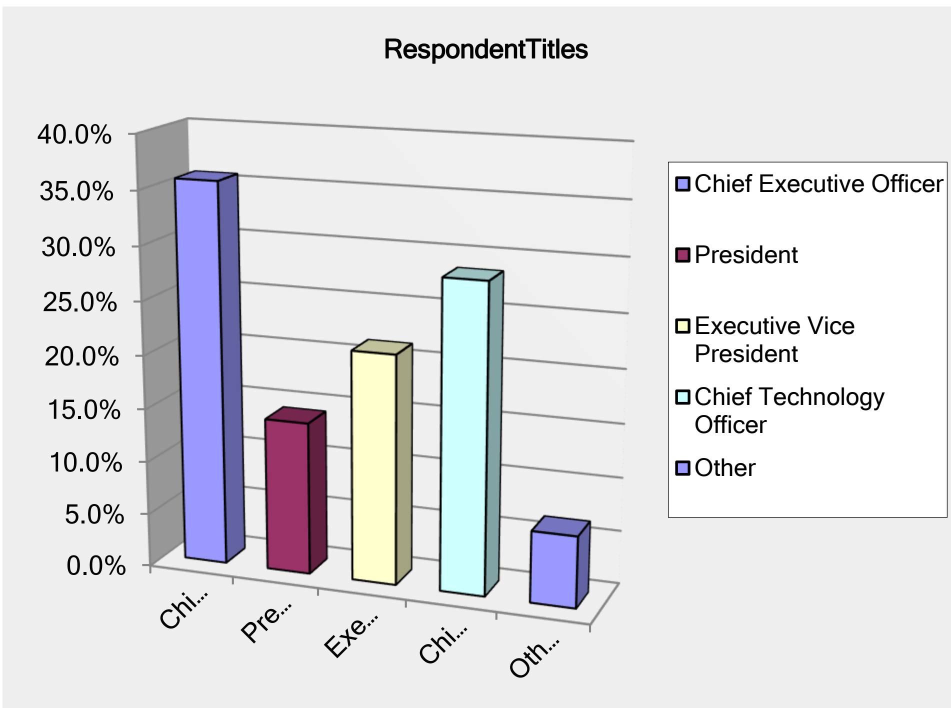


Figure 17 – Respondent Titles

Founding

Organizations within the survey were founded between the years of 1994 and 2007 with a median of 2002 and standard deviation of 4.2 years. Two-thirds (66.7 %) of respondents either founded or co-founded their respective companies.

Participant Metric Priorities

Table 15 and Figure 18 summarizes participants' emphases on the following success metrics when they assess their respective organization's success. In addition, one participant stated a seventh important success metric was whether the organization had built "an amazing place to work". As with most of the data in this study, the correlation coefficients and their p-values were very low. Although, this does indicate a weak linear correlation between organization success and the metrics of question 4, it does not imply that those metrics are inconsequential.

From the last two rows of the data shown in Table 15, the orange shaded cells contain p-values showing that the null hypotheses associated with those columns are rejected. Therefore the alternative hypotheses (H_A: $\mu < 2$) are true for: (1) Revenue growth; (2) Profitability; and (3) Performance with respect to strategic goals. For those three metrics, we conclude that on average, the population of CTO's within the study would view those metrics as more than somewhat important.

The null hypotheses are accepted for: (1) Job Creation; (2) Patent creation; and (3) Recognition. Subsequently, those metrics were viewed as at best somewhat important. This provides valuable insight into the motivations for decision-making, structure, and strategies by these CTO's. The strongest of those motivations are financial and strategic.

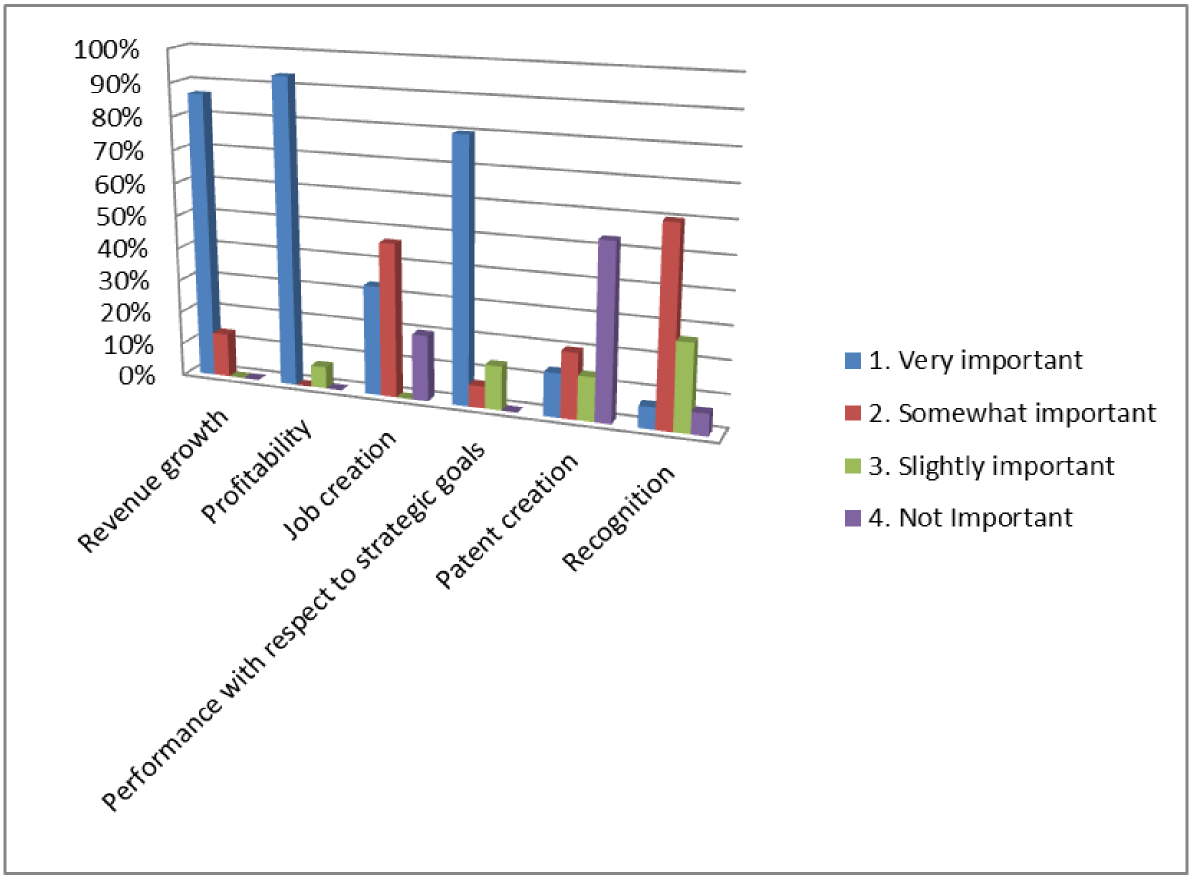


Figure 18 – Participant Success Priorities

Table 15 – Participant Success Priorities

	Question 4. When you assess your organization's success, how important is each of the following metrics?					
	Revenue growth	Profitability	Job creation	Performance with respect to strategic goals	Patent creation	Recognition
Rank/ Response	100%	100%	100%	100%	100%	100%
1. Very important	87%	93%	33%	80%	13%	7%
2. Somewhat important	13%	0%	47%	7%	20%	60%
3. Slightly important	0%	7%	0%	13%	13%	27%
4. Not Important	0%	0%	20%	0%	53%	7%
Rank Mean	1.133	1.133	2.067	1.333	3.067	2.333
Rank Median	1.000	1.000	2.000	1.000	4.000	2.000
Rank Variance (S_{xx})	0.124	0.267	1.210	0.524	1.352	0.524
Rank Std Dev	0.352	0.516	1.100	0.724	1.163	0.724
Correlation Coef. (r)	0.066	-0.383	-0.578	-0.291	-0.031	-0.160
t-stat for H_0: r=0	0.238	-1.495	-2.552	-1.095	-0.111	-0.584
p-value for corr. H_0	0.816	0.157	0.023	0.292	0.913	0.569
t-stat for Ho: $\mu \geq 2$	-9.539	-6.500	0.235	-3.568	3.552	1.784
p-value = P(X < 2)	8.349E-08	7.009E-06	5.911E-01	1.546E-03	9.984E-01	9.519E-01
Mann-Whitney P(X<2)	8.768E-07	1.031E-07	1.480E-01	1.461E-04	9.987E-01	9.874E-01

Participant Progress Expectations

As shown in Table 16, 94% of respondents indicated that their organization's growth had met their expectations, and 47% indicated their growth had exceeded expectations. Although, this question's response does not establish causality between the independent variables within this study and the dependent variable, it does provide strong evidence that these companies' ideologies and policies are accomplishing the goals and expectations set by their respective leadership. This idea is emphasized further when coupled with the previously accepted alternative hypotheses of question four regarding success metric priorities: (1) revenue growth; (2) profitability; and (3) performance with respect to strategic goals.

If we took a null hypothesis here of H_o: $\mu \geq 2$ as: *Within this population, these organizations at best met their growth goals for the period from 2007-2011*. With the p-values in Table 16, H_A would be accepted. That is to say that their growth exceeded their expectations. This provides something of an ideological triangulation to concept of this research, which implies that these organizations' factors and/or policies are affecting prolific success within these technology organizations.

Table 16 – Expectations

	Question 7. How does your organization's growth from 2007 to 2011 compare to your goal for the same?
Rank/ Response	100%
1. Exceeded	47%
2. Met	47%
3. Fell behind	7%
Rank Mean	1.600
Rank Median	2.000
Rank Variance (Sxx)	0.400
Rank Std Dev	0.632
Correlation Coef. (r)	0.589
t-stat for H_0: r=0	2.626
p-value for corr. H_0	0.020
t-stat for Ho: μ ≥ 2	-2.449
p-value = P(X < 2)	1.404E-02
Mann-Whitney P(X<2)	3.160E-03

4.5.5 Structured-Format Data

The individual null hypotheses are stated as follows along with the data confirming or invalidating them. Where the p-values are listed in the tables showing the synopsis of the data and statistical analyses, they are highlighted according to their results. An orange cell indicates a statistical finding of significant difference or that the null hypothesis should be rejected at a level of 0.05. A green cell indicates that the data was not significantly different from the test; therefore, the null hypothesis should be accepted.

Hypothesis 1, Question 8

Hypotheses, H_{1x}, deal with the ideological perceptions of CTO's from this population of highly successful technology organizations. It is, in some ways, a continuation of the background discussion from the previous section that establishes ideological priorities among these CTO's. The response totals and statistical analyses are shown in Figure 19 and Table 17.

Hypothesis 1a:

H_o: $\mu \geq 2$. Particular organizational structure or composition is at best somewhat significant to technology organization success.

With a t-test p-value of 10.85×10^{-2} and a Mann-Whitney test p-value of 5.28×10^{-2}, H_o is marginally accepted.

Hypothesis 1b

H_o: $\mu \geq 2$. Organizational culture as an ideal is at best somewhat significant to technology organization success.

With a t-test p-value of 8.35×10^{-8} and a Mann-Whitney test p-value of 87.68×10^{-8}, H_o is rejected in favor of H_A.

Hypothesis 1c

H_o: $\mu \geq 2$. Leadership as an ideal is at best somewhat significant to technology organization success.

With a t-test p-value of 1.48×10^{-6} and a Mann-Whitney test p-value of 5.26×10^{-6}, H_o is rejected in favor of H_A.

Hypothesis 1d

H_o: $\mu \geq 2$. Marketing is at best somewhat significant to technology organization success.

With a t-test p-value of 6.83×10^{-1} and a Mann-Whitney test p-value of 5.00×10^{-1}, H_o is accepted.

Hypothesis 1e

H_o: $\mu \geq 2$. Creativity is at best somewhat significant to technology organization success.

With a t-test p-value of 10.85×10^{-2} and a Mann-Whitney test p-value of 5.28×10^{-2}, H_o is marginally accepted.

Hypothesis 1f

H_o: $\mu \geq 2$. Innovation is at best somewhat significant to technology organization success.

With a t-test p-value of 34.21×10^{-3} and a Mann-Whitney test p-value of 1.30×10^{-3}, H_o is rejected in favor of H_A.

These CTO's felt organizational culture, leadership, and innovation were more than somewhat significant to their organization's success as confirmed by the acceptance of their alternative hypotheses; therefore, these components are retained within the model.

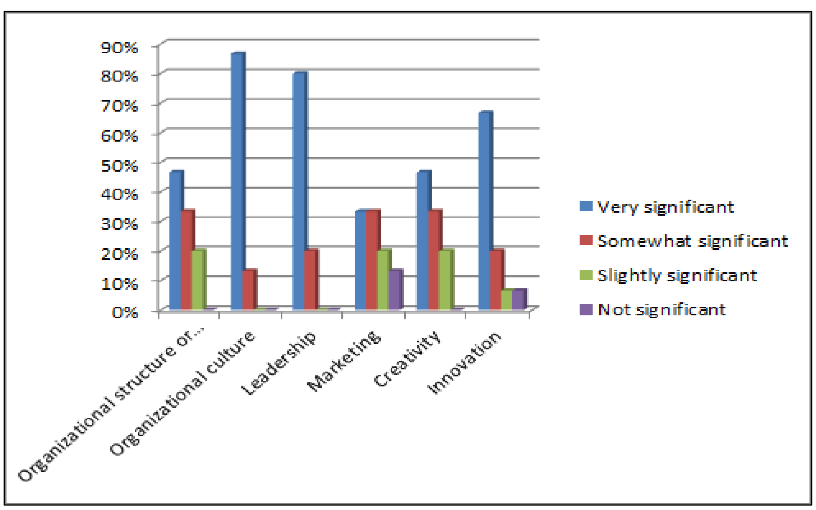


Figure 19 – Ideology Distribution

Table 17 - Ideology

	Question 8. In terms of impact on your organization's success, how significant is each of the following ideals?					
	Organizational structure or composition	Organizational culture	Leadership	Marketing	Creativity	Innovation
1. Very significant	47%	87%	80%	33%	47%	67%
2. Somewhat significant	33%	13%	20%	33%	33%	20%
3. Slightly significant	20%	0%	0%	20%	20%	7%
4. Not significant	0%	0%	0%	13%	0%	7%
Rank Mean	1.733	1.133	1.200	2.133	1.733	1.533
Rank Median	2.000	1.000	1.000	2.000	2.000	1.000
Rank Variance (S_{XX})	0.638	0.124	0.171	1.124	0.638	0.838
Rank Std Dev	0.799	0.352	0.414	1.060	0.799	0.915
Correlation Coef. (r)	0.337	0.335	-0.183	0.111	-0.295	-0.485
t-stat for H_0: r=0	1.291	1.281	-0.671	0.403	-1.113	-1.999
p-value for corr. H_0	0.218	0.221	0.513	0.693	0.284	0.065
t-stat for Ho: $\mu \geq 2$	-1.293	-9.539	-7.483	0.487	-1.293	-1.974
p-value = P(X < 2)	1.085E-01	8.349E-08	1.476E-06	6.831E-01	1.085E-01	3.421E-02
Mann-Whitney P(X<2)	5.281E-02	8.768E-07	5.261E-06	5.001E-01	5.281E-02	1.300E-03

Hypothesis 2, Question 9

These hypotheses establish which ranks of employees have more than somewhat important influence in impacting the technology organization's success. The implication is that these organizations place elevated emphasis on the personnel assigned to these positions and pay special attention to the jobs being performed by these ranks.

Hypothesis 2a:

H_o: $\mu \geq 2$. Influence by executive level personnel is at best somewhat important to technology organization success.

With a t-test p-value of 8.35×10^{-8} and a Mann-Whitney test p-value of 87.68×10^{-8}, H_o is rejected in favor of H_A.

Hypothesis 2b

H_o: $\mu \geq 2$. Influence by managerial level personnel is at best somewhat important to technology organization success.

With a t-test p-value of 23.96×10^{-3} and a Mann-Whitney test p-value of 0.35×10^{-3}, H_o is rejected in favor of H_A.

Hypothesis 2c

H_o: $\mu \geq 2$. Influence by supervisory level personnel is at best somewhat important to technology organization success.

Here, the t-test p-value of 6.28×10^{-2} indicates that Ho should be accepted at the 0.05 level; however, the Mann-Whitney test p-value of 0.29×10^{-2} H_o indicates H_o should be rejected in favor of H_A. Since the data is not normally distributed, the Mann-Whitney test results are of more significance. With a rank mean of 1.643, median of 1.500, and a standard deviation of 0.842, the central tendency of the data tends to support rejection of H_o. Therefore, H_o is rejected in favor of H_A

Hypothesis 2d

H_o: $\mu \geq 2$. Influence by technical leadership personnel such as team lead, etcetera is at best somewhat important to technology organization success.

With a t-test p-value of 0.40×10^{-8} and a Mann-Whitney test p-value of 37.40×10^{-8}, H_o is rejected in favor of H_A.

Hypothesis 2e

H_o: $\mu \geq 2$. Influence by technical personnel such as engineers and technicians are at best somewhat important to technology organization success.

With a t-test p-value of 30.38×10^{-4} and a Mann-Whitney test p-value of 3.50×10^{-4}, H_o is rejected in favor of H_A.

Hypothesis 2f

H_o: $\mu \geq 2$. Influence by non-technical personnel such as human relations and accounting is at best somewhat important to technology organization success.

With a t-test p-value of 8.07×10^{-1} and a Mann-Whitney test p-value of 5.53×10^{-1}, H_o is accepted.

As shown in Figure 20 and Table 18 by way of their respective null hypotheses being rejected in favor of the alternative hypotheses, the impacts of executives, managers, supervisors, technical leaders, and technical personnel are essential to success in technology organization, and are therefore retained in the model. The lowest p-values were observed for the categories of executives, technical leaders, and technical personnel indicating that they were the consensus most influential. The contribution of non-technical personnel within this context is not very or exactly important to organizational success; therefore, it is removed from the model.

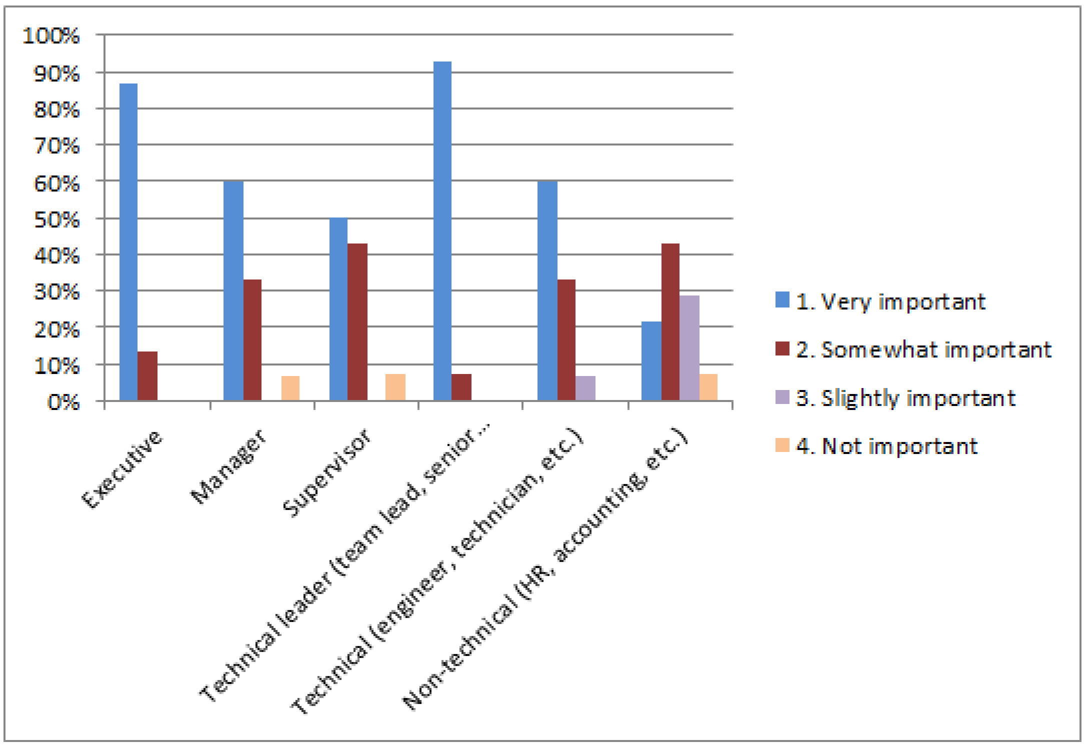


Figure 20 - Leadership Distribution

Table 18 - Leadership Roles

Individual Components	Question 9. In terms of impact on your organization's success, how important is the influence of each of the following ranks?					
	Exec-utive	Manag-er	Super visor	Technical leader (team lead, senior engineer, etc.)	Technical (engineer, technician, etc.)	Non-technical (HR, accounting, etc.)
1. Very important	87%	60%	50%	93%	60%	21%
2. Somewhat important	13%	33%	43%	7%	33%	43%
3. Slightly important	0%	0%	0%	0%	7%	29%
4. Not important	0%	7%	7%	0%	0%	7%
Rank Mean	1.133	1.533	1.643	1.071	1.467	2.214
Rank Median	1.000	1.000	1.500	1.000	1.000	2.000
Rank Variance (Sxx)	0.124	0.695	0.709	0.071	0.410	0.797
Rank Std Dev	0.352	0.834	0.842	0.267	0.640	0.893
Correlation Coef. (r)	-0.114	0.338	0.326	-0.272	-0.342	0.030
t-stat for H_o: r=0	-0.412	1.295	1.194	-0.981	-1.312	0.104
p-value for corr. H_o	0.686	0.216	0.254	0.345	0.211	0.919
t-stat for Ho: µ: ≥ 2	-9.539	-2.168	-1.587	-13.000	-3.228	0.898
p-value = P(X < 2)	8.349E-08	2.396E-02	6.823 E-02	3.978E-09	3.038E-03	8.073E-01
Mann-Whitney P(X<2)	8.768E-07	3.498E-04	2.900 E-03	3.739E-07	3.498E-04	8.529E-01

Hypothesis 3, Question 10

H_o: $\mu \geq 2$.Technology organizational size has no impact on its success.

With a t-test p-value of 4.12×10^{-2} and a Mann-Whitney test p-value of 1.56×10^{-2}, H_o is rejected in favor of H_A.

With the results as shown in Figure 21 and Table 19, the alternative hypothesis is accepted; therefore, it is retained within the model.

Hypothesis 4

This hypothesis deals with two different aspects of strategies toward innovation.

Hypothesis 4a, Question 11

H_o: $\mu \geq 2$. An aggressive technological policy [defined in the literature as a preemptive, long-range strategy for technological innovation (Ettlie, et al., 1984)*] is not an important component of technology organization culture.*

With a t-test p-value of 2.12×10^{-1} and a Mann-Whitney test p-value of 1.35×10^{-1}, H_o is accepted.

Hypothesis 4b, Question 12

H_o: $\mu \geq 2$. Successful technology organizations do not necessarily need an explicit innovation strategy.

With a t-test p-value of 1.04×10^{-1} and a Mann-Whitney test p-value of 0.57×10^{-1}, H_o is accepted.

With respect to 4a, while the mean response rank was 1.8 where a value of one corresponded to “Yes” and 53% of respondents indicated that an aggressive technological policy was essential to success; neither the central tendency of data nor its resulting p-values were enough to reject the null hypothesis. Consistent with 4a are the results of 4b, which confirmed that although a large majority of these companies had an innovation strategy, the data could not with confidence corroborate its necessity. Therefore, although it remains plausible that an aggressive technological policy for innovation and an innovation strategy are essential, neither is retained in the model.

Hypothesis 5, Question 13

Question 13 discovered whether these organizations actively attempted to influence creativity and/or innovation.

Hypothesis 5a:

H_o: $\mu \geq 2$. Very successful technology organizations do not attempt to influence organizational creativity.

With a t-test p-value of 3.87×10^{-1} and a Mann-Whitney test p-value of 2.78×10^{-1}, H_o is accepted. Therefore, it is not retained within the model.

Hypothesis 5b

H_o: $\mu \geq 2$. Very successful technology organizations do not attempt to influence organizational innovation.

With a t-test p-value of 13.30×10^{-3} and a Mann-Whitney test p-value of 3.56×10^{-3}, H_o is rejected in favor of H_A.

With values of 1.467 and 1.000, the responses rank mean and median were in agreement with H_A; however, their variance was relatively high at 0.695, reflecting that 20% of respondents do not attempt to influence innovation. This element is retained within the model.

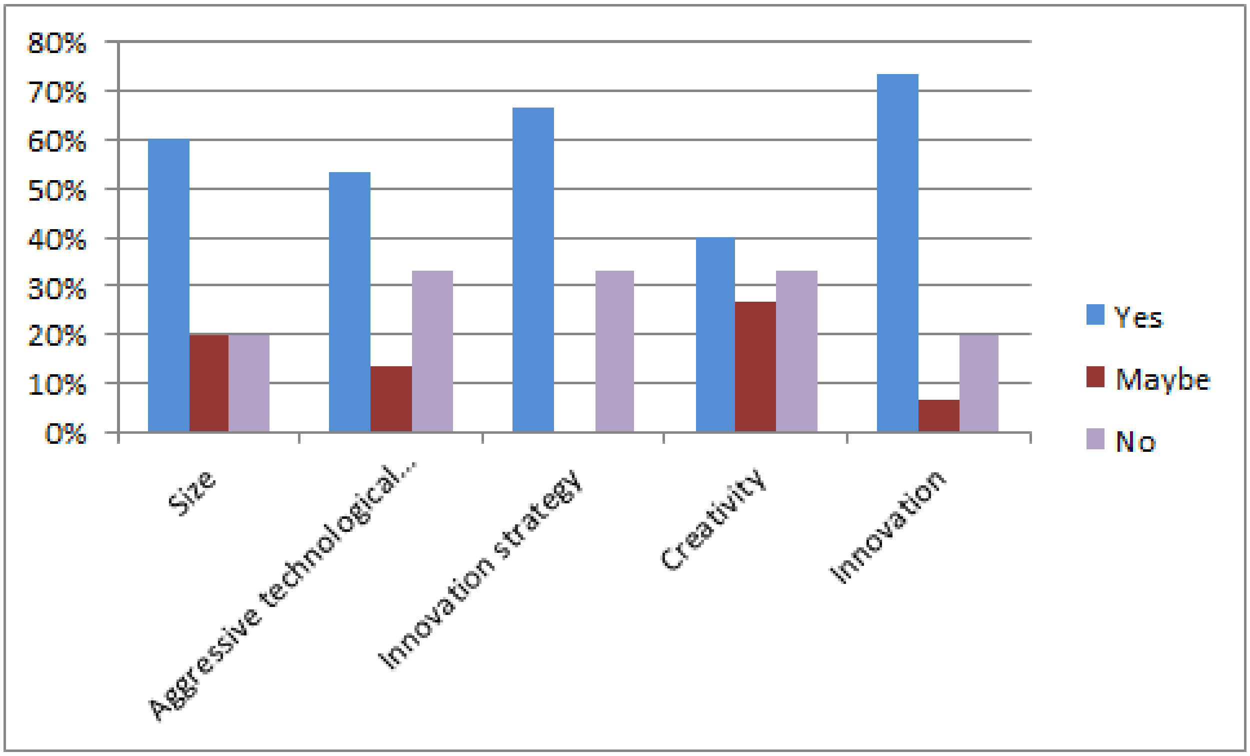


Figure 21 – Size and Policy Distribution

Table 19 – Size and Policy

	Question 10. Does your organization's size influence its success?	Question 11. Has an aggressive technological policy which has been defined in the literature as "a preemptive, long-range strategy for technological innovation" been an important part of your organization's culture?	Question 12. Does your organization have an explicit innovation strategy or strategy towards innovation?	Question 13. Does your organization attempt to influence the following?	
	Size	Aggressive technological policy	Innovation strategy	Creativity	Innovation
1. Yes	60%	53%	67%	40%	73%
2. Maybe	20%	13%	0%	27%	7%
3. No	20%	33%	33%	33%	20%
Rank Mean	1.600	1.800	1.667	1.933	1.467
Rank Median	1.000	1.000	1.000	2.000	1.000
Rank Variance (S_{xx})	0.686	0.886	0.952	0.781	0.695
Rank Std Dev	0.828	0.941	0.976	0.884	0.834
Correlation Coef. (r)	0.259	-0.054	-0.366	-0.138	-0.376
t-stat for H_o: r=0	0.967	-0.194	-1.420	-0.503	-1.463
p-value for corr. H_o	0.350	0.849	0.177	0.623	0.166
t-stat for Ho: μ: ≥ 2	-1.871	-0.823	-1.323	-0.292	-2.477
p-value = P(X < 2)	4.121E-02	2.121E-01	1.035E-01	3.872E-01	1.330E-02
Mann-Whitney P(X<2)	1.558E-02	1.349E-01	5.705E-02	2.777E-01	3.560E-03

Hypothesis 6, Question 14

H_o: $\mu \geq 2$. With respect to specific job duties, chain of command, communications protocol, etc., very successful technology organizations tend towards a fixed as opposed to a flexible organizational structure.

With a t-test p-value of $0.63x\ 10^{-9}$ and a Mann-Whitney test p-value of 103.10×10^{-9}, H_o is rejected in favor of H_A.

Support for H_A indicating these organizations utilize a flexible organizational structure was overwhelming and confirmed by the tight distribution of the responses around the Flexible structure response as shown in Table 20. Flexible organizational structure as a factor is retained within the model.

Hypothesis 7, Question 15

Do team members maintain within the two domains, internal and external to the organization, open communications as opposed to a more rigid or fixed structure whereby leadership is the main conduit of communications.

Hypothesis 7a:

H_o: $\mu \geq 2$. Within successful technology organizations, leadership is not the main conduit of communications to others internal to the organization but external to the team.

With a t-test p-value of 2.73×10^{-1} and a Mann-Whitney test p-value of 1.75×10^{-1}, H_o is accepted.

Hypothesis 7b

H_o: $\mu \geq 2$. Within successful technology organizations, leadership is not the main conduit of communications to others external to the organization.

With a t-test p-value of 10.89×10^{-2} and a Mann-Whitney test p-value of 5.26×10^{-2}, H_o is accepted. The wording of this question prevents the conclusive establishment that open communication is the necessary method of communication between team members and non-team members. Hypotheses were tested both ways (H_o: $\mu \geq 2$ and H_o: $\mu \leq 2$), but neither yielded conclusive results as follows. By not structuring the question specifically around non-leadership personnel's communication, we can conclude only that it is plausible that leadership personnel are not the main conduits of communication as opposed to concluding that non-leadership personnel are the main conduits of communication. So, acceptance of these null hypotheses does not provide conclusive evidence that the conduits of communication components must be retained in the model. Acceptance of H_A as a result of the marginal p-value is also confirmed by the relatively large variance of the responses ranks. Therefore, this characteristic is not retained in the model.

Hypothesis 8, Question 16

H_o: $\mu \geq 2$. Within successful technology organizations, leadership tends towards hands-on/managing as opposed to hands-off/steering styles.

With a t-test p-value of 3.64×10^{-5} and a Mann-Whitney test p-value of 7.63×10^{-5}, H_o is rejected in favor of H_A.

The central tendency measures of response rank mean, median, and variance confirm acceptance of H_A. It is clear that hands-off/steering leadership styles are overwhelmingly preferred. Therefore, hands-off leadership as a style is retained within the model.

Table 20 – Organizational Structure Results

	Question 14. With respect to specific job duties, chain of command, communications protocol, etc., does your organization tend towards a fixed or flexible organizational structure?		Question 15. Is leadership whether a team leader, manager, or otherwise the main conduit of communication between its respective team and the following domains?			Question 16. Does your organization tend towards hands-on or hands-off leadership, i.e. managing versus steering?	
				Internal to the organization but external to the team	External to the organization		
Rank 1	Flexible	93%	Yes	40%	50%	Hands-off/Steering	67%
Rank 2	Fixed	7%	Maybe	33%	29%	Hands-on/Managing	27%
Rank 3			No	27%	21%	Other	7%
Rank Mean		1.067		1.867	1.714		1.286
Rank Median		1.000		2.000	1.500		1.000
Rank Variance (SXX)		0.067		0.695	0.681		0.220
Rank Std Dev		0.258		0.834	0.825		0.469
Correlation Coef. (r)		0.106		-0.179	0.053		0.311
t-stat for Ho: r=0		0.384		-0.656	0.184		1.132
p-value for corr. Ho		0.707		0.522	0.857		0.278
t-stat for Ho: μ: ≥ 2		-14.000		-0.619	-1.295		-5.901
p-value = P(X < 2)		6.317E-10		2.728E-01	1.089E-01		3.641E-05
Mann-Whitney P(X<2)		1.031E-07		1.748E-01	5.264E-02		7.628E-05

Hypothesis 9, Question 17

H_o: $\mu \geq 2$. Within successful technology organizations, innovation tasks and assignments are not managed differently than other tasks and assignments.

With a t-test p-value of 8.69×10^{-1} and a Mann-Whitney test p-value of 9.28×10^{-1}, H_o is accepted.

The null hypothesis is accepted, and the management of innovation tasks and assignments is eliminated from the model. The response rank mean, median, and variance were consistent with acceptance of H_o. Five of the 15 respondents provided commentary on how their respective organizations may or does handle innovative versus non-innovative tasking. Two responded similarly by saying, in Company J's terminology, that "since innovation usually means heading into uncharted waters our management tends to pay more attention". Company O stated that since typical design deadlines may not exist with innovation tasks, their management treated those with less formality.

Hypothesis 10, Question 18

This hypothesis is taken differently than all previous hypotheses within this analysis because of its distribution, as shown in Table 21. All but one company indicated that they maintained a balanced-orientation with respect to time horizon for achieving goals of market dominance. Given the distribution, the t-statistic and p-value for H_o: $\mu \neq 2$ was calculated to see if it was possible to show that H_A: $\mu = 2$ (these organizations maintain a balanced orientation); however, H_A could not be shown to be true.

H_o: $\mu \geq 3$. Successful technology organizations maintain at the longest a short-term orientation with respect to meeting market goals.

With a t-test p-value of 1.08×10^{-10} and a Mann-Whitney test p-value of 6.45×10^{-9}, H_o is rejected in favor of H_A.

The response rank mean, median, and variance of 1.933, 2.000, and 0.067, all agree with the acceptance of H_A. So, the market orientation of balanced or long-term is retained within the model.

Hypothesis 11, Question 19

H_o: $\mu \geq 2$. Successful technology organizations are at best somewhat adept at discovering and adapting to change and evolving technology.

With a t-test p-value of 14.04×10^{-3} and a Mann-Whitney test p-value of 3.16×10^{-3}, H_o is rejected in favor of H_A.

47% of these organizations are very adept at acquiring evolving technology, and where a response rank of one corresponds to Very adept, the response rank mean of 1.6, median of 2.0, and variance of 0.4 all agree with the alternative hypothesis. Therefore, this element is retained within the model.

Hypothesis 12, Question 20

H_o: $\mu \geq 2$. Successful technology organizations practice closed innovation which limits the flow of information.

With a t-test p-value of 1.48×10^{-6} and a Mann-Whitney test p-value of 5.26×10^{-6}, H_o is rejected in favor of H_A.

Company K added a caveat to its selection of Closed Innovation stating that it practiced "somewhat open, but not fully open". With the selection of Closed Innovation, it would seem that the respondent felt that their organization tended more towards closed innovation than open. Given that 80% of these organizations practice open innovation, and where a response rank of one corresponds to Open innovation, the response rank mean of 1.2, median of 1.0, and variance of 0.171 all agree with the alternative hypothesis. Therefore, the practice of open innovation is retained within the model.

Table 21 – Assignments, Focus and Information

	Question 17. Are innovation tasks and assignments managed differently than other tasks and assignments?		Question 18. Does your organization maintain a long term orientation such as a focus on market dominance, etc. or a short term orientation such as a focus on quarterly sales, etc.?		Question 19. How adept is your organization at discovering and adapting to change and evolving technology?		Question 20. Does your organization practice: (1) open innovation which has been defined as the use of free inflows and outflows of information both inside the firm and out; or (2) closed innovation which limits the flow of information?	
Rank 1	Yes	27%	Long term orientation	7%	Very adept	47%	Open innovation	80%
Rank 2	Maybe	20%	Balanced orientation	93%	Somewhat adept	47%	Closed innovation	20%
Rank 3	No	53%	Short term orientation	0%	Slightly adept	7%		
Rank 4					Not adept	0%		
Rank Mean		2.267		1.933		1.600		1.200
Rank Median		3.000		2.000		2.000		1.000
Rank Variance (SXX)		0.781		0.067		0.400		0.171
Rank Std Dev		0.884		0.258		0.632		0.414
Correlation Coef. (r)		-0.055				-0.110		0.274
t-stat for Ho: r=0		-0.198				-0.398		1.029
p-value for corr. Ho		0.846				0.697		0.321

	Question 17. Are innovation tasks and assignments managed differently than other tasks and assignments?	Question 18. Does your organization maintain a long term orientation such as a focus on market dominance, etc. or a short term orientation such as a focus on quarterly sales, etc.?		Question 19. How adept is your organization at discovering and adapting to change and evolving technology?	Question 20. Does your organization practice: (1) open innovation which has been defined as the use of free inflows and outflows of information both inside the firm and out; or (2) closed innovation which limits the flow of information?
t-stat for Ho: μ: ≥ 2	1.169	t-stat for Ho: μ ≥ 3	-16.000	-2.449	-7.483
p-value = P(X < 2)	8.690E-01	p-value = P(X < 3)	1.080E-10	1.404E-02	1.476E-06
Mann-Whitney P(X<2)	9.282E-01	Mann-Whitney P(X<3)	6.447E-9	3.160E-03	5.261E-06

Hypothesis 13, Question 21

H_o: $\mu \geq 2$. Knowledge capacities are at best somewhat effective within these technology organizations.

With a t-test p-value of 8.22×10^{-2} indicates the null hypothesis should be accepted; however, a Mann-Whitney test p-value of 3.34×10^{-2} H_o indicates otherwise. Again, the Mann-Whitney test is considered more reliable because of the non-normal nature of the data. With the central tendency metrics of response rank mean, median, and variance each having values of 1.733, 2.000, and 0.495, support for this component was moderate, but deemed enough to retain the factor within the model.

Hypothesis 14, Question 22

H_o: $\mu \geq 2$. Attempts to identify and utilize external knowledge, technologies or ideas should be done at most occasionally within technology organizations.

With a t-test p-value of 2.13×10^{-4} and a Mann-Whitney test p-value of 3.50×10^{-4}, H_o is rejected in favor of H_A.

All of the organizations attempt to identify and utilize external knowledge, technologies, or ideas at least occasionally, with 60% actively seeking out external sources frequently. This factor is retained within the model.

Hypothesis 15, Question 23

H_o: $\mu \geq 2$. Employee perception of resource availability at best might influence the success of technology projects.

With a t-test p-value of 10.85×10^{-2} and a Mann-Whitney test p-value of 5.28×10^{-2}, H_o is accepted.

Employee perception of resource availability is not retained in the model.

Hypothesis 16, Question 24

H_o: $\mu \geq 2$. Employee perception of the value placed in them by the organization and its leadership is at best important.

With a t-test p-value of 6.58×10^{-4} and a Mann-Whitney test p-value of 11.00×10^{-4}, H_o is rejected in favor of H_A.

This component is retained within the model.

Table 22 - Knowledge and Perceptions Results

	Question 21. How would you characterize your organization's knowledge capacities or abilities to explore, retain, and exploit knowledge into meaningful and useful innovation?		Question 22. How often does your organization attempt to identify and utilize external knowledge, technologies, or ideas?		Question 23. Does employee perception of resource availability influence the success of your organization's technological projects?		Question 24. How important to the success of the organization is employee perception of the value placed in them by the organization and its leadership?	
Rank 1	Very effective	40%	Frequently	60%	Yes	47%	Critical	53%
Rank 2	Somewhat effective	47%	Occasionally	40%	Maybe	33%	Important	47%
Rank 3	Slightly effective	13%	Rarely	0%	No	20%	Not important	0%
Rank 4	Not effective	0%						
Rank Mean		1.733		1.400		1.733		1.467
Rank Median		2.000		1.000		2.000		1.000
Rank Variance (Sxx)		0.495		0.257		0.638		0.267
Rank Std Dev		0.704		0.507		0.799		0.516
Correl. Coef. (r)		-0.021		-0.050		0.337		0.065
t-stat for H_o: r=0		-0.075		-0.180		1.291		0.236
p-value for corr. H_o		0.941		0.860		0.218		0.817
t-stat for Ho: μ: ≥ 2		-1.468		-4.583		-1.293		-4.000
p-value = P(X < 2)		8.216E-02		2.132E-04		1.085E-01		6.580E-04
Mann-Whit. P(X<2)		3.344E-02		3.498E-04		5.281E-02		1.100E-03

Hypothesis 17, Question 25

Certain job characteristics influence the success of technology organizations more than others. This series of hypotheses explores within very successful companies which job characteristics warrant more than moderate emphasis. The implication is that if a statistically significant set of these companies place more than moderate emphasis on any one characteristic, then it must be capable of influencing success.

Hypothesis 17a:

H_o: $\mu \geq 2$. The ideal of job complexity for technical personnel is only important enough to warrant moderate organizational emphasis.

With a t-test p-value of 14.04×10^{-3} and a Mann-Whitney test p-value of 3.16×10^{-3}, H_o is rejected in favor of H_A.

Hypothesis 17b:

H_o: $\mu \geq 2$. The ideal of job complexity for non-technical personnel is only important enough to warrant moderate organizational emphasis.

With a t-test p-value of 7.27×10^{-1} and a Mann-Whitney test p-value of 7.70×10^{-1}, H_o is accepted.

Hypothesis 17c:

H_o: $\mu \geq 2$. The ideal of autonomy in researching solutions is only important enough to warrant moderate organizational emphasis.

With a t-test p-value of 2.70×10^{-2} and a Mann-Whitney test p-value of 0.76×10^{-2}, H_o is rejected in favor of H_A.

Hypothesis 17d:

H_o: $\mu \geq 2$. The ideal of employee ownership and control over their work is only important enough to warrant moderate organizational emphasis.

With a t-test p-value of 1.15×10^{-5} and a Mann-Whitney test p-value of 2.50×10^{-5}, H_o is rejected in favor of H_A.

Hypothesis 17e:

H_o: $\mu \geq 2$. The ideal of flexibility in setting employee's own agenda is only important enough to warrant moderate organizational emphasis.

With a t-test p-value of 2.17×10^{-1} and a Mann-Whitney test p-value of 1.20×10^{-5}, H_o is accepted.

Hypothesis 17f:

H_o: $\mu \geq 2$. The ideal of providing clear role goals and expectations for employees is only important enough to warrant moderate organizational emphasis.

With a t-test p-value of 2.13×10^{-4} and a Mann-Whitney test p-value of 3.50×10^{-4}, H_o is rejected in favor of H_A.

Hypothesis 17g:

H_o: $\mu \geq 2$. The ideal of organizational encouragement and support is only important enough to warrant moderate organizational emphasis.

With a p-value 12.51×10^{-4} and a Mann-Whitney test p-value of 1.00×10^{-4}, H_o is rejected in favor of H_A.

Hypothesis 17h:

H_o: $\mu \geq 2$. The ideal of supervisory encouragement and support is only important enough to warrant moderate organizational emphasis.

With a t-test p-value of 8.22×10^{-2}, the t-test indicates that the null hypothesis should be accepted. However, with the supporting central tendency of the data and a Mann-Whitney test p-value of 3.34×10^{-2}, H_o is rejected in favor of H_A.

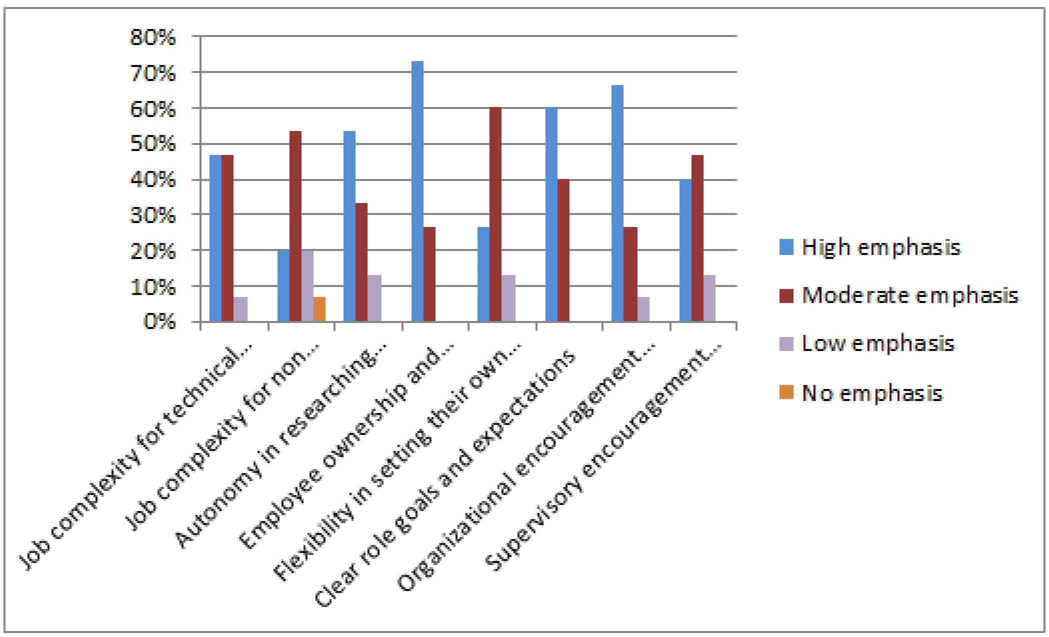


Figure 22 - Job Emphasis Distribution 1

Table 23 - Job Emphasis 1

Individual Components	Question 25. How much emphasis does your organization place on addressing each of the following job characteristics?							
	Job complexity for technical personnel	Job complexity for non technical personnel	Autonomy in researching solutions	Employee ownership and control over their own work	Flexibility in setting their own agenda	Clear role goals and expectations	Organizational encouragement and support	Supervisory encouragement and support
1. High emphasis	47%	20%	53%	73%	27%	60%	67%	40%
2. Moderate emphasis	47%	53%	33%	27%	60%	40%	27%	47%
3. Low emphasis	7%	20%	13%	0%	13%	0%	7%	13%
4. No emphasis	0%	7%	0%	0%	0%	0%	0%	0%
Rank Mean	1.600	2.133	1.600	1.267	1.867	1.400	1.400	1.733
Rank Median	2.000	2.000	1.000	1.000	2.000	1.000	1.000	2.000
Rank Variance	0.400	0.695	0.543	0.210	0.410	0.257	0.400	0.495
Rank Std Dev	0.632	0.834	0.737	0.458	0.640	0.507	0.632	0.704
Correl. Coef. (r)	0.090	-0.048	-0.051	-0.175	-0.135	-0.174	-0.239	-0.155
t-stat: H_0: r=0	0.325	-0.173	-0.186	-0.640	-0.490	-0.638	-0.889	-0.567
p-value: corr. H_0	0.750	0.865	0.855	0.533	0.631	0.534	0.389	0.579
t-stat for Ho: µ: ≥ 2	-2.449	0.619	-2.103	-6.205	-0.807	-4.583	-3.674	-1.468
p-value = P(X < 2)	1.404E-02	7.272E-01	2.703E-02	1.148E-05	2.166E-01	2.132E-04	1.251E-03	8.216E-02
Mann-Whitney P(X<2)	3.160E-03	7.696E-01	7.600E-03	2.499E-05	1.195E-01	3.498E-04	9.995E-05	3.344E-02

Hypothesis 17i:

H_o: $\mu \geq 2$. The ideal of peer or work group encouragement and support is only important enough to warrant moderate organizational emphasis.

With a t-test p-value of 2.76×10^{-2} and a Mann-Whitney test p-value of 0.84×10^{-2}, H_o is rejected in favor of H_A.

Hypothesis 17j:

H_o: $\mu \geq 2$. The ideal of creative role models are only important enough to warrant moderate organizational emphasis.

With a t-test p-value of 6.13×10^{-1} and a Mann-Whitney test p-value of 5.01×10^{-1}, H_o is accepted.

Hypothesis 17k:

H_o: $\mu \geq 2$. The ideal of a system of rewards for employees is only important enough to warrant moderate organizational emphasis.

With a t-test p-value of 2.73×10^{-1} and a Mann-Whitney test p-value of 1.75×10^{-1}, H_o is accepted.

Hypothesis 17l:

H_o: $\mu \geq 2$. The ideal of group dynamics (synergy and attitudes) are only important enough to warrant moderate organizational emphasis.

With a t-test p-value of 14.04×10^{-3} and a Mann-Whitney test p-value of 3.16×10^{-3}, H_o is rejected in favor of H_A.

Hypothesis 17m:

H_o: $\mu \geq 2$. The ideal of fair and supportive evaluation of new ideas is only important enough to warrant moderate organizational emphasis.

With a t-test p-value of 5.19×10^{-2}, the t-test indicates that the null hypothesis should be accepted; however, the Mann-Whitney test p-value of 2.11×10^{-2} indicates that it should be rejected in favor of H_A. Since the data are not normal, the Mann-Whitney test is more credible; therefore, H_o is rejected in favor of H_A.

Hypothesis 17n:

H_o: $\mu \geq 2$. The ideal of collaborative idea flow across the organization is only important enough to warrant moderate organizational emphasis.

With a t-test p-value of 14.52×10^{-3} and a Mann-Whitney test p-value of 3.27×10^{-3}, H_o is rejected in favor of H_A.

Hypothesis 17o:

H_o: $\mu \geq 2$. The ideal of employee risk taking is only important enough to warrant moderate organizational emphasis.

With a t-test p-value of 7.51×10^{-1} and a Mann-Whitney test p-value of 8.53×10^{-1}, H_o is accepted.

Hypothesis 17p:

H_o: $\mu \geq 2$. The ideal of external recognition for achievements is only important enough to warrant moderate organizational emphasis.

With a t-test p-value of 9.87×10^{-1} and a Mann-Whitney test p-value of 9.97×10^{-1}, H_o is accepted.

As shown in Figure 22, Table 23, Figure 23, and Table 24 by way of their respective null hypotheses being rejected in favor of the alternative hypotheses, the following job characteristics are important enough to warrant more than moderate emphasis by companies within this population: (1) job complexity for technical personnel; (2) autonomy in researching solutions; (3) employee ownership and control over their own work; (4) clear role goals and expectations; (5) organizational encouragement and support; (6) supervisory encouragement and support; (7) peer or work group encouragement and support; (8) group dynamics (synergy and attitudes); (9) fair and supportive evaluation of new ideas; and (10) collaborative idea flow across the organization. Therefore, the characteristics are retained in the model. The central tendencies of each of those agreed with the hypotheses findings, and in each case the response rank mean was less than 2.0, where two was the rank assigned to Moderate emphasis. All of these characteristics' rank variances were relatively low.

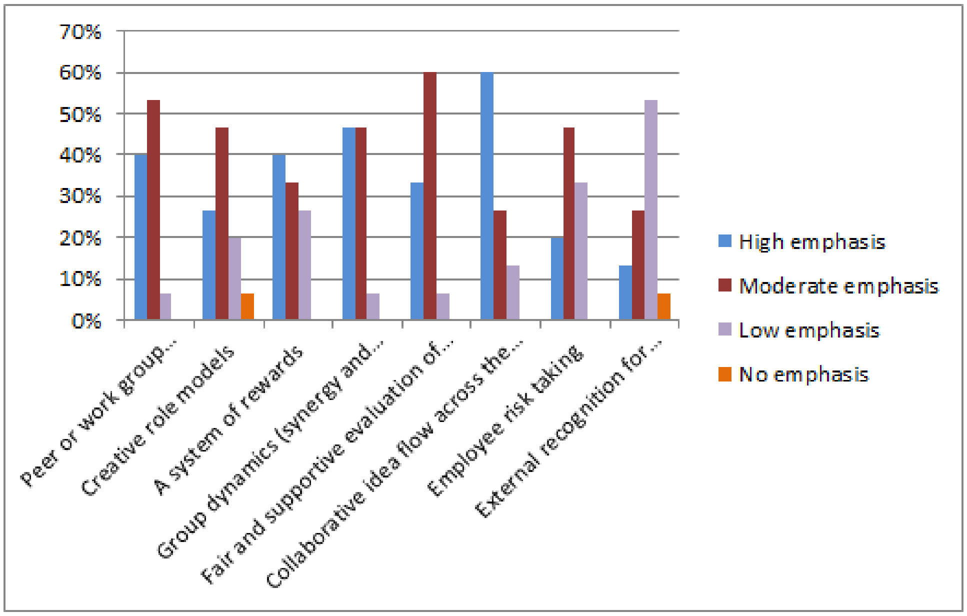


Figure 23 - Job Emphasis Distribution 2

Table 24 - Job Emphasis 2

Individual Components	Peer or work group encouragement and support	Creative role models	A system of rewards	Group dynamics (synergy and attitudes)	Fair and supportive evaluation of new ideas	Collaborative idea flow across the organization	Employee risk taking	External recognition for achievements
	Question 25. How much emphasis does your organization place on addressing each of the following job characteristics?							
High emphasis	40%	27%	40%	47%	33%	60%	20%	13%
Moderate emphasis	53%	47%	33%	47%	60%	27%	47%	27%
Low emphasis	7%	20%	27%	7%	7%	13%	33%	53%
No emphasis	0%	7%	0%	0%	0%	0%	0%	7%
Rank Mean	1.667	2.067	1.867	1.600	1.733	1.533	2.133	2.533
Rank Median	2.000	2.000	2.000	2.000	2.000	1.000	2.000	3.000
Rank Variance	0.381	0.781	0.695	0.400	0.352	0.552	0.552	0.695
Rank Std Dev	0.617	0.884	0.834	0.632	0.594	0.743	0.743	0.834
Correlation Coef. (r)	-0.017	-0.148	-0.293	-0.010	0.082	-0.215	0.286	-0.267
t-stat: H_0: r=0	-0.061	-0.538	-1.104	-0.036	0.295	-0.794	1.076	-1.001
p-value: corr. H_0	0.952	0.599	0.288	0.972	0.772	0.440	0.300	0.334
t-stat for Ho: µ: ≥ 2	-2.092	0.292	-0.619	-2.449	-1.740	-2.432	0.695	2.477
p-value = P(X < 2)	2.759E-02	6.128E-01	2.728E-01	1.404E-02	5.191E-02	1.452E-02	7.507E-01	9.867E-01
Mann-Whitney P(X<2)	8.430E-03	5.011E-01	1.748E-01	3.160E-03	2.107E-02	3.270E-03	8.531E-01	9.968E-01

Hypothesis 18, Question 26

H_o: $\mu \geq 2$. The consequence of innovation to organizational success is at best important.

With a t-test p-value of 30.38×10^{-4} and a Mann-Whitney test p-value of 3.50×10^{-4}, H_o is rejected in favor of H_A.

Innovation is more than important, so it is retained within the model. This is a triangulation of question eight's results, where participants formally acknowledged from an ideological standpoint the significance of innovation.

Hypothesis 19, Question 27

H_o: $\mu \geq 2$. Organizational size at best might influence innovativeness.

With a t-test p-value of 3.87×10^{-1} and a Mann-Whitney test p-value of 2.78×10^{-1}, H_o is accepted.

This factor is not retained within the model.

Hypothesis 20, Question 28

H_o: $\mu \geq 2$. These very successful organizations at best might have focused the majority of their innovative efforts into niche markets with products and services that are related to each other.

With a t-test p-value of 373.90×10^{-7} and a Mann-Whitney test p-value of 8.77×10^{-7}, H_o is rejected in favor of H_A.

Clearly, the majority of these organizations have focused their innovative efforts into niche markets. This characteristic is retained within the model.

Hypothesis 21, Question 29

H_o: $\mu \geq 2$. It is at best important to have a project champion on a project.

With a t-test p-value of 5.70×10^{-5} and a Mann-Whitney test p-value of 10.00×10^{-5}, H_o is rejected in favor of H_A.

With a response rank mean of 1.333, median of 1.000, and variation of 0.238, H_A which states that it is important to have a project champion who is committed to the project, optimistic about its success, and will defend it as needed, is confirmed. A majority of these organizations feel that it is critical. Therefore, this is retained within the model.

Table 25 – Innovation

	Question 26. How important is innovation for your organization's success?		Question 27. Does your organization's size influence its innovativeness?		Question 28. Is it accurate to say that your organization has focused the majority of its innovative efforts into niche markets with technology products and/or services that are related to each other.		Question 29. How important is it to have a project champion which has been defined as someone who is committed to the project, optimistic about its success, and will defend it as needed?	
Response Totals		100%		100%		100%		100%
Rank 1	Critical	60%	Yes	40%	Yes	87%	Critical	67%
Rank 2	Important	33%	Maybe	27%	Maybe	7%	Important	33%
Rank 3	Not Important	7%	No	33%	No	7%	Not important	0%
Rank Mean		1.467		1.933		1.200		1.333
Rank Median		1.000		2.000		1.000		1.000
Rank Variance (Sxx)		0.410		0.781		0.314		0.238
Rank Std Dev		0.640		0.884		0.561		0.488
Correlation Coef. (r)		-0.293		0.290		0.146		-0.172
t-stat for H_0: r=0		-1.103		1.094		0.533		-0.631
p-value for corr. H_0		0.289		0.292		0.602		0.538
t-stat for Ho: μ: ≥ 2		-3.228		-0.292		-5.527		-5.292
p-value = P(X < 2)		3.038E-03		3.872E-01		3.729E-05		5.696E-05
Mann-Whitney P(X<2)		3.498E-04		2.777E-01		8.768E-07		9.995E-05

Hypothesis 22, Question 30

Certain traits are more closely associated with an organization's innovative success than others. This series of hypotheses explores within very successful companies which traits should receive more than moderate emphasis hiring or assigning tasks for personnel essential to the organization's innovative success. Again, the implication is that if a statistically significant set of these companies place high emphasis on any one trait, then it must be a valuable metric for assessing the capacity of an employee to succeed with the confines of innovative success.

Hypothesis 22a:

H_o: $\mu \geq 2$. Individual intellect is only important enough to warrant moderate organizational emphasis.

With a t-test p-value of 5.70×10^{-5} and a Mann-Whitney test p-value of 10.00×10^{-5}, H_o is rejected in favor of H_A.

Hypothesis 22b:

H_o: $\mu \geq 2$. Individual education is only important enough to warrant moderate organizational emphasis.

With a t-test p-value of 3.60×10^{-1} and a Mann-Whitney test p-value of 2.34×10^{-1}, H_o is accepted.

Hypothesis 22c:

H_o: $\mu \geq 2$. Individual training is only important enough to warrant moderate organizational emphasis.

With a t-test p-value of 5.19×10^{-2} and a Mann-Whitney test p-value of 2.10×10^{-2}, H_o is rejected in favor of H_A.

Hypothesis 22d:

H_o: $\mu \geq 2$. Individual experience is only important enough to warrant moderate organizational emphasis.

With a t-test p-value of 6.58×10^{-4} and a Mann-Whitney test p-value of 1.10×10^{-3}, H_o is rejected in favor of H_A.

Hypothesis 22e:

H_o: $\mu \geq 2$. Broad personal interests are only important enough to warrant moderate organizational emphasis.

With a t-test p-value of 8.33×10^{-1} and a Mann-Whitney test p-value of 9.10×10^{-1}, H_o is accepted.

Hypothesis 22f:

H_o: $\mu \geq 2$. Independence of judgment is only important enough to warrant moderate organizational emphasis.

With a t-test p-value of 4.12×10^{-2} and a Mann-Whitney test p-value of 1.10×10^{-3}, H_o is rejected in favor of H_A.

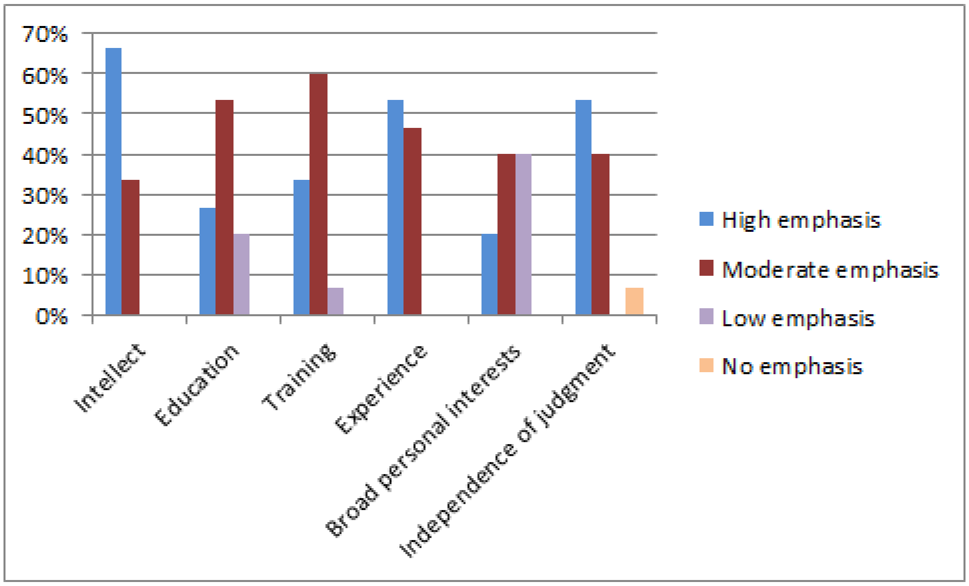


Figure 24 - Hiring Emphasis Distribution 1

Table 26 - Hiring Emphasis 1

Individual Components	Question 30. When hiring or assigning tasks for personnel essential to your organization's innovative success, how much emphasis is placed on each of the following traits?					
	Intellect	Education	Training	Experience	Broad personal interests	Independence of judgment
Response Totals	100%	100%	100%	100%	100%	100%
High emphasis	67%	27%	33%	53%	20%	53%
Moderate emphasis	33%	53%	60%	47%	40%	40%
Low emphasis	0%	20%	7%	0%	40%	0%
No emphasis	0%	0%	0%	0%	0%	7%
Rank Mean	1.333	1.933	1.733	1.467	2.200	1.600
Rank Median	1.000	2.000	2.000	1.000	2.000	1.000
Rank Variance (S_{XX})	0.238	0.495	0.352	0.267	0.600	0.686
Rank Std Dev	0.488	0.704	0.594	0.516	0.775	0.828
Correlation Coef. (r)	0.086	0.410	0.082	-0.118	0.228	-0.008
t-stat for H_0: r=0	0.312	1.619	0.295	-0.429	0.845	-0.027
p-value for corr. H_0	0.760	0.128	0.772	0.674	0.412	0.978
t-stat for Ho: $\mu \geq 2$	-5.292	-0.367	-1.740	-4.000	1.000	-1.871
p-value = P(X < 2)	5.696E-05	3.596E-01	5.191E-02	6.580E-04	8.329E-01	4.121E-02
Mann-Whitney P(X<2)	9.995E-05	2.335E-01	2.107E-02	1.100E-03	9.101E-01	1.100E-03

Hypothesis 22g:

H_o: $\mu \geq 2$. Self-sufficiency or autonomy is only important enough to warrant moderate organizational emphasis.

With a t-test p-value of 1.40×10^{-2} and a Mann-Whitney test p-value of 3.16×10^{-3}, H_o is rejected in favor of H_A.

Hypothesis 22h:

H_o: $\mu \geq 2$. Sense of one's self as creative is only important enough to warrant moderate organizational emphasis.

With a t-test p-value of 5.00×10^{-1} and a Mann-Whitney test p-value of 6.53×10^{-1}, H_o is accepted.

Hypothesis 22i:

H_o: $\mu \geq 2$. Communications skills are only important enough to warrant moderate organizational emphasis.

With a t-test p-value of 6.58×10^{-4} and a Mann-Whitney test p-value of 1.10×10^{-3}, H_o is rejected in favor of H_A.

Hypothesis 22j:

H_o: $\mu \geq 2$. Intrinsic motivation is only important enough to warrant moderate organizational emphasis.

With a t-test p-value of 1.62×10^{-4} and a Mann-Whitney test p-value of 2.90×10^{-4}, H_o is rejected in favor of H_A.

Hypothesis 22k:

H_o: $\mu \geq 2$. Diversity of ethnicity is only important enough to warrant moderate organizational emphasis.

With a t-test p-value of 1.00×10^{-0} and a Mann-Whitney test p-value of 1.00×10^{-0}, H_o is accepted.

Hypothesis 22l:

H_o: $\mu \geq 2$. Diversity of education is only important enough to warrant moderate organizational emphasis.

With a t-test p-value of 9.99×10^{-1} and a Mann-Whitney test p-value of 1.00×10^{-0}, H_o is accepted.

Hypothesis 22m:

H_o: $\mu \geq 2$. Diversity of experience is only important enough to warrant moderate organizational emphasis.

With a t-test p-value of 8.50×10^{-1} and a Mann-Whitney test p-value of 8.53×10^{-1}, H_o is accepted.

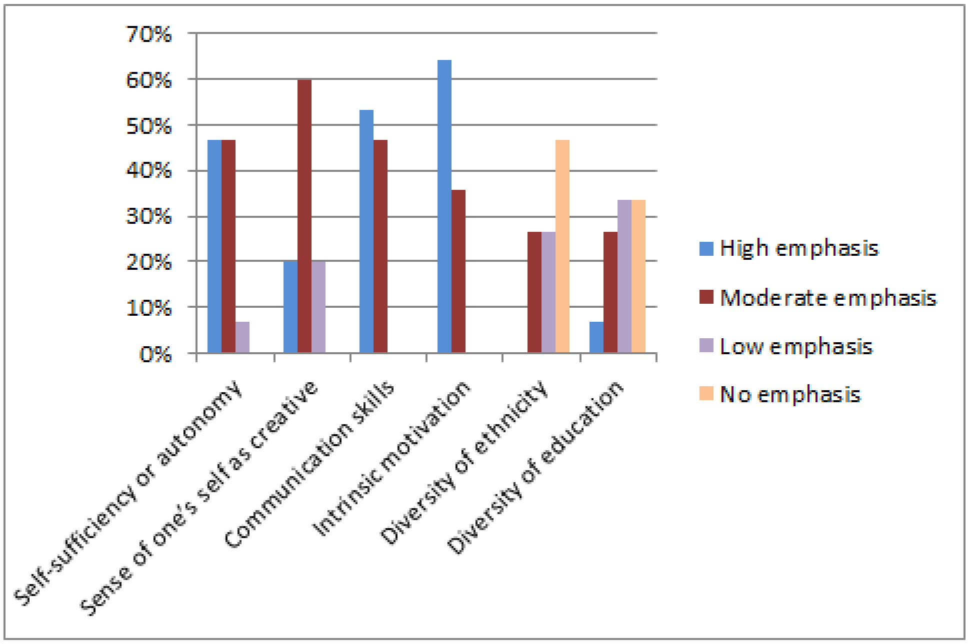


Figure 25 - Hiring Emphasis Distribution 2

Table 27 - Hiring Emphasis 2

	Question 30. When hiring or assigning tasks for personnel essential to your organization's innovative success, how much emphasis is placed on each of the following traits?						
Individual Components	Self-sufficiency or autonomy	Sense of one's self as creative	Communication skills	Intrinsic motivation	Diversity of ethnicity	Diversity of education	Diversity of experience
1. High emphasis	47%	20%	53%	64%	0%	7%	20%
2.Moderate emphasis	47%	60%	47%	36%	27%	27%	47%
3.Low emphasis	7%	20%	0%	0%	27%	33%	20%
4.No emphasis	0%	0%	0%	0%	47%	33%	13%
Rank Mean	1.600	2.000	1.467	1.357	3.200	2.933	2.267
Rank Median	2.000	2.000	1.000	1.000	3.000	3.000	2.000
Rank Variance (S_{xx})	0.400	0.429	0.267	0.247	0.743	0.924	0.924
Rank Std Dev	0.632	0.655	0.516	0.497	0.862	0.961	0.961
Correlation Coef. (r)	-0.160	0.193	-0.179	-0.005	0.059	0.070	-0.149
t-stat for H_o: r=0	-0.583	0.708	-0.657	-0.017	0.212	0.253	-0.543
p-value for corr. H_o	0.569	0.490	0.522	0.987	0.835	0.804	0.596
t-stat for Ho: μ: ≥ 2	-2.449	0.000	-4.000	-4.837	5.392	3.761	1.075
p-value = P(X < 2)	1.404E-02	5.000E-01	6.580E-04	1.622E-04	1.000E+00	9.989E-01	8.496E-01
Mann-Whitney P(X<2)	3.160E-03	6.533E-01	1.100E-03	2.899E-04	1.000E+00	9.999E-01	8.531E-01

Hypothesis 23, Question 31

H_o: $\mu \geq 2$. With respect to innovation solutions, employees are expected to take at a minimum substantial risk (whatever the employee feels is best).

With a t-test p-value of 8.22×10^{-2} and a Mann-Whitney test p-value of 1.00, H_o is accepted.

This factor is not retained within the model.

Hypothesis 24, Question 32

Section 2.5.2 documented where the literature review showed that in some cases certain types of pressures can be productive in stimulating creativity. These null hypotheses state that within very successful technology organizations, employees experience certain pressures less than frequently. As a result of the question wording, these hypotheses cannot establish whether the respondents linked either of the stated pressures to technology organization success or not. Rather, they merely establish whether employees experience them or not. The intended hypotheses are shown as follows; however, despite favorable hypotheses testing, as a result of the ambiguous question wording, these factors cannot justifiably be retained within the model. This is the result of the model focusing on factors shown to be very important to success as opposed to a model that merely reflects reality.

Hypothesis 24a:

H_o: $\mu \geq 2$. Employees experience challenge pressure no more than occasionally.

With a t-test p-value of 1.77×10^{-3} and a Mann-Whitney test p-value of 3.16×10^{-3}, H_o is rejected in favor of H_A.

Challenge pressure as a factor is not retained within the model due to the ambiguity of the question.

Hypothesis 24b:

H_o: $\mu \geq 2$. Employees experience workload pressure no more than occasionally.

With a t-test p-value of 5.69×10^{-5} and a Mann-Whitney test p-value of 10.00×10^{-5}, H_o is rejected in favor of H_A.

Workload pressure as a factor is not retained within the model due to the ambiguity of the question.

Hypothesis 25, Question 33

H_o: $\mu \geq 2$. Marketing representation on innovative project teams is best important.

With a t-test p-value of 9.18×10^{-1} and a Mann-Whitney test p-value of 10.00×10^{-1}, H_o is accepted.

Marketing representation is not retained within the model.

Table 28 – Risk, Pressure, and Marketing

	Question 31. With respect to innovation solutions, how much risk are employees expected to take?		Question 32. How often do your employees experience the following work pressures:			Question 33. In terms of creativity and innovation, how important is it to have marketing representation on innovative project teams?	
				Challenge pressure	Workload pressure		
Rank 1	Substantial	0%	Frequently	47%	67%	Critical	0%
Rank 2	Discretionary (whatever the employee feels is best)	87%	Occasionally	53%	33%	Important	87%
Rank 3	Minimal	13%	Never	0%	0%	Not important	13%
Rank Mean		2.133		1.533	1.333		2.133
Rank Median		2.000		2.000	1.000		2.000
Rank Variance (Sxx)		0.124		0.267	0.238		0.124
Rank Std Dev		0.352		0.516	0.488		0.352
Correlation Coef. (r)		-0.203		-0.004	0.216		0.066
t-stat for H_o: r=0		-0.749		-0.015	0.796		0.238
p-value for corr. H_o		0.467		0.988	0.439		0.816
t-stat for Ho: μ: ≥ 2		12.475		-3.500	-5.292		1.468
p-value = P(X < 2)		216E-02		1.768E-03	5.696E-05		9.178E-01
Mann-Whitney P(X<2)		1.00		3.160E-03	9.995E-05		1.000E+00

Hypothesis 26, Question 34

H_o: $\mu \geq 2$. Single key innovators are essential to technology organization success.

With a t-test p-value of 9.93×10^{-1}, H_o is accepted.

As a result of the response distribution and emphasis placed on this topic within this research, more hypotheses were tested to ascertain whether more information could be extracted from the data. So, the null hypothesis H_o: $\mu \leq 2$ was tested and is summarized as follows.

H_o: $\mu \leq 2$. Single key innovators at best might be essential to technology organizations' success.

With a t-test p-value of 7.39×10^{-3} and a Mann-Whitney test p-value of 1.30×10^{-3}, H_o is rejected in favor of H_A.

Not only do the null hypotheses testing show that it is plausible that a key innovator is not essential to technology organization success, but also that a key innovator is not essential to technology organization success. The model is modified to correctly reflect this result.

Table 29 - Key Innovator

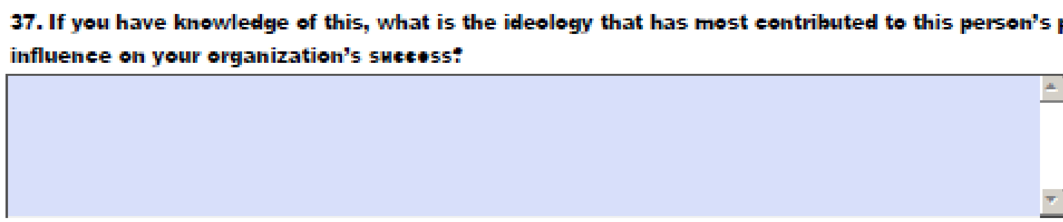
Question 34. Does your organization have a single key innovator that has been essential to the organization's success?	
Response Totals	100%
Yes	13%
Maybe	20%
No	67%
Rank Mean	2.533
Rank Median	3.000
Rank Variance (Sxx)	0.552
Rank Std Dev	0.743
Correlation Coef. (r)	0.422
t-stat for Ho: r ≠ 0	1.677
p-value = P(r = 0)	1.157E-01
t-stat for Ho: μ > 2	2.779
p-value: P(X < 2)	9.926E-01
t-stat for Ho: μ ≤ 2	2.779E+00
p-value: P(X > 2)	7.386E-03
Mann-Whitney P(X>2)	1.300E-03

Five respondents indicated that a single key innovator was either essential or might be essential to the company's success as shown in Table 29. Companies B, C, K, and M all responded that their key innovator held the position level of executive. Company B was the only organization whose key innovator took on multiple roles from executive to project level. Each of these five respondents said their key innovator had substantial involvement in day-to-day operations of the company.

Table 30 - Key innovator Influence

Individual Components	Question 35. What level position does this innovator hold?				Question 36. How much involvement does this innovator have with day-to-day operations?
	Executive	Managerial	Project Level	Purely Technical	Response
Company B	Executive	Managerial	Project Level		Substantial
Company C	Executive				Substantial
Company K	Executive				Substantial
Company M	Executive				Substantial
Company O		Managerial			Substantial

Two respondents provided insight into the open-format question seeking to expound on the ideology contributing to that key innovator's influence, as shown in Figure 26. Company C, which indicated a key innovator was essential to their success responded: "Thinking outside the box. Driving innovation as part of DNA. Following the money. Taking risk. Driving collaboration to achieve big goals with strategic partners. Creating technology platforms to deliver repetitive solutions with speed, scope and scale." And, Company O, which indicated a key innovator might be essential to its success responded: "His determined belief that an innovative method of using different software to perform the same design would yield great benefits to the firm...".



37. If you have knowledge of this, what is the ideology that has most contributed to this person's positive influence on your organization's success?

Figure 26 – Key Innovator Ideology Question

The study failed to that the influence of a key innovator was essential to organization success. Additionally, between the responses of Yes and Maybe, there was no consensus of the ideology behind those innovators' success.

4.5.6 Open-Format Data

There were three open-ended questions at the end of the questionnaire that were designed to elicit information from the participants that may not be anticipated and thereby not discovered with structured questions and ordinal responses. Questions 38 and 39 repeated the theme of the structured question section and provided participants the opportunity to precisely list the top four: (1) factors affecting their organization's success; and (2) threats to its continued success. Question 40 provided participants the opportunity to clarify their organization's culture.

Each of the tables listing participant responses below includes the company's pseudonym and its response. For context and analysis convenience, each company's weighted success ranking was included, as well. Section 4.5.1 established that a rank of 1 indicates the company's growth during the specified time period was in the third quartile of the sample's growth distribution. Within these tables, the organizational success rank was conditionally formatted with the darker blues reflecting higher ranking success as compared to the survey sample set, and the lighter color blue reflecting lower ranking success.

Non-color-coded responses within the following tables indicate that those particular responses were addressed to some degree in the ordinal data section of the survey, or that there was no response provided. Where responses fell within the scope of the previous sections and analyses, no further discussion was provided in this section.

Some responses were not adequately addressed within the preceding sections of the survey. To help with analysis and comparison, each of those responses were color-coded according to the following list where they are documented in the order of their appearance in Table 31 and Table 32.

1. Light maroon highlighted cells indicate concerns about customer and vendor relationships and their associated intricacies.
2. Dark purple emphasizes other disjoint and unique concerns that were anomalies within the data.
3. Orange indicates that there was not enough information provided within the response to fully understand the participant's message.
4. Light green emphasizes concerns about economic instability.
5. Light purple emphasizes regulatory concerns

Question 38: Success Enablers

With few exceptions, the question 38's responses were covered to some degree within the previous ordinal data portion of the survey. Those exceptions are highlighted in Table 31, according to the list above. Four of the six exceptions were provided by Company B whose success was ranked in the lower half of the second quartile of the sample. Aside from Company B, whose top two priorities were customers and vendors, two participants listed customer relationships and associated intricacies among their top four influences on their growth and success. The other two responses were anomalies and were not statistically significant.

Table 31 – Growth and Success Influences-Open Ended

Co.	Rnk	Question 38. Can you identify the four most influential factors (philosophical or otherwise) affecting growth and success within your organization in the order of most important to less important? 1	2	3	4
A	1	No Response	No Response	No Response	No Response
B	3	Commitment to customers	Maintaining relationships with vendors	Location - we are able to instal in several states and counties	The amount of product that we offer; we are not solely a PV company
C	1	Innovation	Collaboration	Value co-creation	Technology platforms
D	4	Innovation	Niche Markets	Strategic Vision	Talent
E	1.5	ability to keep experienced personnel	keeping personnel trained	employee compensation	happiness of employees
F	2.5	Ability to manage growth and maintain culture	Continue to find new ways to market	Staying a "cool" place to work	Ability to keep hiring very good people
G	2.5	Hiring the right people	Keeping corporate culture intact as we grow	Customer satisfaction for repeat business	Building a great place to work
H	2	Focus on Identified Products and target Market segments	Company wide commitment to service goals delivered in	Company wide open culture and flat organizational	A relentless sales philosophy and process that

Co.	Rnk	Question 38. Can you identify the four most influential factors (philosophical or otherwise) affecting growth and success within your organization in the order of most important to less important? 1	2	3	4
			compliance with company values	philosophy that promotes teamwork	seeks to close every lead or opportunity
I	4	Corporate Culture	Ruthless Persistance	Forward Thinking	Good People
J	3	Goals	Accountability	Provide opportunity to talented people	Rhythm
K	4	Team approach	Open Communication	Risk Taking	Perserverance
L	3	Team alignment	Customer interaction	Contnued training	Freedom to innovate
M	1	No Response	No Response	No Response	No Response
N	4	No Response	No Response	No Response	No Response
O	2	Quality of personnel performing engineering design	Ability to step into client's shoes when undertaking design work	Honest and fair dealings in business practices	Building a strong, autonomous atmoshphere and environment for quality people to want to work

Question 39: Impediments

There were sixteen significant threats identified that were not addressed within the ordinal data sections of the questionnaire. Twelve of those sixteen or 75% were beyond the scope of this research as outlined as follows:

1. The four orange cells in Table 32 are responses which lacked enough information to fully understand. Since they were disjoint, they were not statistically significant; therefore, not given further consideration.

2. Five of the twelve respondents indicated concerns regarding threats stemming from changes in the Economy, and they are highlighted light green. However, consideration of this element was deemed outside the scope of this research for two reasons: (1) it is not unique to technology industries or organizations; and (2) no organization is immune to those threats.

3. The light purple cells show concerns about increased governmental and bureaucratic regulations impeding organizational success. Governmental regulation is largely beyond the control of technology organizations; therefore, it was given no further consideration.

Three participants viewed adverse customer relations and concerns as a potential threat to their continued success. These three participants (Companies E, F, and H) were different from the three organizations responding to question 38 that customer relations and concerns were a factor to their success and growth (Companies B, C, and G). This means six of 15 or 40% of participants identified customer relations and concerns as top factors influencing success either.

Finally, one person identified access to capital as a potential threat to growth and success. Question 23 addressed a related topic which is the impact of employee perception of resource availability, but no attempt was made within the questionnaire to assess the direct impact of resource availability.

Table 32 – Threats to Success-Open Ended

Co.	Rnk	Question 39. What are the four most significant threats to your organization's continued growth and success? 1	2	3	4
A	1	No Response	No Response	No Response	No Response
B	3	Competitors	Changes in the market	The introduction of financing/leasing	Staying relevant
C	1	Ability to quickly adapt to changing Enviroment	Sustainability of models	Unstable Economic Market conditions	Ability to scale and or shrink without loosing Innovation culture and DNA
D	4	Competition	Technological Stagnation	Lack of resources and/or talent	Poor Execution
E	1.5	ability to win contracts	ability to find experienced personnel	ability to find new customers	customer perception of company
F	2.5	Significant down turn of the economy	Open source toolkits become stale and are replaced by other technologies	Unable to maintain quality of work as company grows	Loss of good reputation somehow.
G	2.5	Not being able to attract and retain the right talent	Outgrowing smaller clients, and only relying on a smaller number of large clients	Becoming a bland shell of the original culture	Quality of work suffering becuse of scaling issues with growing too fast
H	2	Failure to attract new customers via sub standard sales and marketing effort	Failure to meet customers service expectations	Regulatory climate creating excessive overhead	Disruptive changes in service delivery technology (but this also could be opportunity)
I	4	Government Meddling, Regulation, and	Economic Uncertainty - Effects Accesiblity	H1B Visa's and Offshoring	Finding Candidates with Ownership

Co.	Rnk	Question 39. What are the four most significant threats to your organization's continued growth and success? 1	2	3	4
		Economic &Social Engineering	to Credit, Cash Flow, Customer Spending		Thinking and Work Ethic
J	3	Economy	Regulation	Competition	Commoditization
K	4	Internal Pressures (asking too much from too few resources	Poor economy reduces sales and research contract opportunities	Planning limitations	Execution limitations
L	3	Commoditzation in key areas	No Response	No Response	No Response
M	1	No Response	No Response	No Response	No Response
N	4	No Response	No Response	No Response	No Response
O	2	Access to capital	Ability to attract and retain sufficient human resources	Commoditization of engineering services	Project risk that escalates

Question 40: Organizational Culture

The only two responses that were not thoroughly addressed in the structured question section of the survey were, once again, customer relations and its intricacies. All other responses were cohesive with the structured question, ordinal data section.

Table 33 – Organizational Culture-Open Ended

Co.	Rnk	Q 40: Can you briefly describe your organization's culture which has been defined as the core principles that guide employee decisions and behaviors?
A	1	No response
B	3	To always act in the best interest of the customer and cater as much as we can to their needs.
C	1	Powering sustainable solutions through collaboration, innovation and value co-creation
D	4	Entrepreneurial based culture focused on innovation in a niche market.

Co.	Rnk	Q 40: Can you briefly describe your organization’s culture which has been defined as the core principles that guide employee decisions and behaviors?
E	1.5	No response
F	2.5	[name deleted for anonymity] is an open source company that has a very flat structure. We sell the services of the employees of the company. As such it is important that we have the very best people working for [name deleted for anonymity] To do this we must first keep the work very interesting and rewarding. Second, make it a culture of low "busy work". The employees must be able to impress and over deliver.
G	2.5	7 core values: Substance over style Have I helped my team enough? Go figure it out - move beyond fear We are fanatical about our craft Don't just serve - build the relationship There is no flying under the radar I don't have all the answers and I won't pretend that I do
H	2	We have established a very open culture with a flat organizational structure. We promote a very pragmatic approach that encourages self enabling within a reasonable risk consideration. We use Core Values as operating guideline. Each employee has a wallet sized card with all key company contact telephones incl. cell phones. On the back of that card the company values are printed. They are: 1) Treat Customers and Partners fairly and with Appreciation 2) Share technical expertise with our customers and partners 3) Strive to exceed customer and partner expectations 4) We win through our customers and partners success We also have additional core values that focus on our employees and our investors but our number one priority is on the customer. We believe that by satisfying our clients all of the other objectives of all of our stakeholders will be met or exceeded.
I	4	Our Core Values say it Best..... 1. Take Care of the Customer or Someone Else Will. Customer service is not a department, it’s an attitude. Customer service is vital to our business. Technical solutions are our job, but customers are our business. Most of our business comes from existing customers. There are little things we can do everyday that make a big difference–answering E-mails promptly and courteously, answering the phone and returning calls. 2. Details Matter. Details create the big picture. When things go wrong with software it’s often the result of missing a small detail along the way. The road to redemption is long and uncomfortable. 3.Never Forget the Big Picture. The best way to maintain a steady effort is to never forget the big picture. It’s easy to get wrapped up in a small detail and lose sight of how it may affect the rest of the project. 4. Take Ownership. Ownership is the cornerstone of a strong team. Treat each project as if it were your name on the front

Co.	Rnk	Q 40: Can you briefly describe your organization's culture which has been defined as the core principles that guide employee decisions and behaviors?
		door – and on the signature line of everyone's paycheck. 5. Be Thorough. Genius is nothing but continued attention. We have to pay attention to a lot of stuff. Taking time to make sure every task is completed before handing it off saves time. 6. Be Consistent. Consistency reduces mistakes. A disciplined and consistent approach creates an environment of dependability and allows you to troubleshoot problems easily. 7. Constantly Re-Invent Yourself. Always be learning and seeking knowledge. Make good use of your time and never stop investing in your own skill set. The moment you stop learning is the moment you become a liability instead of an asset. 8. You are Bit-Wizards. It's not a one man team, win or lose. On this team, we're all united in a common goal. This company sinks or swims based on the effort, dedication, pride, and professionalism of the people who work here. We are a team that derives our ability to stay in business from each person's contributions. 9. Marketing the Company Is Everybody's Responsibility. Always be looking for new opportunities. This is not only good for our continued success, but it's good for the customer. When we look for opportunities, we are also looking for ways to increase the customers' success. That makes us valuable partners. 10. Company Profitability Is Everybody's Responsibility. Make smart choices about time, resources and expenses. Everything you and every team member does affect our bottom line and ultimately our ability to increase pay and bonuses. It also determines how much we grow. 11. Track Your Time Daily and Accurately. Value your time as a business resource. This is how we get paid and this is how we account for our time to the customers. An error here means that one customer is over-billed and other may be under-billed, which are both are unacceptable. 12. Use your Time Efficiently and Effectively. Efficiency is doing things right; effectiveness is doing the right things. Your goal is to have 40 billable hours every week. Sometimes that isn't possible. In those cases, your time should be spent wisely to enhance your education or on internal projects that move the company forward. 13. Work Together. If everyone is working together, then success takes care of itself. Your title may be software engineer or administrative assistant, but our success depends on everyone working together to fill in the gaps. Whether it's filling the fridge with sodas or emptying a trash can, there are no tasks that are beneath any team member. 14. Treat Other Team Members Like Family. We are in this together. Buck up, get the job done and don't worry about who gets credit because we know everyone's contribution. 15. First

Co.	Rnk	Q 40: Can you briefly describe your organization's culture which has been defined as the core principles that guide employee decisions and behaviors?
		Impressions are Everything. It's the first impression that will open the door or close it. Whether it's an application, a website, or a portal, users decide in the first three minutes if they like an application. It if looks like crap, they'll think its crap. In the end, perception is reality.
J	3	Respect, Integrity and Appreciation
K	4	All team members are valued. All views are listened to. Requests, not demands.
L	3	Our Values include; Customer focus Excellence Innovation Passion Integrity Respect
M	1	No response
N	4	No response
O	2	Honesty and ethics; professionalism; attention to detail; commitment to budgets and deadlines

Open-Format Data Summary

The open-format questions provided an excellent triangulation of the data collected in the structured question section with one exception: focus on customers and intricacies of those relationships may be statistically important and were not identified within the study. The omission of the impact of customers and those relationships was a recurring theme from the incremental analysis of questions 38-40. Although, the one response to question 39 regarding the availability of capital was not statistically significant, it is clearly an important consideration and should have been included within the study.

4.6 Findings

The model describing the hypotheses postulated as a result of the literature review is shown in Figure 12 and as dictated by hypotheses testing on the questionnaire data, the revised model is shown in Figure 27. In the revised model, the superscript next to many factors correspond the question number used as the basis for its inclusion. The basic structure of the model is largely the same as the proposed model; however, the factors included therein changed. Factors that showed significant importance and/or strong positive indications of importance were included within the model.

4.6.1 Process

Each element was tested first using the more traditional hypothesis testing via t-statistic, then to improve confidence each element was tested using the Mann-Whitney U-test which was created for testing non-parametric data. The t-tests were conducted in Excel, and the Mann-Whitney tests were conducted in OriginPro via a temporary Evaluation license, as illustrated in Figure 14, Figure 15, and Figure 16. In most cases the Mann-Whitney test findings of significant difference were the same as the t-test results. In the cases where the test results were different, the data's central tendencies were evaluated, and in all cases, it was deemed that the Mann-Whitney test findings were more accurate. Therefore, they were the decision criteria. Although, correlation coefficients were calculated, they provided virtually no insight as discussed in Sections 4.5.3 and 4.6.3.

Response categories within the questionnaire were carefully constructed to include specific terminology for hypothesis testing purposes. Typical hypothesis testing looked at whether the factor's impact was computed as being more than "Somewhat significant" where the Likert scale was: (1) Very significant; (2) Somewhat significant; (3) Slightly significant; or (4) Not significant. In other words, H_A: $\mu < 2$. The adjective *Very* was chosen as the top category descriptor intentionally, because very is defined as exactly or precisely. Very was interpreted within this research as being exactly or precisely required or not optional for these levels of success within technology organizations.

4.6.2 Outcome

A synopsis of all hypotheses test results is shown in Table 34**Error! Reference source not found.**.

Table 34 – Hypotheses Test Synopsis

Hyp #	Independent Variable	Ho	Concept Model Block #	MW p-value	Support Level	Conclusion
H1a	Particular org. structure or composition	$\mu \geq 2$	1	5.28E-02	N/A	Ideologically, ________ is more than somewhat significant
H1b	Org. culture			8.77E-07	Strong	
H1c	Leadership			5.26E-06	Strong	
H1d	Marketing			5.00E-01	N/A	
H1e	Creativity			5.28E-02	N/A	
H1f	Innovation			1.30E-03	Moderate	
H2a	Influence of executives	$\mu \geq 2$	2	8.77E-07	Strong	Influence of __________ personnel is more than somewhat important
H2b	Influence of managers			3.50E-04	Moderate	
H2c	Influence of supervisors			2.90E-03	Moderate	
H2d	Influence of technical leaders (team leads, etc.)			3.74E-07	Strong	
H2e	Influence of technical (engineers, technicians, etc.)			3.50E-04	Moderate	
H2f	Influence of non-technical (marketing, etc.)			8.53E-01	N/A	N/A
H3	Organizational size	$\mu \geq 2$	6	1.56E-02	Moderate	Size has an impact

Hyp #	Independent Variable	Ho	Concept Model Block #	MW p-value	Support Level	Conclusion
H4a	Aggressive technological policy	$\mu \geq 2$	N/A	1.35E-01	N/A	N/A
H4b	Explicit innovation strategy			5.71E-02	N/A	N/A
H5a	Actively attempt to influence creativity	$\mu \geq 2$	N/A	2.78E-01	N/A	N/A
H5b	Actively attempt to influence innovation		3	3.56E-03	Moderate	Org. attempts to influence innovation
H6	Fixed vs. flexible org. structure	$\mu \geq 2$	N/A	1.03E-07	Strong	Org. tends toward flexible org. structure
H7a	Internally, leadership is not main conduit of comm.	$\mu \geq 2$	N/A	1.75E-01	N/A	Ambiguous question, inconclusive
H7b	Externally, leadership is not main conduit of comm.			5.26E-02	N/A	
H8	Hands-on/managing vs. hands-off/steering	$\mu \geq 2$	3	7.63E-05	Moderate	Leadership tends toward hands-off/steering style
H9	Unique mgt of innovation tasks/assignments	$\mu \geq 2$	N/A	9.28E-01	N/A	N/A

Hyp #	Independent Variable	Ho	Concept Model Block #	MW p-value	Support Level	Conclusion
H10	Orientation towards meeting market goals	μ > 3	3	6.45E-09	Strong	Org. orientation wrt to meeting market goals is more than short-term
H11	Adeptness at discovering/adapting to change and evolving tech.	μ ≥ 2	3	3.16E-03	Moderate	Orgs. more than somewhat adept
H12	Practice of closed vs. open innovation	μ ≥ 2	3	5.26E-06	Strong	Orgs. practice open innovation
H13	Org. knowledge capacities' effectiveness	μ ≥ 2	3	3.34E-02	Moderate	Knowledge capacities more than somewhat effective
H14	Frequency of attempts to identify and utilize external knowledge, technologies, etc.	μ ≥ 2	3	3.50E-04	Moderate	Orgs. attempt to identify and utilize external knowledge, technologies or ideas more than occasionally
H15	Employee perception of resource availability	μ ≥ 2	N/A	5.28E-02	N/A	

Hyp #	Independent Variable	Ho	Concept Model Block #	MW p-value	Support Level	Conclusion
H16	Employee perception of value placed in them by org.	μ ≥ 2	3	1.10E-03	Moderate	Employee perception of value in them by org is more than important
H17a	Job complexity for tech. personnel	μ ≥ 2	4	3.16E-03	Moderate	______________ should receive more than moderate org emphasis
H17b	Job complexity for non-tech. personnel			7.70E-01	N/A	
H17c	Autonomy in researching solutions			7.60E-03	Moderate	
H17d	Employee ownership and control over work			2.50E-05	Moderate	
H17e	Flexibility in setting employee's own agenda			1.20E-01	N/A	
H17f	Clear role goals and expectations for employees			3.50E-04	Moderate	
H17g	Organizational encouragement and support			1.00E-04	Moderate	

Hyp #	Independent Variable	Ho	Concept Model Block #	MW p-value	Support Level	Conclusion
H17h	Supervisory encouragement and support			3.34E-02	Moderate	
H17i	Peer or work group encouragement and support			8.43E-03	Moderate	
H17j	Creative role models			5.01E-01	N/A	
H17k	System of rewards			1.75E-01	N/A	
H17l	Group dynamics (synergy and attitudes)			3.16E-03	Moderate	__________ should receive more than moderate org emphasis
H17m	Fair and supportive evaluation of new ideas			2.11E-02	Moderate	
H17n	Collaborative idea flow			3.27E-03	Moderate	
H17o	Employee risk taking			8.53E-01	N/A	
H17p	External recognition			9.97E-01	N/A	
H18	Innovation as an ideal	μ ≥ 2	3	3.50E-04	Moderate	Innovation more than important
H19	Org size	μ ≥ 2	N/A	2.78E-01	N/A	

Hyp #	Independent Variable	Ho	Concept Model Block #	MW p-value	Support Level	Conclusion
H20	Products/svcs in niche markets	μ ≥ 2	3	8.77E-07	Strong	These tech orgs have focused most of their innovative efforts into niche markets
H21	Importance of project champion	μ ≥ 2	3	1.00E-04	Moderate	Having a project champion is more than important
H22a	Individual intellect	μ ≥ 2	5	1.00E-04	Moderate	When hiring or assigning tasks essential to innovative success, ________ receives more than moderate org emphasis
H22b	Individual education			2.34E-01	N/A	
H22c	Individual training			2.11E-02	Moderate	
H22d	Individual experience			1.10E-03	Moderate	
H22e	Broad personal interests			9.10E-01	N/A	
H22f	Independence of judgment			1.10E-03	Moderate	
H22g	Self-sufficiency or autonomy			3.16E-03	Moderate	
H22h	Sense of one's self as creative			6.53E-01	N/A	
H22i	Communications skills			1.10E-03	Moderate	
H22j	Intrinsic motivation			2.90E-04	Moderate	
H22k	Diversity of ethnicity			1.00E+00	N/A	

Hyp #	Independent Variable	Ho	Concept Model Block #	MW p-value	Support Level	Conclusion
H22l	Diversity of education			1.00E+00	N/A	
H22m	Diversity of experience			8.53E-01	N/A	
H23	Risk taking	μ ≥ 2	N/A	1	N/A	
H24a	Challenge pressure	μ ≥ 2	N/A	3.16E-03	Moderate	Ambiguous question. Employees experience _____ pressure more than occasionally, but it may not be linked to success
H24b	Workload pressure			1.00E-04	Moderate	
H25	Mkt represent on innov. Proj teams	μ ≥ 2	N/A	1.00E+00	N/A	N/A
H26	Key innovators	μ < 2	3	1.30E-03	Moderate	Key innovators not essential

What may have been the single most significant finding was the discovery that these respondents do not attribute single key innovators as being essential to the success of their organizations. As pointed out in paragraph 5 of Section 5.3, this leaves serious questions to be answered.

Conceptual Model

In terms of conceptual model's structure, the difference between the original proposed model and the revised model was the addition of block 8, Metrics and Confidence shown in Figure 27. This was done to reflect that these CTO's access the success of their organizations by a different set of metrics than used within this research, new job creation and revenue growth. This block does not impact the model, itself, because this research was designed around the definition of success as shown in block 7.

Blocks 1 and 2 reflect an overarching and top level ideology that work in concert to influence every other factor within the model. Block 3, Strategy and Posture, is shaped by th joint influence of blocks 1 and 2, and it influences every aspect of the model. Technology organization strategy and posture serve as the foundation for establishing particular job factors of block 4 and hiring and task assignments of block 5.

As well, blocks 4 and 5, Job Factors and Hiring and Task Assignment work in concert to shape each other. Then they each directly feed into the desired outcome shown as block 7, Prolific Success in Technology Organizations as shown in Figure 27.

Verification

The open-ended questions served as a “sanity check” of the data to ascertain if the structured question section of the questionnaire had omitted any critically important factors. Section 4.5.6 documents that participants were asked to identify both the top factors to which they would attribute growth and success and their perceived top threats to that continued growth and success within their organizations. The only element identified more than once was concern about customers and intricacies of those relationships as discussed in the last paragraph of Section 4.5.6. A cursory review indicates that these factors are not statistically significant; however, they could be. Block 6 of the model includes a category for Unknown others, which allows for item like this of which the statistical significance is unknown.

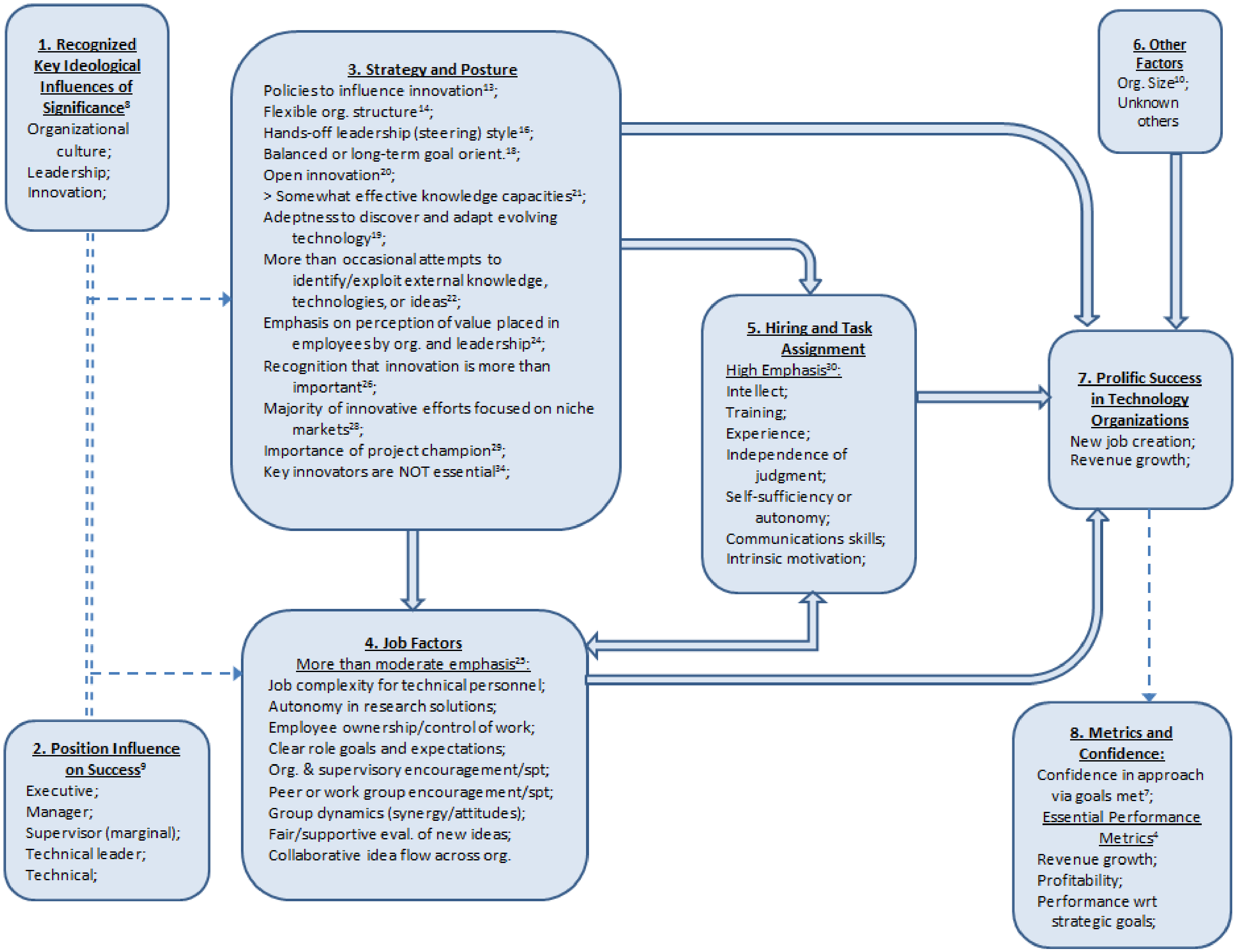


Figure 27 – Revised Conceptual Model

4.6.3 Linear Correlation

As shown in the data analysis, very little information was gleaned from the calculated correlation coefficients. Correlation coefficients' null hypotheses stated that the coefficients were not equal to zero, H_o: $r \neq 0$. Only two alternative hypotheses were accepted, showing that there was no linear correlation between the dependent and independent variables. With respect to magnitude and polarity of correlation coefficients, there was little credible consistency between the variables. In places where the magnitude was reasonable, the polarity was often counterintuitive and inconsistent with reasoning. This was expected to some extent and did not imply that the particular factor was insignificant to organizational success. This was in large part a casualty of not having a population that included unsuccessful organizations; rather, it meant that there was not sufficient evidence to conclude that the distribution of technology organization success (the dependent variable) depended linearly on the particular independent variable being considered. Indeed, weak correlation coexists in perfect unison with strong emphasis on the particular factors, as is shown in this study.

As briefly discussed above; the weak linear correlation was in large part due to the structure of the study. All independent variables were tested against a dependent variable whose ranking corresponded to its within-sample hierarchy. In other words, the lowest ranked dependent variable was still an exceptionally successful technology organization. This was evidenced by its inclusion in the Inc. 5000, a list ranking the 5000 most successful companies in the United States. Because of this within-sample hierarchy, it was expected that very important factors would receive nearly unanimous elevated and priority status among from these organizations. Therefore, independent variables showing lower emphasis and importance were not typically indicative of a less success within the confines of the study population.

It is very likely that there would have been much higher linear correlation between independent and dependent variables had this research included unsuccessful or even non-growing organizations and the success ranking accurately reflected this.

So, although the correlation coefficients and their p-values were included in the data, the provided virtually no insight into the factors influencing success within technology organizations.

CHAPTER 5 CONCLUSIONS AND RECOMMENDATIONS

The goal within this research was to answer the research question, according to active CTO's within very successful technology organizations, what are the key factors influencing prolific success within technology organizations? Then, to use this to create an instrument which could be used by other technology organizations to assess their own propensity to prolific success. The intent of this research was two-fold: (1) provide insight according to these CTOs useful to technology organizations for immediately improving their propensity for success; and (2) to build a foundation on which further research and publishing could be conducted for the benefit of the community.

To facilitate this, a literature review was performed of research and factors influencing outcomes within similar contexts such as innovation, creativity, R&D, etcetera. Hypotheses were postulated that those factors would also influence success within very successful technology organizations, and a conceptual model was created to illustrate those interactions. To test those hypotheses among a sample of the CTOs or equivalent in a population of America's most successful technology companies, an online questionnaire was created, a sample of organizations were randomly selected from this population, and their CTOs or equivalent were invited to participate in the study. The questionnaire primarily consisted of structured Likert-item questions but also included an open-format section. The open-format section was designed to explore whether consensus key factors had been omitted from consideration within the structured-format section.

5.1 Individual Components

The conceptual model provides a visual illustration of the CTOs' perceived most crucial factors and how they affect their organization's success. The individual conclusions are as follows.

According to the CTOs of this study, the following provides a synopsis of the key influences on great success within technology organizations.

1. From an ideological standpoint, the greatest organizational emphasis is placed on maintaining an effective culture and leadership style followed by a focus on innovation.
2. With respect to the influence of personnel on organizational success, the influence wielded by executives and technical leaders are most important followed by managers, supervisors, and technical workers such as engineers and technicians.
3. Organizational size does influence success.
4. Technology organizations should attempt to actively influence innovation.
5. Flexible organizational structure as it relates to specific job duties, chain of command, communications protocol, etcetera, is very important.
6. A hands-off/steering leadership style is the preferred style.
7. With respect to achieving market goals, more than a short-term orientation is desirable.

8. It is important to be more than somewhat adept at discovering and adapting to change and evolving technology.

9. Open innovation which has been defined as the use of free inflows and outflows of information is the preferred practice.

10. Knowledge capacities should be more than somewhat effective.

11. Organizational attempts to identify and utilize external knowledge, technologies, or ideas should be made more often than occasionally.

12. Technology organizations should recognize that employee perception of the value placed in them by the organization is more than important.

13. With respect to job characteristics, technology organizations should place more than moderate emphasis on the following: (a) job complexity for technical personnel; (b) autonomy in researching solutions; (c) employee ownership and control over their own work; (d) clear role goals and expectations; (e) organizational encouragement and support; (f) supervisory encouragement and support; (g) peer or work group encouragement and support; (h) group dynamics (synergy and attitudes); (i) fair and supportive evaluation of new ideas; and (j) collaborative idea flow across the organization.

14. Innovation as an ideal is more than important.

15. It is optimal to focus the majority of organizational innovative efforts into niche markets with technology products and/or services that are related to each other.

16. When hiring or assigning tasks essential to innovative success, the organization should place more than moderate emphasis on the characteristics of: (a) Individual intellect; (b) individual training; (c) individual experience; (d) independence of judgment; (e) self-sufficiency or autonomy; (f) communications skills; and (g) intrinsic motivation.

17. Single key innovators are not essential to technology organization success.

5.2 <u>Recommendations</u>

In today's economic environment, organizational success is a difficult goal. However, the population comprising this research is proof that with the right recipe, it is possible to create a thriving technology organization. According to the CTOs of organizations within this study, the organizational culture, posture, and other factors identified herein are important for prolific levels of technology organization success. Therefore, any technology organization wishing to experience prolific levels of success like those within this population should consider reviewing and comparing their own organization's posture and priorities to those identified by these CTOs whose track records show impressive success. Where the two diverge, they should evaluate ways to reconcile them. Specifically, aspiring CTOs and organizations should consider the following questions:

1. From an ideological standpoint, do we (my organization) place the greatest emphasis on maintaining an effective culture and leadership style followed by a focus on innovation?

2. Do we incorporate into our organizational culture and posture the knowledge that with respect to the influence of personnel to organizational success, the influence wielded by executives and technical leaders are most important followed by managers, supervisors, and technical workers such as engineers and technicians?

3. Do we attempt to actively influence innovation?

4. Do we utilize a flexible organizational structure as it relates to specific job duties, chain of command, communications protocol, etcetera?

5. Does our leadership utilize a hands-off/steering leadership style?

6. With respect to achieving market goals, do we maintain at least a balanced-term orientation?

7. Is my organization more than somewhat adept at discovering and adapting to change and evolving technology?

8. Do we practice open innovation which has been defined as the use of free inflows and outflows of information?

9. Are our knowledge capacities more than somewhat effective?

10. Do we attempt to identify and utilize external knowledge, technologies, or ideas more often than occasionally?

11. Does my organization factor into its culture and posture the knowledge that employee perception of the value placed in them by the organization is more than important? Or, perhaps more directly: To what extent do my employees believe this organization values them?

12. Do we place more than moderate emphasis on the job characteristics: (a) job complexity for technical personnel; (b) autonomy in researching solutions; (c) employee ownership and control over their own work; (d) clear role goals and expectations; (e) organizational encouragement and support; (f) supervisory encouragement and support; (g) peer or work group encouragement and support; (h) group dynamics (synergy and attitudes); (i) fair and supportive evaluation of new ideas; and (j) collaborative idea flow across the organization?

13. Do our policies reflect that innovation as an ideal is more than important?

14. Are the majority of our organizational innovative efforts focused into niche markets with technology products and/or services that are related to each other?

15. When hiring or assigning tasks essential to innovative success, do we place more than moderate emphasis on the characteristics of: (a) Individual intellect; (b) individual training; (c) individual experience; (d) independence of judgment; (e) self-sufficiency or autonomy; (f) communications skills; and (g) intrinsic motivation?

16. Do our policies, culture, and posture reflect that a single key innovator is not essential to success?

5.3 Future Research

The findings of this research highlight a number of areas that could benefit from future research. This research focused on the factors deemed by the CTOs or equivalent of the representative sample set of very successful technology organizations to have a significant impact on their organizations' success. Further research could address the following:

1. This research evaluated the factors that influence success within these organizations. Future research could look at schemes for impacting those factors.

2. This research focused on organizations that had very recently (between 2007 and 2011) had experienced substantial growth. This implies that prior to 2007 each of the organizations were much smaller companies, often employing only a few employees. Future research could focus on discovering whether the same factors that were key in growing the organization from very small to current level are the same as those that would enable technology organizations to continue growing until they reach, for example, Fortune 500 status.

3. Hypothesis 3 showed that organization size does influence its success, but the question of how and why remains unknown.

4. The rejection of $H26_o$ showed that a key innovator was not essential to these organizations' success. Indeed, this research showed that only 13% of these highly successful technology organization's CTOs concluded that a single key innovator was essential to the organization's success. However, most if not all of these companies were founded by what could be considered an innovator. The results of $H26_o$ seem to indicate that the impact of the founding innovator dwindled. More research could and should be done to assess this finding.

5. The responses to question 38 provide some evidence that the dynamics of customer relationships and the intricacies of those relationships may be important and/or statistically significant within the context of success of technology organizations.

6. As discussed in Section 4.5.6, one respondent indicated that resource availability was his top concern regarding threats to organizational success. Although, one response is not statistically significant, its consideration as a potential impact is an obvious oversight within the design of the study and could be evaluated further.

5.4 <u>Lessons Learned</u>

This research was a long journey and the lessons learned ran the gamut from learning how to break an extremely large unmanageable assignment down into manageable portions and accomplishing them to honing my skills in hypotheses testing and correlation evaluation. There were, however, many lesson learned that would have streamlined and improved this research quite a lot. For, example:

1. As is clear from the evolution of the methodology from Chapter 3 to that used in Chapter 4, data collection is a very large challenge in this type of research. Here, the research scope stipulated that participation and interviews with CTOs from a population of America's fastest growing technology companies be the method of data collection. However, the success of those organizations precluded the participation of their CTOs, so alternate means of data collection had to be selected. Furthermore, that alternate data collection mandated an adapted methodology of analysis and theory building. Although, data collection was expected to be a challenge, it was not expected to be

insurmountable. A better job could have been done in more thoroughly considering potential problems with data collection (conducting interviews) and creating a contingency plan.

2. The wording of survey response choices are very important and should be conceived with the end analyses and hypotheses at the forefront. In this study, the end analyses and hypotheses were taken into consideration while crafting the survey; however, with the insight and experience that comes with hindsight, a better job could have been done specifying some of the available response options. For example, choices such as those of question 25 were: (1) High emphasis; (2) Moderate emphasis; (3) Low emphasis; or (4) No emphasis. It would have been better to have worded the question to be more consistent with the other response categories where “very” was the top category. This would have allowed a more consistent approach towards postulating null hypotheses and subsequent analyses.

3. Certain other question wordings caused the resulting null hypotheses to be broader than they could have been. The wording of this question 15 prevented conclusive establishment that open communication was the necessary method of communication between team members and non-team members. Hypotheses were tested both ways (H_o: $\mu \geq 2$ and H_o: $\mu \leq 2$), but neither yielded conclusive results as follows. By not structuring the question specifically around non-leadership personnel’s communication, we can conclude only that it is plausible that leadership personnel are not the main conduits of communication as opposed to concluding that non-leadership

personnel are the main conduits of communication. Furthermore, that either is essential to the success of the organization.

APPENDIX A: IRB APPROVAL LETTER

University of Central Florida

University of Central Florida Institutional Review Board
Office of Research & Commercialization
12201 Research Parkway, Suite 501
Orlando, Florida 32826-3246
Telephone: 407-823-2901 or 407-882-2276
www.research.ucf.edu/compliance/irb.html

Approval of Exempt Human Research

From: **UCF Institutional Review Board #1**
FWA00000351, IRB00001138

To: **Joseph D. Bass**

Date: **June 14, 2012**

Dear Researcher:

On 6/14/2012, the IRB approved the following activity as human participant research that is exempt from regulation:

Type of Review:	Exempt Determination
Project Title:	Success Factors in Technology Organizations
Investigator:	Joseph D Bass
IRB Number:	SBE-12-08524
Funding Agency:	
Grant Title:	
Research ID:	N/A

This determination applies only to the activities described in the IRB submission and does not apply should any changes be made. If changes are made and there are questions about whether these changes affect the exempt status of the human research, please contact the IRB. When you have completed your research, please submit a Study Closure request in iRIS so that IRB records will be accurate.

In the conduct of this research, you are responsible to follow the requirements of the Investigator Manual.

On behalf of Sophia Dziegielewski, Ph.D., L.C.S.W., UCF IRB Chair, this letter is signed by:

Signature applied by Joanne Muratori on 06/14/2012 02:33:24 PM EDT

Joanne Muratori

IRB Coordinator

APPENDIX B: INVITATION LETTER

PO Box 6576
Miramar Beach, FL 32550

August 20, 2012

Mr. XXXX
Chief Technology Officer
Company A
Address Line 1
Address Line 2
City, ST Zip

Dear Mr. XXXX:

In partial fulfillment of the requirements for the degree of Doctor of Philosophy at the University of Central Florida, I am researching the primary factors affecting success within technology organizations as described in the enclosed Explanation of Research.

I request your participation because of your astute insight as evidenced by the success enjoyed by your organization. I know that your time is very valuable and if you agree to participate, you will be asked to respond to two brief online questionnaires. Each should take about 10 minutes to complete.

This research will be documented within my doctoral dissertation, and the findings published in a scientific journal.

Your assistance is greatly appreciated and very important, as this is one of the few ways for acquiring this kind of information. To accept or decline the invitation, please email joe.bass@knights.ucf.edu. If you're not able to respond, I will follow up with your office within a few days.

Best Regards,

Joe Bass,

Enclosure: Explanation of Research

APPENDIX C: EXPLANATION OF RESEARCH

University of Central Florida

EXPLANATION OF RESEARCH

Title of Project: Success Factors in Technology Organizations

Principal Investigator: Joseph Bass, Ph.D. Candidate

Faculty Supervisor: Ahmad Elshennawy, Ph.D.

You are being invited to take part in a research study. Whether you take part is up to you.

Description of Study: The purpose of this research is to assess the primary factors affecting profound success within technology organizations. It is to evaluate those factors by conducting case studies of select successful high-tech organizations. Within this context, emphasis is on assessing the impact, role, and underlying philosophy of a single key innovator or select group of key innovators within those organizations.

Participation: If you agree to participate, you will be asked to respond to two online questionnaires, one at the outset and a second after the initial responses have been evaluated. The second questionnaire will narrow the focus of the discovery with the insight of the aggregate data from the initial questionnaires. Each of the two questionnaires will require approximately 10-15 minutes of time.

Confidentiality: You will be described within reports by your position and not personally identified, and your organization will be identified within reports by a pseudonym such as "Company A". All paper field notes will be stored indefinitely in a secure cabinet.

Risk/Benefits: There are no known risks to participating in this study. The potential benefits to you for participating are the knowledge and insight gained by you from the research.

Results/Findings: At the conclusion of the research, a copy of the Findings, Conclusions, and Recommendations will be made available to you.

Study Contact for questions about the study or to report a problem: If you have questions, concerns, or complaints:

Joseph Bass, Ph.D. Candidate, Dept. of Industrial Engineering & Management Systems
Joe.Bass@knights.ucf.edu
(850) 982-7515

Dr. Ahmad Elshennawy, Faculty Supervisor, Dept. of Industrial Engineering & Management Systems
Ahmad.Elshennawy@ucf.edu
(407) 823-5742 or (407) 823-3073

Institutional Oversight: Research at the University of Central Florida involving human participants is carried out under the oversight of the Institutional Review Board (IRB). This research has been reviewed and approved by the IRB. For information about the rights of people who take part in research, please contact:

Institutional Review Board, University of Central Florida
Office of Research & Commercialization
12201 Research Parkway, Suite 501
Orlando, FL 32826-3246
(407) 823-2901

APPENDIX D: INVITATION EMAIL

University of Central Florida study participation - Google Chrome

https://by2prd0710.outlook.com/owa/?ae=Item&a=Open&t=IPM.Note&id=RgAAAACV6BZR64t%2fTY5wO1H1z6IwBwC%2f6oCWEI2

Reply Reply All Forward Chat

University of Central Florida study participation

Joe Bass

Friday, November 30, 2012 3:27 PM

To: [redacted]

- This message was sent with High importance.
- You forwarded this message on 30-Nov-12 3:32 PM.

Mr. [redacted]
View in HTML -

On 19 November 2012 I sent a letter requesting your participation in a study being conducted at the University of Central Florida. This research is in partial fulfillment of the requirements for the degree of Doctor of Philosophy.

If you can participate, please follow this link to the questionnaire. I know that your time is very valuable, so it is a brief questionnaire and should only take 5-10 minutes to complete.

https://www.surveymonkey.com/s/[redacted]
Access code: UCF-2012

As a token of my appreciation, I've included a link to a $5 Starbucks egift card below.

https://starbucks.cashstar.com/gift-card/view/DtkJGxvN15MkzHs
Challenge code: [redacted]

Your input is vital to the study and would be greatly appreciated, as this is one of few ways for acquiring this kind of information.

If for some reason you didn't receive the cover letter and Explanation of Research by mail, please let me know. I will gladly provide those documents via an Adobe Acrobat file.

Best Regards,
Joe Bass
[redacted]

APPENDIX E: SURVEY

Success in Technology Organizations

Background Information

1. What is your title?

- Chief Executive Officer
- President
- Executive Vice President
- Chief Technology Officer

Other (please specify)

2. In what year was your company founded?

3. Are you the founder?

- Yes
- No

4. When you assess your organization's success, how important is each of the following metrics?

	1. Very important	2. Somewhat important	3. Slightly important	4. Not Important
Revenue growth				
Profitability				
Job creation				
Performance with respect to strategic goals				
Patent creation				
Recognition				

Other (please specify)

Your answers to the next two questions are important in order to better correlate technology organization growth with organizational culture and ideology.

5. What was your organization's approximate gross annual revenue in the following years?

2007

2011

6. Approximately, how many did your organization employ in each of the following years?

2007

2011

Success in Technology Organizations

7. How does your organization's growth from 2007 to 2011 compare to your goal for the same?

- Exceeded
- Met
- Fell Behind

Other (please specify)

Organizational Components

Wherever the following terms are used, the definitions below are invoked:

Creativity is the generation of original and useful ideas (Amabile, 1988).

Innovation consists of two parts: (1) the generation of original and useful ideas (creativity); and (2) the conversion of those ideas into products or applications (Roberts, 1988).

Organizational Culture is the set of beliefs, values, and assumptions that are shared by members of an organization. It is the core principles that guide their decisions and behaviors (Schein, 1985).

8. In terms of impact on your organization's success, how significant is each of the following ideals?

	1. Very significant	2. Somewhat significant	3. Slightly significant	4. Not significant
Organizational structure or composition				
Organizational culture				
Leadership				
Marketing				
Creativity				
Innovation				

Success in Technology Organizations

9. In terms of impact on your organization's success, how important is the influence of each of the following ranks?

	1. Very important	2. Somewhat important	3. Slightly important	4. Not Important
Executive				
Manager				
Supervisor				
Technical leader (team lead, senior engineer, etc.)				
Technical (engineer, technician, etc.)				
Non-technical (HR, accounting, etc.)				

Other (please specify)

10. Does your organization's size influence its sucess?

- Yes
- No
- Maybe

11. Has an aggressive technological policy which has been defined in the literature as "a preemptive, long-range strategy for technological innovation" been an important part of your organization's culture?

- Yes
- No
- Maybe

12. Does your organization have an explicit innovation strategy or strategy towards innovation?

- Yes
- No
- Maybe

13. Does your organization attempt to influence the following?

	Yes	No	Maybe
Creativity			
Innovation			

Success in Technology Organizations

14. With respect to specific job duties, chain of command, communications protocol, etc., does your organization tend towards a fixed or flexible organizational structure?

- Fixed
- Flexible

Other (please specify)

15. Is leadership whether a team leader, manager, or otherwise the main conduit of communication between its respective team and the following domains?

	Yes	No	Maybe
Internal to the organization but external to the team			
External to the organization			

16. Does your organization tend towards hands-on or hands-off leadership, i.e. managing versus steering?

- Hands-on/Managing
- Hands-off/Steering

Other (please specify)

17. Are innovation tasks and assignments managed differently than other tasks and assignments?

- Yes
- No
- Maybe

If so, how?

18. Does your organization maintain a long term orientation such as a focus on market dominance, etc. or a short term orientation such as a focus on quarterly sales, etc.?

- Long term orientation
- Balanced orientation
- Short term orientation

Success in Technology Organizations

19. How adept is your organization at discovering and adapting to change and evolving technology?

- Very adept
- Somewhat adept
- Slightly adept
- Not adept

20. Does your organization practice: (1) open innovation which has been defined as the use of free inflows and outflows of information both inside the firm and out; or (2) closed innovation which limits the flow of information?

- Open innovation
- Closed innovation

Other (please specify)

21. How would you characterize your organization's knowledge capacities or abilities to explore, retain, and exploit knowledge into meaningful and useful innovation?

- Very effective
- Somewhat effective
- Slightly effective
- Not effective

22. How often does your organization attempt to indentify and utilize external knowledge, technologies, or ideas?

- Frequently
- Occasionally
- Rarely

23. Does employee perception of resource availability influence the success of your organization's technological projects?

- Yes
- No
- Maybe

24. How important to the success of the organization is employee perception of the value placed in them by the organization and its leadership?

- Critical
- Important
- Not important

Success in Technology Organizations

25. How much emphasis does your organization place on addressing each of the following job characteristics?

	1. High emphasis	2. Moderate emphasis	3. Low emphasis	4. No emphasis
Job complexity for technical personnel	○	○	○	○
Job complexity for non technical personnel	○	○	○	○
Autonomy in researching solutions	○	○	○	○
Employee ownership and control over their own work	○	○	○	○
Flexibility in setting their own agenda	○	○	○	○
Clear role goals and expectations	○	○	○	○
Organizational encouragement and support	○	○	○	○
Supervisory encouragement and support	○	○	○	○
Peer or work group encouragement and support	○	○	○	○
Creative role models	○	○	○	○
A system of rewards	○	○	○	○
Group dynamics (synergy and attitudes)	○	○	○	○
Fair and supportive evaluation of new ideas	○	○	○	○
Collaborative idea flow across the organization	○	○	○	○
Employee risk taking	○	○	○	○
External recognition for achievements	○	○	○	○

Innovation

Success in Technology Organizations

26. How important is innovation for your organization's success?

- Critical
- Important
- Not Important

27. Does your organization's size influence its innovativeness?

- Yes
- No
- Maybe

28. Is it accurate to say that your organization has focused the majority of its innovative efforts into niche markets with technology products and/or services that are related to each other.

- Yes
- No
- Maybe

Other (please specify)

29. How important is it to have a project champion which has been defined as someone who is committed to the project, optimistic about its success, and will defend it as needed?

- Critical
- Important
- Not important

Success in Technology Organizations

30. When hiring or assigning tasks for personnel essential to your organization's innovative success, how much emphasis is placed on each of the following traits?

	1. High emphasis	2. Moderate emphasis	3. Low emphasis	4. No emphasis
Intellect				
Education				
Training				
Experience				
Broad personal interests				
Independence of judgment				
Self-sufficiency or autonomy				
Sense of one's self as creative				
Communication skills				
Intrinsic motivation				
Diversity of ethnicity				
Diversity of education				
Diversity of experience				

31. With respect to innovation solutions, how much risk are employees expected to take?

- Substantial
- Discretionary (whatever the employee feels is best)
- Minimal

32. How often do your employees experience the following work pressures:

	Frequently	Occasionally	Never
Challenge pressure			
Workload pressure			

33. In terms of creativity and innovation, how important is it to have marketing representation on innovative project teams?

- Critical
- Important
- Not important

Other (please specify)

Success in Technology Organizations

34. Does your organization have a single key innovator that has been essential to the organization's success?

- Yes
- No
- Maybe

Innovator Influence

35. What level position does this innovator hold?

- Executive
- Managerial
- Project Level
- Purely Technical

Other (please specify)

36. How much involvement does this innovator have with day-to-day operations?

- Substantial
- Limited
- None

37. If you have knowledge of this, what is the ideology that has most contributed to this person's positive influence on your organization's success?

Discussion Questions

38. Can you identify the four most influential factors (philosophical or otherwise) affecting growth and success within your organization in the order of most important to less important?

1.
2.
3.
4.

Success in Technology Organizations

39. What are the four most significant threats to your organization's continued growth and success?

1.

2.

3.

4.

40. Can you briefly describe your organization's culture which has been defined as the core principles that guide employee decisions and behaviors?

APPENDIX F: RAW DATA/STATISTICAL ANALYSES

	A	B	C	D	E	F	G	H	I	J	K	L	M
1		RespondentID	EndDate	IP Address	Custom Data	Question 1. What is your title?		Question 2. In what year was your company founded?	Question 3. Are you the founder?				
2	Response Rank 1					*Chief Executive Officer*	1		*Yes*	1	*1. Very important*	1	*1. Very important*
3	Response Rank 2					*Chief Technology Officer*	2		*Maybe*	2	*2. Somewhat important*	2	*2. Somewhat important*
4	Response Rank 3					*President*	3		*No*	3	*3. Slightly important*	3	*3. Slightly important*
5	Response Rank 4					Executive Vice President	4	Not provided by			*4. Not Important*	4	*4. Not Important*
6	Individual Components					Response	Post Survey Rank	Open-Ended Response	Response	Post Survey Rank	Revenue growth	Post Survey Rank	Profitability
7	Company A	2114225296	09/28/2012	[redacted]		Chief Technology Officer	2	2007	No	3	1. Very important	1	3. Slightly important
8	Company B	2054694742	09/25/2012			Executive Vice President	4	2007	Yes	1	1. Very important	1	1. Very important
9	Company C	2029974278	09/22/2012			Chief Executive Officer	1	1994	Yes	1	1. Very important	1	1. Very important
10	Company D	1998363023	09/13/2012			Chief Technology Officer	2	2000	Yes	1	1. Very important	1	1. Very important
11	Company E	1997919658	09/13/2012			Executive Vice President	4	2005	Yes	1	1. Very important	1	1. Very important
12	Company F	1984867321	09/06/2012			Chief Technology Officer	2	1998	Yes	1	1. Very important	1	1. Very important
13	Company G	1983775322	09/05/2012			Chief Technology Officer	2	2004	Yes	1	2. Somewhat important	2	1. Very important
14	Company H	1983655154	09/05/2012			Chief Executive Officer	1	2002	No	3	1. Very important	1	1. Very important
15	Company I	1972152736	08/29/2012			Chief Executive Officer	1	2000	Yes	1	1. Very important	1	1. Very important
16	Company J	1956664450	08/21/2012			President	3	1997	Yes	1	2. Somewhat important	2	1. Very important
17	Company K	2371442523	12/03/2012			Executive Vice President	4	2003	No	3	1. Very important	1	1. Very important
18	Company L	2361100798	11/27/2012			Other-Chief Scientist		1998	No	3	1. Very important	1	1. Very important
19	Company M	2349678499	11/19/2012			Chief Executive Officer	1	2007	Yes	1	1. Very important	1	1. Very important
20	Company N	2345874535	11/19/2012			Chief Executive Officer	1	1999	No	3	1. Very important	1	1. Very important
21	Company O	2376196683	12/06/2012			President	3	2006	Yes	1	1. Very important	1	1. Very important
22	Response Totals					14			15		15		15
23	Rank 1					5	36%		10	67%	13	87%	14
24	Rank 2					4	29%		0	0%	2	13%	0
25	Rank 3					2	14%		5	33%	0	0%	1
26	Rank 4					3	21%				0	0%	0
27	Rank Mean									1.667		1.133	
28	Rank Median							2002		1.000		1.000	
29	Rank Variance (Sxx)									0.952		0.124	
30	Rank Std Dev							4.2		0.976		0.352	
32	Correlation Coef. (r)									0.151		0.0658	
33	t-stat for Ho: r ≠ 0									0.550		0.238	
34	p-value = P(r = 0)									5.907E-01		8.156E-01	
36	t-stat for Ho: μ ≥ 2									-1.323		-9.539	
37	p-value = P(X < 2)									1.035E-01		8.349E-08	
38	Mann-Whitney P(X<2)											8.768E-07	

	A	N	O	P	Q	R	S	T	U	V	W	X
1		Question 4. When you assess your organization's success, how important is each of the following metrics?										Question 5. Wh organization's appr annual revenue in the
2	Response Rank 1	1	*1. Very important*	1	*1. Very important*	1	*1. Very important*	1	*1. Very important*	1		
3	Response Rank 2	2	*2. Somewhat important*	2	*2. Somewhat important*	2	*2. Somewhat important*	2	*2. Somewhat important*	2		
4	Response Rank 3	3	*3. Slightly important*	3	*3. Slightly important*	3	*3. Slightly important*	3	*3. Slightly important*	3		
5	Response Rank 4	4	*4. Not Important*	4	*4. Not Important*	4	*4. Not Important*	4	*4. Not Important*	4		
6	Individual Components	Post Survey Rank	Job creation	Post Survey Rank	Performance with respect to strategic goals	Post Survey Rank	Patent creation	Post Survey Rank	Recognition	Post Survey Rank	Other (please specify)	2007
7	Company A	3	4. Not Important	4	1. Very important	1	4. Not Important	4	2. Somewhat important	2		103100
8	Company B	1	2. Somewhat important	2	1. Very important	1	3. Slightly important	3	2. Somewhat important	2		4,000,000
9	Company C	1	2. Somewhat important	2	1. Very important	1	1. Very important	1	2. Somewhat important	2		4,000,000
10	Company D	1	2. Somewhat important	2	1. Very important	1	2. Somewhat important	2	2. Somewhat important	2		10,000,000
11	Company E	1	1. Very important	1	1. Very important	1	3. Slightly important	3	2. Somewhat important	2		1,300,000
12	Company F	1	2. Somewhat important	2	3. Slightly important	3	4. Not Important	4	1. Very important	1		5,600,000
13	Company G	1	2. Somewhat important	2	2. Somewhat important	2	4. Not Important	4	3. Slightly important	3	Building an amazing place to work	3,400,000
14	Company H	1	4. Not Important	4	1. Very important	1	2. Somewhat important	2	3. Slightly important	3		358,000
15	Company I	1	2. Somewhat important	2	1. Very important	1	4. Not Important	4	2. Somewhat important	2		1,762,000
16	Company J	1	1. Very important	1	1. Very important	1	4. Not Important	4	4. Not Important	4		28,000,000
17	Company K	1	1. Very important	1	1. Very important	1	2. Somewhat important	2	2. Somewhat important	2		2,100,000
18	Company L	1	1. Very important	1	1. Very important	1	1. Very important	1	2. Somewhat important	2		75,000,000
19	Company M	1	4. Not Important	4	3. Slightly important	3	4. Not Important	4	3. Slightly important	3		113,000
20	Company N	1	1. Very important	1	1. Very important	1	4. Not Important	4	2. Somewhat important	2		10,800,000
21	Company O	1	2. Somewhat important	2	1. Very important	1	4. Not Important	4	3. Slightly important	3		3,433,654
22	Response Totals		15		15		15		15			
23	Rank 1	93%	5	33%	12	80%	2	13%	1	7%		
24	Rank 2	0%	7	47%	1	7%	3	20%	9	60%		
25	Rank 3	7%	0	0%	2	13%	2	13%	4	27%		
26	Rank 4	0%	3	20%	0	0%	8	53%	1	7%		
27	Rank Mean	1.133		2.067		1.333		3.067		2.333		
28	Rank Median	1.000		2.000		1.000		4.000		2.000		
29	Rank Variance (Sxx)	0.267		1.210		0.524		1.352		0.524		
30	Rank Std Dev	0.516		1.100		0.724		1.163		0.724		
32	Correlation Coef. (r)	-0.383		-0.578		-0.291		-0.031		-0.160		
33	t-stat for Ho: r = 0	-1.495		-2.552		-1.095		-0.111		-0.584		
34	p-value = P(r = 0)	1.572E-01		2.304E-02		2.919E-01		9.132E-01		5.686E-01		
36	t-stat for Ho: μ: ≥ 2	-6.500		0.235		-3.568		3.552		1.784		
37	p-value = P(X < 2)	7.009E-06		5.911E-01		1.546E-03		9.984E-01		9.519E-01		
38	Mann-Whitney P(X<2)	1.031E-07		1.480E-01		1.461E-04		9.987E-01		9.874E-01		

Participant did not respond. 2008 value came from online.

Respondant indicated 0 for 2007, Inc 500 shows 113,000 for 2008 (3 yr return)

	A	Y	Z	AA	AB	AC	AD	AE	AF	AG	AH	AI	AJ	AK
1		hat was your proximate gross e following years?	Calculated Annualized Revenue Growth	Question 6. Approximately, how many did your organization employ in each of the following years?		Calculated Annualized Job Growth	Question 7. How does your organization's growth from 2007 to 2011 compare to your goal for the same?		Question 8. In terms of impact on your organization's succ					
2	Response Rank 1						Exceeded	1	1. Very significant	1	1. Very significant	1	1. Very significant	1
3	Response Rank 2						Met	2	2. Somewhat significant	2	2. Somewhat significant	2	2. Somewhat significant	2
4	Response Rank 3						Fell Behind	3	3. Slightly significant	3	3. Slightly significant	3	3. Slightly significant	3
5	Response Rank 4								*4. Not significant*	4	*4. Not significant*	4	*4. Not significant*	4
6	Individual Components	2011	Annualized Revenue Growth	2007	2011	Annualized Job Growth	Response	Post Survey Rank	Organizational structure or composition	Post Survey Rank	Organizational culture	Post Survey Rank	Leadership	Post Survey Rank
7	Company A	8600000	337%	11	68	84%	Exceeded	1	1. Very significant	1	1. Very significant	1	1. Very significant	1
8	Company B	10,000,000	26%	25	65	27%	Exceeded	1	1. Very significant	1	2. Somewhat significant	2	1. Very significant	1
9	Company C	214,000,000	170%	7	40	55%	Exceeded	1	1. Very significant	1	1. Very significant	1	1. Very significant	1
10	Company D	22,000,000	22%	65	100	11%	Met	2	2. Somewhat significant	2	2. Somewhat significant	2	1. Very significant	1
11	Company E	5,900,000	46%	11	70	59%	Exceeded	1	2. Somewhat significant	2	1. Very significant	1	2. Somewhat significant	2
12	Company F	27,972,000	49%	39	104	28%	Exceeded	1	2. Somewhat significant	2	1. Very significant	1	2. Somewhat significant	2
13	Company G	12,400,000	38%	38	106	29%	Exceeded	1	2. Somewhat significant	2	1. Very significant	1	2. Somewhat significant	2
14	Company H	3,121,000	72%	6	18	32%	Met	2	1. Very significant	1	1. Very significant	1	1. Very significant	1
15	Company I	2,366,000	8%	17	24	9%	Fell Behind	3	3. Slightly significant	3	1. Very significant	1	1. Very significant	1
16	Company J	78,000,000	29%	170	375	22%	Met	2	3. Slightly significant	3	1. Very significant	1	1. Very significant	1
17	Company K	3,700,000	15%	12	26	21%	Met	2	2. Somewhat significant	2	1. Very significant	1	1. Very significant	1
18	Company L	250,000,000	35%	150	400	28%	Met	2	1. Very significant	1	1. Very significant	1	1. Very significant	1
19	Company M	27,000,000	521%	3	170	284%	Met	2	1. Very significant	1	1. Very significant	1	1. Very significant	1
20	Company N	19,200,000	15%	64	130	19%	Met	2	1. Very significant	1	1. Very significant	1	1. Very significant	1
21	Company O	30,282,197	72%	20	49	25%	Exceeded	1	3. Slightly significant	3	1. Very significant	1	1. Very significant	1
22	Response Totals						15		15		15		15	
23	Rank 1						7	47%	7	47%	13	87%	12	80%
24	Rank 2						7	47%	5	33%	2	13%	3	20%
25	Rank 3						1	7%	3	20%	0	0%	0	0%
26	Rank 4								0	0%	0	0%	0	0%
27	Rank Mean							1.600		1.733		1.133		1.200
28	Rank Median							2.000		2.000		1.000		1.000
29	Rank Variance (Sxx)							0.400		0.638		0.124		0.171
30	Rank Std Dev							0.632		0.799		0.352		0.414
32	Correlation Coef. (r)							0.589		0.337		0.335		-0.183
33	t-stat for Ho: r = 0							2.626		1.291		1.281		-0.671
34	p-value = P(r = 0)							1.994E-02		2.176E-01		2.210E-01		5.133E-01
36	t-stat for Ho: μ: ≥ 2							-2.449		-1.293		-9.539		-7.483
37	p-value = P(X < 2)							1.404E-02		1.085E-01		8.349E-08		1.476E-06
38	Mann-Whitney P(X<2)							3.160E-03		5.281E-02		8.768E-07		5.261E-06

Participant did not respond. 2008 value came from online.

Respondant indicated 1 for 2007, Inc 500 shows 3 for 2008 (3 yr return)

	A	AL	AM	AN	AO	AP	AQ	AR	AS	AT	AU	AV	AW
1		cess, how significant is each of the following ideals?										Question 9. In terms of impact on your organization's succe	
2	Response Rank 1	1. Very significant	1	1. Very significant	1	1. Very significant	1	1. Very important	1	1. Very important	1	1. Very important	1
3	Response Rank 2	2. Somewhat significant	2	2. Somewhat significant	2	2. Somewhat significant	2	2. Somewhat important	2	2. Somewhat important	2	2. Somewhat important	2
4	Response Rank 3	3. Slightly significant	3	3. Slightly significant	3	3. Slightly significant	3	3. Slightly important	3	3. Slightly important	3	3. Slightly important	3
5	Response Rank 4	*4. Not significant*	4	*4. Not significant*	4	*4. Not significant*	4	4. Not important	4	4. Not important	4	4. Not important	4
6	Individual Components	Marketing	Post Survey Rank	Creativity	Post Survey Rank	Innovation	Post Survey Rank	Executive	Post Survey Rank	Manager	Post Survey Rank	Supervisor	Post Survey Rank
7	Company A	1. Very significant	1	1. Very significant	1	1. Very significant	1	1. Very important	1	1. Very important	1	1. Very important	1
8	Company B	1. Very significant	1	1. Very significant	1	1. Very significant	1	1. Very important	1	1. Very important	1	1. Very important	1
9	Company C	1. Very significant	1	1. Very significant	1	1. Very significant	1	1. Very important	1	1. Very important	1	1. Very important	1
10	Company D	2. Somewhat significant	2	1. Very significant	1	1. Very significant	1	1. Very important	1	1. Very important	1	1. Very important	1
11	Company E	3. Slightly significant	3	3. Slightly significant	3	3. Slightly significant	3	2. Somewhat important	2	2. Somewhat important	2	2. Somewhat important	2
12	Company F	3. Slightly significant	3	1. Very significant	1	1. Very significant	1	1. Very important	1	1. Very important	1	2. Somewhat important	2
13	Company G	4. Not significant	4	2. Somewhat significant	2	2. Somewhat significant	2	1. Very important	1	2. Somewhat important	2	2. Somewhat important	2
14	Company H	2. Somewhat significant	2	2. Somewhat significant	2	1. Very significant	1	1. Very important	1	2. Somewhat important	2		
15	Company I	1. Very significant	1	1. Very significant	1	1. Very significant	1	1. Very important	1	4. Not Important	4	4. Not Important	4
16	Company J	4. Not significant	4	2. Somewhat significant	2	2. Somewhat significant	2	1. Very important	1	1. Very important	1	1. Very important	1
17	Company K	2. Somewhat significant	2	2. Somewhat significant	2	1. Very significant	1	1. Very important	1	2. Somewhat important	2	2. Somewhat important	2
18	Company L	2. Somewhat significant	2	1. Very significant	1	1. Very significant	1	2. Somewhat important	2	2. Somewhat important	2	2. Somewhat important	2
19	Company M	1. Very significant	1	3. Slightly significant	3	4. Not significant	4	1. Very important	1	1. Very important	1	1. Very important	1
20	Company N	2. Somewhat significant	2	2. Somewhat significant	2	1. Very significant	1	1. Very important	1	1. Very important	1	1. Very important	1
21	Company O	3. Slightly significant	3	3. Slightly significant	3	2. Somewhat significant	2	1. Very important	1	1. Very important	1	2. Somewhat important	2
22	Response Totals	15		15		15		15		15		14	
23	Rank 1	5	33%	7	47%	10	67%	13	87%	9	60%	7	50%
24	Rank 2	5	33%	5	33%	3	20%	2	13%	5	33%	6	43%
25	Rank 3	3	20%	3	20%	1	7%	0	0%	0	0%	0	0%
26	Rank 4	2	13%	0	0%	1	7%	0	0%	1	7%	1	7%
27	Rank Mean		2.133		1.733		1.533		1.133		1.533		1.643
28	Rank Median		2.000		2.000		1.000		1.000		1.000		1.500
29	Rank Variance (Sxx)		1.124		0.638		0.838		0.124		0.695		0.709
30	Rank Std Dev		1.060		0.799		0.915		0.352		0.834		0.842
32	Correlation Coef. (r)		0.111		-0.295		-0.485		-0.114		0.338		0.326
33	t-stat for Ho: r = 0		0.403		-1.113		-1.999		-0.412		1.295		1.194
34	p-value = P(r = 0)		6.929E-01		2.845E-01		6.542E-02		6.864E-01		2.162E-01		2.539E-01
36	t-stat for Ho: μ ≥ 2		0.487		-1.293		-1.974		-9.539		-2.168		-1.587
37	p-value = P(X < 2)		6.831E-01		1.085E-01		3.421E-02		8.349E-08		2.396E-02		6.823E-02
38	Mann-Whitney P(X<2)		5.001E-01		5.281E-02		1.300E-03		8.768E-07		3.498E-04		2.900E-03

	A	AX	AY	AZ	BA	BB	BC	BD	BE	BF	BG	BH	BI
1		ss, how important is the influence of each of the following ranks?						Question 10. Does your organization's size influence its succss?		Question 11. Has an aggressive technological policy which has been defined in the literature as "a preemptive, long-range strategy for technological innovation" been an important part of your organization's culture?		Question 12. Does your organization have an explicit innovation strategy or strategy towards innovation?	
2	Response Rank 1	1. Very important	1	1. Very important	1	1. Very important	1	Yes	1	Yes	1	Yes	1
3	Response Rank 2	2. Somewhat important	2	2. Somewhat important	2	2. Somewhat important	2	Maybe	2	Maybe	2	Maybe	2
4	Response Rank 3	3. Slightly important	3	3. Slightly important	3	3. Slightly important	3	No	3	No	3	No	3
5	Response Rank 4	4. Not important	4	4. Not important	4	4. Not important	4						
6	Individual Components	Technical leader (team lead, senior engineer, etc.)	Post Survey Rank	Technical (engineer, technician, etc.)	Post Survey Rank	Non-technical (HR, accounting, etc.)	Post Survey Rank	Response	Post Survey Rank	Response	Post Survey Rank	Response	Post Survey Rank
7	Company A	1. Very important	1	1. Very important	1	3. Slightly important	3	Yes	1	Yes	1	Yes	1
8	Company B	1. Very important	1	1. Very important	1	2. Somewhat important	2	Maybe	2	Yes	1	Yes	1
9	Company C	1. Very important	1	1. Very important	1	1. Very important	1	Yes	1	Yes	1	Yes	1
10	Company D	1. Very important	1	1. Very important	1	2. Somewhat important	2	No	3	No	3	Yes	1
11	Company E	2. Somewhat important	2	2. Somewhat important	2	2. Somewhat important	2	Maybe	2	No	3	No	3
12	Company F			1. Very important	1	2. Somewhat important	2	Yes	1	No	3	Yes	1
13	Company G	1. Very important	1	1. Very important	1	4. Not Important	4	Yes	1	Yes	1	No	3
14	Company H	1. Very important	1	2. Somewhat important	2	3. Slightly important	3	Yes	1	Yes	1	Yes	1
15	Company I	1. Very important	1	2. Somewhat important	2	3. Slightly important	3	Yes	1	Yes	1	Yes	1
16	Company J	1. Very important	1	1. Very important	1	1. Very important	1	No	3	No	3	No	3
17	Company K	1. Very important	1	1. Very important	1	3. Slightly important	3	Yes	1	Maybe	2	Yes	1
18	Company L	1. Very important	1	2. Somewhat important	2			Yes	1	Yes	1	Yes	1
19	Company M	1. Very important	1	3. Slightly important	3	2. Somewhat important	2	Yes	1	No	3	No	3
20	Company N	1. Very important	1	1. Very important	1	1. Very important	1	Maybe	2	Yes	1	Yes	1
21	Company O	1. Very important	1	2. Somewhat important	2	2. Somewhat important	2	No	3	Maybe	2	No	3
22	Response Totals	14		15		14		15		15		15	
23	Rank 1	13	93%	9	60%	3	21%	9	60%	8	53%	10	67%
24	Rank 2	1	7%	5	33%	6	43%	3	20%	2	13%	0	0%
25	Rank 3	0	0%	1	7%	4	29%	3	20%	5	33%	5	33%
26	Rank 4	0	0%	0	0%	1	7%						
27	Rank Mean		1.071		1.467		2.214		1.600		1.800		1.667
28	Rank Median		1.000		1.000		2.000		1.000		1.000		1.000
29	Rank Variance (Sxx)		0.071		0.410		0.797		0.686		0.886		0.952
30	Rank Std Dev		0.267		0.640		0.893		0.828		0.941		0.976
32	Correlation Coef. (r)		-0.272		-0.342		0.030		0.259		-0.054		-0.366
33	t-stat for Ho: r = 0		-0.981		-1.312		0.104		0.967		-0.194		-1.420
34	p-value = P(r = 0)		3.445E-01		2.107E-01		9.190E-01		3.498E-01		8.492E-01		1.775E-01
36	t-stat for Ho: μ: ≥ 2		-13.000		-3.228		0.898		-1.871		-0.823		-1.323
37	p-value = P(X < 2)		3.978E-09		3.038E-03		8.073E-01		4.121E-02		2.121E-01		1.035E-01
38	Mann-Whitney P(X<2)		3.739E-07		3.498E-04		8.529E-01		1.558E-02		1.349E-01		5.705E-02

	A	BJ	BK	BL	BM	BN	BO	BP
1		Question 13. Does your organization attempt to influence the following?				Question 14. With respect to specific job duties, chain of command, communications protocol, etc., does your organization tend towards a fixed or flexible organizational structure?		
2	Response Rank 1	Yes	1	Yes	1	Flexible	1	
3	Response Rank 2	Maybe	2	Maybe	2	Fixed	2	
4	Response Rank 3	No	3	No	3			
5	Response Rank 4							
6	Individual Components	Creativity	Post Survey Rank	Innovation	Post Survey Rank	Response	Post Survey Rank	Other (please specify)
7	Company A	Yes	1	Yes	1	Flexible	1	
8	Company B	Yes	1	Yes	1	Flexible	1	
9	Company C	Yes	1	Yes	1	Flexible	1	
10	Company D	Yes	1	Yes	1	Flexible	1	
11	Company E	No	3	No	3	Flexible	1	
12	Company F	No	3	No	3	Flexible	1	
13	Company G	No	3	Yes	1	Flexible	1	
14	Company H	Maybe	2	Yes	1	Flexible	1	
15	Company I	Yes	1	Yes	1	Flexible	1	
16	Company J	Maybe	2	Maybe	2	Fixed	2	
17	Company K	No	3	Yes	1	Flexible	1	
18	Company L	Yes	1	Yes	1	Flexible	1	
19	Company M	No	3	No	3	Flexible	1	
20	Company N	Maybe	2	Yes	1	Flexible	1	
21	Company O	Maybe	2	Yes	1	Flexible	1	
22	Response Totals	15		15		15		
23	Rank 1	6	40%	11	73%	14	93%	
24	Rank 2	4	27%	1	7%	1	7%	
25	Rank 3	5	33%	3	20%			
26	Rank 4							
27	Rank Mean		1.933		1.467		1.067	
28	Rank Median		2.000		1.000		1.000	
29	Rank Variance (Sxx)		0.781		0.695		0.067	
30	Rank Std Dev		0.884		0.834		0.258	
32	Correlation Coef. (r)		-0.138		-0.376		0.106	
33	t-stat for Ho: r = 0		-0.503		-1.463		0.384	
34	p-value = P(r = 0)		6.230E-01		1.656E-01		7.067E-01	
36	t-stat for Ho: μ: ≥ 2		-0.292		-2.477		-14.000	
37	p-value = P(X < 2)		3.872E-01		1.330E-02		6.317E-10	
38	Mann-Whitney P(X<2)		2.777E-01		3.560E-03		1.031E-07	

	A	BQ	BR	BS	BT	BU	BV	BW	BX	BY
1		Question 15. Is leadership whether a team leader, manager, or otherwise the main conduit of communication between its respective team and the following domains?				Question 16. Does your organization tend towards hands-on or hands-off leadership, i.e. managing versus steering?				
2	Response Rank 1	Yes	1	Yes	1	Hands-off/Steering	1		Yes	1
3	Response Rank 2	Maybe	2	Maybe	2	Hands-on/Managing	2		Maybe	2
4	Response Rank 3	No	3	No	3				No	3
5	Response Rank 4									
6	Individual Components	Internal to the organization but external to the team	Post Survey Rank	External to the organization	Post Survey Rank	Response	Post Survey Rank	Other (please specify)	Response	Post Survey Rank
7	Company A	No	3	Yes	1	Hands-off/Steering	1		No	3
8	Company B	Yes	1			Hands-off/Steering	1		No	3
9	Company C	Maybe	2	Maybe	2	Hands-off/Steering	1		No	3
10	Company D	No	3	No	3	Hands-off/Steering	1		No	3
11	Company E	Yes	1	Yes	1	Hands-off/Steering	1		Yes	1
12	Company F	No	3	Yes	1	Hands-off/Steering	1		No	3
13	Company G	No	3	No	3	Hands-off/Steering	1		Yes	1
14	Company H	Maybe	2	Yes	1	Hands-on/Managing	2		Yes	1
15	Company I	Yes	1	Yes	1			's & Leads a d	Yes	1
16	Company J	Maybe	2	Maybe	2	Hands-on/Managing	2		Maybe	2
17	Company K	Yes	1	Yes	1	Hands-off/Steering	1		No	3
18	Company L	Yes	1	Yes	1	Hands-on/Managing	2		No	3
19	Company M	Maybe	2	Maybe	2	Hands-off/Steering	1		No	3
20	Company N	Maybe	2	Maybe	2	Hands-on/Managing	2		Maybe	2
21	Company O	Yes	1	No	3	Hands-off/Steering	1		Maybe	2
22	Response Totals	15		14		14			15	
23	Rank 1	6	40%	7	50%	10	71%		4	27%
24	Rank 2	5	33%	4	29%	4	29%		3	20%
25	Rank 3	4	27%	3	21%				8	53%
26	Rank 4									
27	Rank Mean		1.867		1.714		1.286			2.267
28	Rank Median		2.000		1.500		1.000			3.000
29	Rank Variance (Sxx)		0.695		0.681		0.220			0.781
30	Rank Std Dev		0.834		0.825		0.469			0.884
32	Correlation Coef. (r)		-0.179		0.053		0.311			-0.055
33	t-stat for Ho: r = 0		-0.656		0.184		1.132			-0.198
34	p-value = P(r = 0)		5.222E-01		8.571E-01		2.780E-01			8.461E-01
36	t-stat for Ho: μ: ≥ 2		-0.619		-1.295		-5.701			1.169
37	p-value = P(X < 2)		2.728E-01		1.089E-01		3.641E-05			8.690E-01
38	Mann-Whitney P(X<2)		1.748E-01		5.264E-02		7.628E-05			9.282E-01

	A	BZ
1		Question 17. Are innovation tasks and assignments managed differently than other tasks and assignments?
2	Response Rank 1	
3	Response Rank 2	
4	Response Rank 3	
5	Response Rank 4	
6	Individual Components	If so, how?
7	Company A	
8	Company B	
9	Company C	
10	Company D	
11	Company E	contracted work tasks come before innovation tasks unless the contracted tasks are innovative
12	Company F	
13	Company G	
14	Company H	the process and cross functional process reviews.
15	Company I	There are some people that are pre-disposed to think outside the box and have the ability to think big and small picture and innovate. I think it is a talent and a skill. It can be learned but takes a lot of mentoring and time.
16	Company J	Since innovation usually means heading into uncharted waters our management tends to pay more attention.
17	Company K	
18	Company L	
19	Company M	
20	Company N	
21	Company O	Less formality; typical design deadlines may not exist; less structure from clients when compared to routine engineering work
22	Response Totals	
23	Rank 1	
24	Rank 2	
25	Rank 3	
26	Rank 4	
27	Rank Mean	
28	Rank Median	
29	Rank Variance (Sxx)	
30	Rank Std Dev	
32	Correlation Coef. (r)	
33	t-stat for Ho: r ≠ 0	
34	p-value = P(r = 0)	
36	t-stat for Ho: μ: ≥ 2	
37	p-value = P(X < 2)	
38	Mann-Whitney P(X<2)	

	A	CA	CB	CC	CD	CE	CF	CG	CH	CI	CJ	CK
1		Question 18. Does your organization maintain a long term orientation such as a focus on market dominance, etc. or a short term orientation such as a focus on quarterly sales, etc.?		Question 19. How adept is your organization at discovering and adapting to change and evolving technology?		Question 20. Does your organization practice: (1) open innovation which has been defined as the use of free inflows and outflows of information both inside the firm and out; or (2) closed innovation which limits the flow of information?			Question 21. How would you characterize your organization's knowledge capacities or abilities to explore, retain, and exploit knowledge into meaningful and useful innovation?		Question 22. How often does your organization attempt to identify and utilize external knowledge, technologies, or ideas?	
2	Response Rank 1	Long term orientation	1	Very adept	1	Open innovation	1		Very effective	1	Frequently	1
3	Response Rank 2	Balanced orientation	2	Somewhat adept	2	Closed innovation	2		Somewhat effective	2	Occasionally	2
4	Response Rank 3	Short term orientation	3	Slightly adept	3				Slightly effective	3	Rarely	3
5	Response Rank 4			Not adept	4				Not effective	4		
6	Individual Components	Response	Post Survey Rank	Response	Post Survey Rank	Response	Post Survey Rank	Other (please specify)	Response	Post Survey Rank	Response	Post Survey Rank
7	Company A	Balanced orientation	2	Somewhat adept	2	Open innovation	1		Somewhat effective	2	Frequently	1
8	Company B	Balanced orientation	2	Somewhat adept	2	Open innovation	1		Somewhat effective	2	Frequently	1
9	Company C	Balanced orientation	2	Very adept	1	Open innovation	1		Very effective	1	Frequently	1
10	Company D	Balanced orientation	2	Very adept	1	Open innovation	1		Very effective	1	Frequently	1
11	Company E	Balanced orientation	2	Somewhat adept	2	Open innovation	1		Somewhat effective	2	Frequently	1
12	Company F	Balanced orientation	2	Somewhat adept	2	Open innovation	1		Somewhat effective	2	Occasionally	2
13	Company G	Balanced orientation	2	Very adept	1	Closed innovation	2		Slightly effective	3	Occasionally	2
14	Company H	Balanced orientation	2	Somewhat adept	2	Open innovation	1		Very effective	1	Frequently	1
15	Company I	Balanced orientation	2	Very adept	1	Open innovation	1		Very effective	1	Frequently	1
16	Company J	Balanced orientation	2	Slightly adept	3	Closed innovation	2		Somewhat effective	2	Occasionally	2
17	Company K	Balanced orientation	2	Somewhat adept	2	Closed innovation	2	Somewhat open, but not fully open	Somewhat effective	2	Occasionally	2
18	Company L	Balanced orientation	2	Very adept	1	Open innovation	1		Very effective	1	Frequently	1
19	Company M	Balanced orientation	2	Very adept	1	Open innovation	1		Very effective	1	Occasionally	2
20	Company N	Balanced orientation	2	Very adept	1	Open innovation	1		Somewhat effective	2	Frequently	1
21	Company O	Long term orientation	1	Somewhat adept	2	Open innovation	1		Slightly effective	3	Occasionally	2
22	Response Totals	15		15		15			15		15	
23	Rank 1	1	7%	7	47%	12	80%		6	40%	9	60%
24	Rank 2	14	93%	7	47%	3	20%		7	47%	6	40%
25	Rank 3	0	0%	1	7%				2	13%	0	0%
26	Rank 4			0	0%				0	0%		
27	Rank Mean		1.933		1.600		1.200			1.733		1.400
28	Rank Median		2.000		2.000		1.000			2.000		1.000
29	Rank Variance (Sxx)		0.067		0.400		0.171			0.495		0.257
30	Rank Std Dev		0.258		0.632		0.414			0.704		0.507
32	Correlation Coef. (r)				-0.110		0.274			-0.021		-0.050
33	t-stat for Ho: r = 0				-0.398		1.029			-0.075		-0.180
34	p-value = P(r = 0)				6.965E-01		3.211E-01			9.409E-01		8.600E-01
36	t-stat for Ho: μ: ≥ 2	t-stat for Ho: μ ≥ 3	-16.000		-2.449		-7.483			-1.468		-4.583
37	p-value = P(X < 2)	p-value = P(X < μ)	1.080E-10		1.404E-02		1.476E-06			8.216E-02		2.132E-04
38	Mann-Whitney P(X<2)	Mann-Whitney P(X<3)	6.447E-09		3.160E-03		5.261E-06			3.344E-02		3.498E-04

	A	CL	CM	CN	CO	CP	CQ	CR	CS	CT	CU	CV	CW
1		Question 23. Does employee perception of resource availability influence the success of your organization's technological projects?		Question 24. How important to the success of the organization is employee perception of the value placed in them by the organization and its leadership?									
2	Response Rank 1	Yes	1	Critical	1	1. High emphasis	1	1. High emphasis	1	1. High emphasis	1	1. High emphasis	1
3	Response Rank 2	Maybe	2	Important	2	2. Moderate emphasis	2	2. Moderate emphasis	2	2. Moderate emphasis	2	2. Moderate emphasis	2
4	Response Rank 3	No	3	Not important	3	3. Low emphasis	3	3. Low emphasis	3	3. Low emphasis	3	3. Low emphasis	3
5	Response Rank 4					4. No emphasis	4	4. No emphasis	4	4. No emphasis	4	4. No emphasis	4
6	Individual Components	Response	Post Survey Rank	Response	Post Survey Rank	Job complexity for technical personnel	Post Survey Rank	Job complexity for non technical personnel	Post Survey Rank	Autonomy in researching solutions	Post Survey Rank	Employee ownership and control over their own work	Post Survey Rank
7	Company A	Yes	1	Critical	1	1. High emphasis	1	2. Moderate emphasis	2	1. High emphasis	1	2. Moderate emphasis	2
8	Company B	Maybe	2	Important	2	2. Moderate emphasis	2	2. Moderate emphasis	2	1. High emphasis	1	1. High emphasis	1
9	Company C	Maybe	2	Important	2	1. High emphasis	1	2. Moderate emphasis	2	1. High emphasis	1	1. High emphasis	1
10	Company D	No	3	Important	2	2. Moderate emphasis	2	2. Moderate emphasis	2	1. High emphasis	1	1. High emphasis	1
11	Company E	Yes	1	Critical	1	2. Moderate emphasis	2	2. Moderate emphasis	2	2. Moderate emphasis	2	1. High emphasis	1
12	Company F	Maybe	2	Important	2	2. Moderate emphasis	2	2. Moderate emphasis	2	1. High emphasis	1	1. High emphasis	1
13	Company G	Yes	1	Critical	1	1. High emphasis	1	3. Low emphasis	3	1. High emphasis	1	1. High emphasis	1
14	Company H	Maybe	2	Critical	1	2. Moderate emphasis	2	2. Moderate emphasis	2	2. Moderate emphasis	2	1. High emphasis	1
15	Company I	Yes	1	Critical	1	1. High emphasis	1	1. High emphasis	1	2. Moderate emphasis	2	1. High emphasis	1
16	Company J	No	3	Important	2	2. Moderate emphasis	2	3. Low emphasis	3	2. Moderate emphasis	2	2. Moderate emphasis	2
17	Company K	Yes	1	Critical	1	2. Moderate emphasis	2	3. Low emphasis	3	1. High emphasis	1	1. High emphasis	1
18	Company L	Yes	1	Important	2	1. High emphasis	1	2. Moderate emphasis	2	1. High emphasis	1	1. High emphasis	1
19	Company M	Yes	1	Critical	1	1. High emphasis	1	1. High emphasis	1	3. Low emphasis	3	2. Moderate emphasis	2
20	Company N	No	3	Critical	1	1. High emphasis	1	1. High emphasis	1	3. Low emphasis	3	2. Moderate emphasis	2
21	Company O	Maybe	2	Important	2	3. Low emphasis	3	4. No emphasis	4	2. Moderate emphasis	2	1. High emphasis	1
22	Response Totals	15		15		15		15		15		15	
23	Rank 1	7	47%	8	53%	7	47%	3	20%	8	53%	11	73%
24	Rank 2	5	33%	7	47%	7	47%	8	53%	5	33%	4	27%
25	Rank 3	3	20%	0	0%	1	7%	3	20%	2	13%	0	0%
26	Rank 4					0	0%	1	7%	0	0%	0	0%
27	Rank Mean		1.733		1.467		1.600		2.133		1.600		1.267
28	Rank Median		2.000		1.000		2.000		2.000		1.000		1.000
29	Rank Variance (Sxx)		0.638		0.267		0.400		0.695		0.543		0.210
30	Rank Std Dev		0.799		0.516		0.632		0.834		0.737		0.458
32	Correlation Coef. (r)		0.337		0.065		0.090		-0.048		-0.051		-0.175
33	t-stat for Ho: r = 0		1.291		0.236		0.325		-0.173		-0.186		-0.640
34	p-value = P(r = 0)		2.176E-01		8.172E-01		7.499E-01		8.651E-01		8.555E-01		5.328E-01
36	t-stat for Ho: µ: ≥ 2		-1.293		-4.000		-2.449		0.619		-2.103		-6.205
37	p-value = P(X < 2)		1.085E-01		6.580E-04		1.404E-02		7.272E-01		2.703E-02		1.148E-05
38	Mann-Whitney P(X<2)		5.281E-02		1.100E-03		3.160E-03		7.696E-01		7.600E-03		2.499E-05

	A	CX	CY	CZ	DA	DB	DC	DD	DE	DF	DG	DH	DI
1		Question 25. How much emphasis does your organization place on addressing each of the following job characteristics?											
2	Response Rank 1	1. High emphasis	1	1. High emphasis	1	1. High emphasis	1	1. High emphasis	1	1. High emphasis	1	1. High emphasis	1
3	Response Rank 2	2. Moderate emphasis	2	2. Moderate emphasis	2	2. Moderate emphasis	2	2. Moderate emphasis	2	2. Moderate emphasis	2	2. Moderate emphasis	2
4	Response Rank 3	3. Low emphasis	3	3. Low emphasis	3	3. Low emphasis	3	3. Low emphasis	3	3. Low emphasis	3	3. Low emphasis	3
5	Response Rank 4	4. No emphasis	4	4. No emphasis	4	4. No emphasis	4	4. No emphasis	4	4. No emphasis	4	4. No emphasis	4
6	Individual Components	Flexibility in setting their own agenda	Post Survey Rank	Clear role goals and expectations	Post Survey Rank	Organizational encouragement and support	Post Survey Rank	Supervisory encouragement and support	Post Survey Rank	Peer or work group encouragement and support	Post Survey Rank	Creative role models	Post Survey Rank
7	Company A	2. Moderate emphasis	2	1. High emphasis	1	1. High emphasis	1	2. Moderate emphasis	2	1. High emphasis	1	1. High emphasis	1
8	Company B	2. Moderate emphasis	2	2. Moderate emphasis	2	1. High emphasis	1	1. High emphasis	1	1. High emphasis	1	2. Moderate emphasis	2
9	Company C	2. Moderate emphasis	2	1. High emphasis	1	1. High emphasis	1	1. High emphasis	1	1. High emphasis	1	1. High emphasis	1
10	Company D	2. Moderate emphasis	2	1. High emphasis	1	2. Moderate emphasis	2	2. Moderate emphasis	2	2. Moderate emphasis	2	2. Moderate emphasis	2
11	Company E	3. Low emphasis	3	2. Moderate emphasis	2	2. Moderate emphasis	2	2. Moderate emphasis	2	2. Moderate emphasis	2	2. Moderate emphasis	2
12	Company F	1. High emphasis	1	2. Moderate emphasis	2	2. Moderate emphasis	2	3. Low emphasis	3	2. Moderate emphasis	2	2. Moderate emphasis	2
13	Company G	1. High emphasis	1	1. High emphasis	1	1. High emphasis	1	3. Low emphasis	3	2. Moderate emphasis	2	3. Low emphasis	3
14	Company H	2. Moderate emphasis	2	1. High emphasis	1	1. High emphasis	1	1. High emphasis	1	1. High emphasis	1	2. Moderate emphasis	2
15	Company I	2. Moderate emphasis	2	2. Moderate emphasis	2	1. High emphasis	1	1. High emphasis	1	1. High emphasis	1	1. High emphasis	1
16	Company J	3. Low emphasis	3	1. High emphasis	1	1. High emphasis	1	2. Moderate emphasis	2	2. Moderate emphasis	2	3. Low emphasis	3
17	Company K	1. High emphasis	1	1. High emphasis	1	1. High emphasis	1	2. Moderate emphasis	2	2. Moderate emphasis	2	2. Moderate emphasis	2
18	Company L	2. Moderate emphasis	2	1. High emphasis	1	1. High emphasis	1	1. High emphasis	1	1. High emphasis	1	1. High emphasis	1
19	Company M	2. Moderate emphasis	2	2. Moderate emphasis	2	2. Moderate emphasis	2	2. Moderate emphasis	2	3. Low emphasis	3	4. No emphasis	4
20	Company N	2. Moderate emphasis	2	1. High emphasis	1	1. High emphasis	1	1. High emphasis	1	2. Moderate emphasis	2	2. Moderate emphasis	2
21	Company O	1. High emphasis	1	2. Moderate emphasis	2	3. Low emphasis	3	2. Moderate emphasis	2	2. Moderate emphasis	2	3. Low emphasis	3
22	Response Totals	15		15		15		15		15		15	
23	Rank 1	4	27%	9	60%	10	67%	6	40%	6	40%	4	27%
24	Rank 2	9	60%	6	40%	4	27%	7	47%	8	53%	7	47%
25	Rank 3	2	13%	0	0%	1	7%	2	13%	1	7%	3	20%
26	Rank 4	0	0%	0	0%	0	0%	0	0%	0	0%	1	7%
27	Rank Mean		1.867		1.400		1.400		1.733		1.667		2.067
28	Rank Median		2.000		1.000		1.000		2.000		2.000		2.000
29	Rank Variance (Sxx)		0.410		0.257		0.400		0.495		0.381		0.781
30	Rank Std Dev		0.640		0.507		0.632		0.704		0.617		0.884
32	Correlation Coef. (r)		-0.135		-0.174		-0.239		-0.155		-0.017		-0.148
33	t-stat for Ho: r ≠ 0		-0.490		-0.638		-0.889		-0.567		-0.061		-0.538
34	p-value = P(r = 0)		6.314E-01		5.338E-01		3.888E-01		5.795E-01		9.519E-01		5.990E-01
36	t-stat for Ho: μ ≥ 2		-0.807		-4.583		-3.674		-1.468		-2.092		0.292
37	p-value = P(X < 2)		2.166E-01		2.132E-04		1.251E-03		8.216E-02		2.759E-02		6.128E-01
38	Mann-Whitney P(X<2)		1.195E-01		3.498E-04		9.995E-05		3.344E-02		8.430E-03		5.011E-01

	A	DJ	DK	DL	DM	DN	DO	DP	DQ	DR	DS	DT	DU
1													
2	Response Rank 1	1. High emphasis	1	1. High emphasis	1	1. High emphasis	1	1. High emphasis	1	1. High emphasis	1	1. High emphasis	1
3	Response Rank 2	2. Moderate emphasis	2	2. Moderate emphasis	2	2. Moderate emphasis	2	2. Moderate emphasis	2	2. Moderate emphasis	2	2. Moderate emphasis	2
4	Response Rank 3	3. Low emphasis	3	3. Low emphasis	3	3. Low emphasis	3	3. Low emphasis	3	3. Low emphasis	3	3. Low emphasis	3
5	Response Rank 4	4. No emphasis	4	4. No emphasis	4	4. No emphasis	4	4. No emphasis	4	4. No emphasis	4	4. No emphasis	4
6	Individual Components	A system of rewards	Post Survey Rank	Group dynamics (synergy and attitudes)	Post Survey Rank	Fair and supportive evaluation of new ideas	Post Survey Rank	Collaborative idea flow across the organization	Post Survey Rank	Employee risk taking	Post Survey Rank	External recognition for achievements	Post Survey Rank
7	Company A	3. Low emphasis	3	1. High emphasis	1	2. Moderate emphasis	2	1. High emphasis	1	1. High emphasis	1	3. Low emphasis	3
8	Company B	2. Moderate emphasis	2	1. High emphasis	1	2. Moderate emphasis	2	1. High emphasis	1	1. High emphasis	1	1. High emphasis	1
9	Company C	1. High emphasis	1	1. High emphasis	1	1. High emphasis	1	1. High emphasis	1	1. High emphasis	1	2. Moderate emphasis	2
10	Company D	2. Moderate emphasis	2	2. Moderate emphasis	2	2. Moderate emphasis	2	1. High emphasis	1	3. Low emphasis	3	3. Low emphasis	3
11	Company E	3. Low emphasis	3	2. Moderate emphasis	2	2. Moderate emphasis	2	3. Low emphasis	3	3. Low emphasis	3	3. Low emphasis	3
12	Company F	2. Moderate emphasis	2	2. Moderate emphasis	2	2. Moderate emphasis	2	1. High emphasis	1	2. Moderate emphasis	2	2. Moderate emphasis	2
13	Company G	3. Low emphasis	3	1. High emphasis	1	1. High emphasis	1	1. High emphasis	1	2. Moderate emphasis	2	3. Low emphasis	3
14	Company H	2. Moderate emphasis	2	2. Moderate emphasis	2	2. Moderate emphasis	2	1. High emphasis	1	2. Moderate emphasis	2	3. Low emphasis	3
15	Company I	1. High emphasis	1	1. High emphasis	1	2. Moderate emphasis	2	2. Moderate emphasis	2	2. Moderate emphasis	2	1. High emphasis	1
16	Company J	1. High emphasis	1	1. High emphasis	1	3. Low emphasis	3	2. Moderate emphasis	2	3. Low emphasis	3	4. No emphasis	4
17	Company K	2. Moderate emphasis	2	2. Moderate emphasis	2	2. Moderate emphasis	2	2. Moderate emphasis	2	3. Low emphasis	3	3. Low emphasis	3
18	Company L	1. High emphasis	1	1. High emphasis	1	1. High emphasis	1	1. High emphasis	1	2. Moderate emphasis	2	2. Moderate emphasis	2
19	Company M	1. High emphasis	1	2. Moderate emphasis	2	2. Moderate emphasis	2	3. Low emphasis	3	3. Low emphasis	3	3. Low emphasis	3
20	Company N	1. High emphasis	1	2. Moderate emphasis	2	1. High emphasis	1	1. High emphasis	1	2. Moderate emphasis	2	2. Moderate emphasis	2
21	Company O	3. Low emphasis	3	3. Low emphasis	3	1. High emphasis	1	2. Moderate emphasis	2	2. Moderate emphasis	2	3. Low emphasis	3
22	Response Totals	15		15		15		15		15		15	
23	Rank 1	6	40%	7	47%	5	33%	9	60%	3	20%	2	13%
24	Rank 2	5	33%	7	47%	9	60%	4	27%	7	47%	4	27%
25	Rank 3	4	27%	1	7%	1	7%	2	13%	5	33%	8	53%
26	Rank 4	0	0%	0	0%	0	0%	0	0%	0	0%	1	7%
27	Rank Mean		1.867		1.600		1.733		1.533		2.133		2.533
28	Rank Median		2.000		2.000		2.000		1.000		2.000		3.000
29	Rank Variance (Sxx)		0.695		0.400		0.352		0.552		0.552		0.695
30	Rank Std Dev		0.834		0.632		0.594		0.743		0.743		0.834
32	Correlation Coef. (r)		-0.293		-0.010		0.082		-0.215		0.286		-0.267
33	t-stat for Ho: r = 0		-1.104		-0.036		0.295		-0.794		1.076		-1.001
34	p-value = P(r = 0)		2.884E-01		9.718E-01		7.724E-01		4.403E-01		3.003E-01		3.339E-01
36	t-stat for Ho: µ: ≥ 2		-0.619		-2.449		-1.740		-2.432		0.695		2.477
37	p-value = P(X < 2)		2.728E-01		1.404E-02		5.191E-02		1.452E-02		7.507E-01		9.867E-01
38	Mann-Whitney P(X<2)		1.748E-01		3.160E-03		2.107E-02		3.270E-03		8.531E-01		9.968E-01

	A	DV	DW	DX	DY	DZ	EA	EB	EC	ED	EE	EF	EG	EH
1		Question 26. How important is innovation for your organization's success?		Question 27. Does your organization's size influence its innovativeness?		Question 28. Is it accurate to say that your organization has focused the majority of its innovative efforts into niche markets with technology products and/or services that are related to each other.			Question 29. How important is it to have a project champion which has been defined as someone who is committed to the project, optimistic about its success, and will defend it as needed?					
2	Response Rank 1	Critical	1	Yes	1	Yes	1		Critical	1	1. High emphasis	1	1. High emphasis	1
3	Response Rank 2	Important	2	Maybe	2	Maybe	2		Important	2	2. Moderate emphasis	2	2. Moderate emphasis	2
4	Response Rank 3	Not Important	3	No	3	No	3		Not important	3	3. Low emphasis	3	3. Low emphasis	3
5	Response Rank 4										4. No emphasis	4	4. No emphasis	4
6	Individual Components	Response	Post Survey Rank	Response	Post Survey Rank	Response	Post Survey Rank	Other (please specify)	Response	Post Survey Rank	Intellect	Post Survey Rank	Education	Post Survey Rank
7	Company A	Critical	1	Yes	1	Yes	1		Important	2	1. High emphasis	1	2. Moderate emphasis	2
8	Company B	Critical	1	No	3	Yes	1		Important	2	1. High emphasis	1	2. Moderate emphasis	2
9	Company C	Critical	1	Yes	1	Yes	1		Critical	1	1. High emphasis	1	1. High emphasis	1
10	Company D	Critical	1	No	3	Yes	1		Critical	1	1. High emphasis	1	3. Low emphasis	3
11	Company E	Important	2	No	3	Yes	1		Important	2	2. Moderate emphasis	2	2. Moderate emphasis	2
12	Company F	Critical	1	No	3	Yes	1		Critical	1	1. High emphasis	1	1. High emphasis	1
13	Company G	Important	2	No	3	No	3		Critical	1	1. High emphasis	1	3. Low emphasis	3
14	Company H	Critical	1	Yes	1	Yes	1		Important	2	1. High emphasis	1	2. Moderate emphasis	2
15	Company I	Important	2	Yes	1	Yes	1		Critical	1	1. High emphasis	1	1. High emphasis	1
16	Company J	Important	2	Maybe	2	Yes	1		Critical	1	2. Moderate emphasis	2	2. Moderate emphasis	2
17	Company K	Critical	1	Maybe	2	Maybe	2		Critical	1	1. High emphasis	1	2. Moderate emphasis	2
18	Company L	Critical	1	Yes	1	Yes	1		Critical	1	2. Moderate emphasis	2	2. Moderate emphasis	2
19	Company M	Not Important	3	Yes	1	Yes	1		Critical	1	1. High emphasis	1	1. High emphasis	1
20	Company N	Critical	1	Maybe	2	Yes	1		Important	2	2. Moderate emphasis	2	3. Low emphasis	3
21	Company O	Important	2	Maybe	2	Yes	1		Critical	1	2. Moderate emphasis	2	2. Moderate emphasis	2
22	Response Totals	15		15		15			15		15		15	
23	Rank 1	9	60%	6	40%	13	87%		10	67%	10	67%	4	27%
24	Rank 2	5	33%	4	27%	1	7%		5	33%	5	33%	8	53%
25	Rank 3	1	7%	5	33%	1	7%		0	0%	0	0%	3	20%
26	Rank 4										0	0%	0	0%
27	Rank Mean		1.467		1.933		1.200			1.333		1.333		1.933
28	Rank Median		1.000		2.000		1.000			1.000		1.000		2.000
29	Rank Variance (Sxx)		0.410		0.781		0.314			0.238		0.238		0.495
30	Rank Std Dev		0.640		0.884		0.561			0.488		0.488		0.704
32	Correlation Coef. (r)		-0.293		0.290		0.146			-0.172		0.086		0.410
33	t-stat for Ho: r = 0		-1.103		1.094		0.533			-0.631		0.312		1.619
34	p-value = P(r = 0)		2.886E-01		2.923E-01		6.021E-01			5.381E-01		7.596E-01		1.278E-01
36	t-stat for Ho: µ: ≥ 2		-3.228		-0.292		-5.527			-5.292		-5.292		-0.367
37	p-value = P(X < 2)		3.038E-03		3.872E-01		3.729E-05			5.696E-05		5.696E-05		3.596E-01
38	Mann-Whitney P(X<2)		3.498E-04		2.777E-01		8.768E-07			9.995E-05		9.995E-05		2.335E-01

	A	EI	EJ	EK	EL	EM	EN	EO	EP	EQ	ER	ES	ET
1						Question 30. When hiring or assigning tasks for personnel essential to your organization's innovative success, how much emphasis is placed on ea							
2	Response Rank 1	1. High emphasis	1	1. High emphasis	1	1. High emphasis	1	1. High emphasis	1	1. High emphasis	1	1. High emphasis	1
3	Response Rank 2	2. Moderate emphasis	2	2. Moderate emphasis	2	2. Moderate emphasis	2	2. Moderate emphasis	2	2. Moderate emphasis	2	2. Moderate emphasis	2
4	Response Rank 3	3. Low emphasis	3	3. Low emphasis	3	3. Low emphasis	3	3. Low emphasis	3	3. Low emphasis	3	3. Low emphasis	3
5	Response Rank 4	4. No emphasis	4	4. No emphasis	4	4. No emphasis	4	4. No emphasis	4	4. No emphasis	4	4. No emphasis	4
6	Individual Components	Training	Post Survey Rank	Experience	Post Survey Rank	Broad personal interests	Post Survey Rank	Independence of judgment	Post Survey Rank	Self-sufficiency or autonomy	Post Survey Rank	Sense of one's self as creative	Post Survey Rank
7	Company A	2. Moderate emphasis	2	2. Moderate emphasis	2	2. Moderate emphasis	2	1. High emphasis	1	2. Moderate emphasis	2	2. Moderate emphasis	2
8	Company B	2. Moderate emphasis	2	2. Moderate emphasis	2	1. High emphasis	1	1. High emphasis	1	1. High emphasis	1	1. High emphasis	1
9	Company C	1. High emphasis	1	1. High emphasis	1	2. Moderate emphasis	2	1. High emphasis	1	2. Moderate emphasis	2	1. High emphasis	1
10	Company D	2. Moderate emphasis	2	1. High emphasis	1	2. Moderate emphasis	2	1. High emphasis	1	1. High emphasis	1	2. Moderate emphasis	2
11	Company E	2. Moderate emphasis	2	2. Moderate emphasis	2	2. Moderate emphasis	2	2. Moderate emphasis	2	2. Moderate emphasis	2	2. Moderate emphasis	2
12	Company F	2. Moderate emphasis	2	2. Moderate emphasis	2	2. Moderate emphasis	2	2. Moderate emphasis	2	1. High emphasis	1	2. Moderate emphasis	2
13	Company G	3. Low emphasis	3	1. High emphasis	1	3. Low emphasis	3	1. High emphasis	1	1. High emphasis	1	2. Moderate emphasis	2
14	Company H	2. Moderate emphasis	2	2. Moderate emphasis	2	3. Low emphasis	3	2. Moderate emphasis	2	2. Moderate emphasis	2	2. Moderate emphasis	2
15	Company I	1. High emphasis	1	1. High emphasis	1	2. Moderate emphasis	2	1. High emphasis	1	1. High emphasis	1	3. Low emphasis	3
16	Company J	2. Moderate emphasis	2	2. Moderate emphasis	2	3. Low emphasis	3	2. Moderate emphasis	2	3. Low emphasis	3	3. Low emphasis	3
17	Company K	2. Moderate emphasis	2	2. Moderate emphasis	2	3. Low emphasis	3	2. Moderate emphasis	2	2. Moderate emphasis	2	2. Moderate emphasis	2
18	Company L	2. Moderate emphasis	2	1. High emphasis	1	1. High emphasis	1	1. High emphasis	1	1. High emphasis	1	1. High emphasis	1
19	Company M	1. High emphasis	1	1. High emphasis	1	1. High emphasis	1	1. High emphasis	1	1. High emphasis	1	2. Moderate emphasis	2
20	Company N	1. High emphasis	1	1. High emphasis	1	3. Low emphasis	3	2. Moderate emphasis	2	2. Moderate emphasis	2	2. Moderate emphasis	2
21	Company O	1. High emphasis	1	1. High emphasis	1	3. Low emphasis	3	4. No emphasis	4	2. Moderate emphasis	2	3. Low emphasis	3
22	Response Totals	15		15		15		15		15		15	
23	Rank 1	5	33%	8	53%	3	20%	8	53%	7	47%	3	20%
24	Rank 2	9	60%	7	47%	6	40%	6	40%	7	47%	9	60%
25	Rank 3	1	7%	0	0%	6	40%	0	0%	1	7%	3	20%
26	Rank 4	0	0%	0	0%	0	0%	1	7%	0	0%	0	0%
27	Rank Mean		1.733		1.467		2.200		1.600		1.600		2.000
28	Rank Median		2.000		1.000		2.000		1.000		2.000		2.000
29	Rank Variance (Sxx)		0.352		0.267		0.600		0.686		0.400		0.429
30	Rank Std Dev		0.594		0.516		0.775		0.828		0.632		0.655
32	Correlation Coef. (r)		0.082		-0.118		0.228		-0.008		-0.160		0.193
33	t-stat for Ho: r = 0		0.295		-0.429		0.845		-0.027		-0.583		0.708
34	p-value = P(r = 0)		7.724E-01		6.745E-01		4.124E-01		9.785E-01		5.691E-01		4.903E-01
36	t-stat for Ho: μ ≥ 2		-1.740		-4.000		1.000		-1.871		-2.449		0.000
37	p-value = P(X < 2)		5.191E-02		6.580E-04		8.329E-01		4.121E-02		1.404E-02		5.000E-01
38	Mann-Whitney P(X<2)		2.107E-02		1.100E-03		9.101E-01		1.100E-03		3.160E-03		6.533E-01

	A	EU	EV	EW	EX	EY	EZ	FA	FB	FC	FD
1		ach of the following traits?									
2	Response Rank 1	1. High emphasis	1	1. High emphasis	1	1. High emphasis	1	1. High emphasis	1	1. High emphasis	1
3	Response Rank 2	2. Moderate emphasis	2	2. Moderate emphasis	2	2. Moderate emphasis	2	2. Moderate emphasis	2	2. Moderate emphasis	2
4	Response Rank 3	3. Low emphasis	3	3. Low emphasis	3	3. Low emphasis	3	3. Low emphasis	3	3. Low emphasis	3
5	Response Rank 4	4. No emphasis	4	4. No emphasis	4	4. No emphasis	4	4. No emphasis	4	4. No emphasis	4
6	Individual Components	Communication skills	Post Survey Rank	Intrinsic motivation	Post Survey Rank	Diversity of ethnicity	Post Survey Rank	Diversity of education	Post Survey Rank	Diversity of experience	Post Survey Rank
7	Company A	1. High emphasis	1	1. High emphasis	1	4. No emphasis	4	4. No emphasis	4	2. Moderate emphasis	2
8	Company B	2. Moderate emphasis	2	1. High emphasis	1	2. Moderate emphasis	2	2. Moderate emphasis	2	1. High emphasis	1
9	Company C	2. Moderate emphasis	2	1. High emphasis	1	2. Moderate emphasis	2	1. High emphasis	1	1. High emphasis	1
10	Company D	2. Moderate emphasis	2	2. Moderate emphasis	2	3. Low emphasis	3	3. Low emphasis	3	2. Moderate emphasis	2
11	Company E	2. Moderate emphasis	2	2. Moderate emphasis	2	2. Moderate emphasis	2	2. Moderate emphasis	2	2. Moderate emphasis	2
12	Company F	1. High emphasis	1	2. Moderate emphasis	2	4. No emphasis	4	2. Moderate emphasis	2	2. Moderate emphasis	2
13	Company G	1. High emphasis	1	1. High emphasis	1	4. No emphasis	4	4. No emphasis	4	4. No emphasis	4
14	Company H	2. Moderate emphasis	2	2. Moderate emphasis	2	3. Low emphasis	3	3. Low emphasis	3	3. Low emphasis	3
15	Company I	1. High emphasis	1	1. High emphasis	1	4. No emphasis	4	4. No emphasis	4	2. Moderate emphasis	2
16	Company J	1. High emphasis	1	2. Moderate emphasis	2	3. Low emphasis	3	3. Low emphasis	3	3. Low emphasis	3
17	Company K	1. High emphasis	1	1. High emphasis	1	4. No emphasis	4	3. Low emphasis	3	3. Low emphasis	3
18	Company L	2. Moderate emphasis	2	1. High emphasis	1	2. Moderate emphasis	2	2. Moderate emphasis	2	2. Moderate emphasis	2
19	Company M	1. High emphasis	1	1. High emphasis	1	4. No emphasis	4	4. No emphasis	4	4. No emphasis	4
20	Company N	1. High emphasis	1	1. High emphasis	1	3. Low emphasis	3	3. Low emphasis	3	1. High emphasis	1
21	Company O	2. Moderate emphasis	2			4. No emphasis	4	4. No emphasis	4	2. Moderate emphasis	2
22	Response Totals	15		14		15		15		15	
23	Rank 1	8	53%	9	64%	0	0%	1	7%	3	20%
24	Rank 2	7	47%	5	36%	4	27%	4	27%	7	47%
25	Rank 3	0	0%	0	0%	4	27%	5	33%	3	20%
26	Rank 4	0	0%	0	0%	7	47%	5	33%	2	13%
27	Rank Mean		1.467		1.357		3.200		2.933		2.267
28	Rank Median		1.000		1.000		3.000		3.000		2.000
29	Rank Variance (Sxx)		0.267		0.247		0.743		0.924		0.924
30	Rank Std Dev		0.516		0.497		0.862		0.961		0.961
32	Correlation Coef. (r)		-0.179		-0.005		0.059		0.070		-0.149
33	t-stat for Ho: r = 0		-0.657		-0.017		0.212		0.253		-0.543
34	p-value = P(r = 0)		5.219E-01		9.868E-01		8.355E-01		8.038E-01		5.959E-01
36	t-stat for Ho: μ: ≥ 2		-4.000		-4.837		5.392		3.761		1.075
37	p-value = P(X < 2)		6.580E-04		1.622E-04		1.000E+00		9.989E-01		8.496E-01
38	Mann-Whitney P(X<2)		1.100E-03		2.899E-04		1.000E+00		9.999E-01		8.531E-01

	A	FD	FE	FF	FG	FH	FI	FJ	FK	FL	FM	FN
1			Question 31. With respect to innovation solutions, how much risk are employees expected to take?		Question 32. How often do your employees experience the following work pressures:				Question 33. In terms of creativity and innovation, how important is it to have marketing representation on innovative project teams?		Question 34. Does your organization have a single key innovator that has been essential to the organization's success?	
2	Response Rank 1	1	Substantial	1	Frequently	1	Frequently	1	Critical	1	Yes	1
3	Response Rank 2	2	Discretionary (whatever the employee feels is best)	2	Occasionally	2	Occasionally	2	Important	2	Maybe	2
4	Response Rank 3	3	Minimal	3	Never	3	Never	3	Not important	3	No	3
5	Response Rank 4	4										
6	Individual Components	Post Survey Rank	Response	Post Survey Rank	Challenge pressure	Post Survey Rank	Workload pressure	Post Survey Rank	Response	Post Survey Rank	Response	Post Survey Rank
7	Company A	2	Discretionary (whatever the employee feels is best)	2	Frequently	1	Frequently	1	Important	2	No	3
8	Company B	1	Discretionary (whatever the employee feels is best)	2	Occasionally	2	Occasionally	2	Important	2	Maybe	2
9	Company C	1	Discretionary (whatever the employee feels is best)	2	Frequently	1	Frequently	1	Important	2	Yes	1
10	Company D	2	Discretionary (whatever the employee feels is best)	2	Occasionally	2	Occasionally	2	Important	2	No	3
11	Company E	2	Discretionary (whatever the employee feels is best)	2	Occasionally	2	Frequently	1	Important	2	No	3
12	Company F	2	Discretionary (whatever the employee feels is best)	2	Occasionally	2	Frequently	1	Important	2	No	3
13	Company G	4	Discretionary (whatever the employee feels is best)	2	Occasionally	2	Occasionally	2	Not important	3	No	3
14	Company H	3	Discretionary (whatever the employee feels is best)	2	Occasionally	2	Frequently	1	Important	2	No	3
15	Company I	2	Discretionary (whatever the employee feels is best)	2	Frequently	1	Frequently	1	Important	2	No	3
16	Company J	3	Minimal	3	Occasionally	2	Occasionally	2	Not important	3	No	3
17	Company K	3	Discretionary (whatever the employee feels is best)	2	Frequently	1	Frequently	1	Important	2	Maybe	2
18	Company L	2	Discretionary (whatever the employee feels is best)	2	Frequently	1	Frequently	1	Important	2	No	3
19	Company M	4	Minimal	3	Frequently	1	Frequently	1	Important	2	Yes	1
20	Company N	1	Discretionary (whatever the employee feels is best)	2	Frequently	1	Frequently	1	Important	2	No	3
21	Company O	2	Discretionary (whatever the employee feels is best)	2	Occasionally	2	Occasionally	2	Important	2	Maybe	2
22	Response Totals		15		15		15		15		15	
23	Rank 1	20%	0	0%	7	47%	10	67%	0	0%	2	13%
24	Rank 2	47%	13	87%	8	53%	5	33%	13	87%	3	20%
25	Rank 3	20%	2	13%	0	0%	0	0%	2	13%	10	67%
26	Rank 4	13%										
27	Rank Mean	2.267		2.133		1.533		1.333		2.133		2.533
28	Rank Median	2.000		2.000		2.000		1.000		2.000		3.000
29	Rank Variance (Sxx)	0.924		0.124		0.267		0.238		0.124		0.552
30	Rank Std Dev	0.961		0.352		0.516		0.488		0.352		0.743
32	Correlation Coef. (r)	-0.149		-0.203		-0.004		0.216		0.066		0.422
33	t-stat for Ho: r = 0	-0.543		-0.749		-0.015		0.796		0.238		1.677
34	p-value = P(r = 0)	5.959E-01		4.665E-01		9.885E-01		4.394E-01		8.156E-01		1.157E-01
36	t-stat for Ho: $\mu \geq 2$	1.075		1.468		-3.500		-5.292		1.468		2.779
37	p-value = P(X < 2)	8.496E-01		8.216E-02		1.768E-03		5.696E-05		9.178E-01		9.926E-01
38	Mann-Whitney P(X<2)	8.531E-01		1.000E+00		3.160E-03		9.995E-05		1.000E+00		
39	μ:										t-stat for Ho: $\mu \leq 2$	2.779
40	2										p-value: P(X > 2)	7.386E-03
41											Mann-Whitney P(X>2)	1.300E-03

	A	FO	FP	FQ	FR	FS	FT
1		Question 35. What level position does this innovator hold?				Question 36. How much involvement does this innovator have with day-to-day operations?	Question 37. If you have knowledge of this, what is the ideology that has most contributed to this person's positive influence on your organization's success?
2	Response Rank 1						
3	Response Rank 2						
4	Response Rank 3						
5	Response Rank 4						
6	Individual Components	Executive	Managerial	Project Level	Purely Technical	Response	Open-Ended Response
7	Company A						
8	Company B	Executive	Managerial	Project Level		Substantial	
9	Company C	Executive				Substantial	Thinking outside the box. Driving innovation as part of DNA. Following the money. Taking risk. Driving collaboration to acheive big goals with strategic partners. Creating technology platforms to deliver repetitive solutions with speed, scope and scale.
10	Company D						
11	Company E						
12	Company F						
13	Company G						
14	Company H						
15	Company I						
16	Company J						
17	Company K	Executive				Substantial	
18	Company L						
19	Company M	Executive				Substantial	
20	Company N						
21	Company O		Managerial			Substantial	His determined belief that an innovative method of using different software to perform the same design would yield great benefits to the firm...
22	Response Totals						
23	Rank 1						
24	Rank 2						
25	Rank 3						
26	Rank 4						
27	Rank Mean						
28	Rank Median						
29	Rank Variance (Sxx)						
30	Rank Std Dev						
32	Correlation Coef. (r)						
33	t-stat for Ho: r = 0						
34	p-value = P(r = 0)						
36	t-stat for Ho: μ: ≥ 2						
37	p-value = P(X < 2)						
38	Mann-Whitney P(X<2)						

	A	C	D	E	F
1	Co.	Question 38. Can you identify the four most influential factors (philosophical or otherwise) affecting growth and			
2		1	2	3	4
3	A	No Response	No Response	No Response	No Response
4	B	Commitment to customers	Maintaining relationships with vendors	Location - we are able to instal in several states and counties	The amount of product that we offer; we are not solely a PV company
5	C	Innovation	Collaboration	Value co-creation	Technology platforms
6	D	Innovation	Niche Markets	Strategic Vision	Talent
7	E	ability to keep experienced personnel	keeping personnel trained	employee compensation	happiness of employees
8	F	Ability to manage growth and maintain culture	Continue to find new ways to market	Staying a "cool" place to work	Ability to keep hiring very good people
9	G	Hiring the right people	Keeping corporate culture intact as we grow	Customer satisfaction for repeat business	Building a great place to work
10	H	Focus on Identified Products and target Market segments	Company wide commitment to service goals delivered in compliance with company values	Company wide open culture and flat organizational philosophy that promotes teamwork	A relentless sales philosophy and process that seeks to close every lead or opportunity
11	I	Corporate Culture	Ruthless Persistance	Forward Thinking	Good People
12	J	Goals	Accountability	Provide opportunity to talented people	Rhythm
13	K	Team approach	Open Communication	Risk Taking	Perserverance
14	L	Team alignment	Customer interaction	Contnued training	Freedom to innovate
15	M	No Response	No Response	No Response	No Response
16	N	No Response	No Response	No Response	No Response
17	O	Quality of personnel performing engineering design	Ability to step into client's shoes when undertaking design work	Honest and fair dealings in business practices	Building a strong, autonomous atmoshphere and environment for quality people to want to work

Co.	Question 39. What are the four most significant threats to your organization's continued growth and success? 1	2	3	4
A	No Response	No Response	No Response	No Response
B	Competitors	Changes in the market	The introduction of financing/leasing	Staying relevant
C	Ability to quickly adapt to changing Enviroment	Sustainability of models	Unstable Economic Market conditions	Ability to scale and or shrink without loosing Innovation culture and DNA
D	Competition	Technological Stagnation	Lack of resources and/or talent	Poor Execution
E	ability to win contracts	ability to find experienced personnel	ability to find new customers	customer perception of company
F	Significant down turn of the economy	Open source toolkits become stale and are replaced by other technologies	Unable to maintain quality of work as company grows	Loss of good reputation somehow.
G	Not being able to attract and retain the right talent	Outgrowing smaller clients, and only relying on a smaller number of large clients	Becoming a bland shell of the original culture	Quality of work suffering becuse of scaling issues with growing too fast
H	Failure to attract new customers via sub standard sales and marketing effort	Failure to meet customers service expectations	Regulatory climate creating excessive overhead	Disruptive changes in service delivery technology (but this also could be opportunity)
I	Government Meddling, Regulation, and Economic &Social Engineering	Economic Uncertainty - Effects Accesiblity to Credit, Cash Flow, Customer Spending	H1B Visa's and Offshoring	Finding Candidates with Ownership Thinking and Work Ethic
J	Economy	Regulation	Competition	Commoditization
K	Internal Pressures (asking too much from too few resources	Poor economy reduces sales and research contract opportunities	Planning limitations	Execution limitations
L	Commoditzation in key areas	No Response	No Response	No Response
M	No Response	No Response	No Response	No Response
N	No Response	No Response	No Response	No Response
O	Access to capital	Ability to attract and retain sufficient human resources	Commoditization of engineering services	Project risk that escalates

Co.	Q 40: Can you briefly describe your organization's culture which has been defined as the core principles that guide employee decisions and behaviors?
A	No response
B	To always act in the best interest of the customer and cater as much as we can to their needs.
C	Powering sustainable solutions through collaboration, innovation and value co-creation
D	Entrepreneurial based culture focused on innovation in a niche market.
E	No response
F	[name deleted for anonymity] is an open source company that has a very flat structure. We sell the services of the employees of the company. As such it is important that we have the very best people working for [name deleted for anonymity] To do this we must first keep the work very interesting and rewarding. Second, make it a culture of low "busy work". The employees must be able to impress and over deliver.
G	7 core values: Substance over style Have I helped my team enough? Go figure it out - move beyond fear We are fanatical about our craft Don't just serve - build the relationship There is no flying under the radar I don't have all the answers and I won't pretend that I do
H	We have established a very open culture with a flat organizational structure. We promote a very pragmatic approach that encourages self enabling within a reasonable risk consideration. We use Core Values as operating guideline. Each employee has a wallet sized card with all key company contact telephones incl. cell phones. On the back of that card the company values are printed. They are: 1) Treat Customers and Partners fairly and with Appreciation 2) Share technical expertise with our customers and partners 3) Strive to exceed customer and partner expectations 4) We win through our customers and partners success We also have additional core values that focus on our employees and our investors but our number one priority is on the customer. We believe that by satisfying our clients all of the other objectives of all of our stakeholders will be met or exceeded.
I	Our Core Values say it Best..... 1. Take Care of the Customer or Someone Else Will. Customer service is not a department, it's an attitude. Customer service is vital to our business. Technical solutions are our job, but customers are our business. Most of our business comes from existing customers. There are little things we can do everyday that make a big difference—answering E-mails promptly and courteously, answering the phone and returning calls. 2. Details Matter. Details create the big picture. When things go wrong with software it's often the result of missing a small detail along the way. The road to redemption is long and uncomfortable. 3.Never Forget the Big Picture. The best way to maintain a steady effort is to never forget the big picture. It's easy to get wrapped up in a small detail and lose sight of how it may affect the rest of the project. 4. Take Ownership. Ownership is the cornerstone of a strong team. Treat each project as if it were your name on the front door – and on the signature line of everyone's paycheck. 5. Be Thorough. Genius is nothing but continued attention. We have to pay attention to a lot of stuff. Taking time to make sure every task is completed before handing it off saves time. 6. Be Consistent. Consistency reduces mistakes. A disciplined and consistent approach creates an environment of dependability and allows you to troubleshoot problems easily. 7. Constantly Re-Invent Yourself. Always be learning and seeking knowledge. Make good use of your time and never stop investing in your own skill set. The moment you stop learning is the moment you become a liability instead of an asset. 8. You are Bit-Wizards. It's not a one man team, win or lose. On this team, we're all united in a common goal. This company sinks or swims based on the effort, dedication, pride, and professionalism of the people who work here. We are a team that derives our ability to stay in business from each person's contributions. 9. Marketing the Company Is Everybody's Responsibility. Always be looking for new opportunities. This is not only good for our continued success, but it's good for the customer. When we look for opportunities, we are also looking for ways to increase the customers' success. That makes us valuable partners. 10. Company Profitability Is Everybody's Responsibility. Make smart choices about time, resources and expenses. Everything you and every team member does affect our bottom line and ultimately our ability to increase pay and bonuses. It also determines how much we grow. 11. Track Your Time Daily and Accurately. Value your time as a business resource. This is how we get paid and this is how we account for our time to the customers. An error here means that one customer is over-billed and other may be under-billed, which are both are unacceptable. 12. Use your Time Efficiently and Effectively. Efficiency is doing things right; effectiveness is doing the right things. Your goal is to have 40 billable hours every week. Sometimes that isn't possible. In those cases, your time should be spent wisely to enhance your education or on internal projects that move the company forward. 13. Work Together. If everyone is working together, then success takes care of itself. Your title may be software engineer or administrative assistant, but our success depends on everyone working together to fill in the gaps. Whether it's filling the fridge with sodas or emptying a trash can, there are no tasks that are beneath any team member. 14. Treat Other Team Members Like Family. We are in this together. Buck up, get the job done and don't worry about who gets credit because we know everyone's contribution. 15. First Impressions are Everything. It's the first impression that will open the door or close it. Whether it's an application, a website, or a portal, users decide in the first three minutes if they like an application. It if looks like crap, they'll think its crap. In the end, perception is reality.
J	Respect, Integrity and Appreciation
K	All team members are valued. All views are listened to. Requests, not demands.
L	Our Values include; Customer focus Excellence Innovation Passion Integrity Respect
M	No response
N	No response
O	Honesty and ethics; professionalism; attention to detail; commitment to budgets and deadlines

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