A Generalized Approach to Measure and Predict Innovation Maturity Progression Aligned to Business Objectives

by Melvin Kinnebrew Jr.

B.S. in Computer Science, May 1989, University of Maryland
M.A. in Information Systems, May 1992, Webster University

A Praxis submitted to

The Faculty of
The School of Engineering and Applied Science
of the George Washington University
in partial fulfillment of the requirements
for the degree of Doctor of Engineering

January 19, 2018

Praxis directed by

Muhammad Islam
Professional Lecturer of Engineering Management and Systems Engineering

Justin Eggstaff
Professional Lecturer of Engineering Management and Systems Engineering

The School of Engineering and Applied Science of The George Washington University certifies that Melvin Kinnebrew Jr. has passed the Final Examination for the degree of Doctor of Engineering as of August 25, 2017 Praxis defense. This is the final and approved form of the Praxis.

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Melvin Kinnebrew Jr.

Praxis Research Committee:

Muhamad Islam, Professional Lecturer of Engineering Management and Systems Engineering, Praxis Co-Director

Justin Eggstaff, Professional Lecturer of Engineering Management and Systems Engineering, Praxis Co-Director

Shahram Sarkani, Professor of Engineering Management and Systems Engineering, Committee Member

Thomas A. Mazzuchi, Professor of Engineering Management and Systems Engineering & of Decision Sciences, Committee Member

Michael Conlin, Vice President, Chief Technology Officer, US Public Sector DXC.technology, Committee Member

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Dedication

This work is dedicated to my entire family, who's support, understanding, and patience is truly appreciated. They are the source of my inspiration and my energy. Without their loving devotion, none of this would have been possible.

Abstract of Praxis

A Generalized Approach to Measure and Predict Innovation Maturity Progression Aligned to Business Objectives

The ability to manage transformative change is paramount to success of an organization trying to accommodate the unique characteristics of continuous market disruptions. The rate of change the business environment must accommodate requires an approach that provides decision-makers with the ability to identify, forecast, and pick potential innovation alternatives that produce the greatest measured impact. The use of existing innovation maturity models provides limited insight and industry practitioners lack a generalized means to validate the contextual correlation between innovation maturity progression and business outcomes. Knowing the overall maturity level of the process or capability alone will not provide the granularity needed to identify, assess, or suggest which innovations produce the greatest impact. The purpose of this quantitative study is to evaluate the critical attributes that drive innovation maturity progression.

This research establishes an extended Innovation Maturity Model (IMMe) as a generalized framework to measure and predict an organization's transformation by aligning and measuring innovation processes, capabilities, and activities in context to business outcomes. Additionally, statistically significant regressions explained which IMMe attributes and components were accountable for maturity progression. The ability to isolate the potential changes that have the greatest overall impact on the

business enables decision makers with a tool to identify, account for, and adapt to evolving criterion.

The IMMe consist of five components: innovation process, innovation portfolio, business and functional criterion, and a semantic model. The components of the IMMe provide a generalized mechanism to predict and measure innovation progression aligned specifically to business objectives and outcomes. Three industry environments were tested with the IMMe, and insights from these case studies show the model to be viable and useful in support of innovation management processes. The additional components of the IMMe provide the needed bridge to establish a definitive relationship and correlation between innovation maturity progression and business outcomes. The IMMe will help leaders and decision makers identify relationships between planned, predicted, and evolving criterion to hit an elusive moving target – continuous transformation.

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Chapter 1 Introduction

This chapter presents the background and overview outlining the general and specifics of the problem addressed. The research hypotheses are introduced, as well as the practical frameworks leveraged from literature and industry providing the basis for which the hypotheses were established. Relevant definitions are outlined including limitations that establish the study's boundaries used to facilitate understanding and the potential for generalizing the results for practical application.

1.1 Business Overview

As business conditions and market trends shift, an organizations ability to adapt and anticipate changes is essential to survival. In such a relentlessly competitive environment, companies must be capable of measuring their position in the market and their progress along a predefined strategy (Ryan 2010). Innovation management is a continuous and complicated process that pertains to a majority of an organization's activities and resources (Michnik, 2013). The ability to integrate and leverage technical innovations is seen as one of the most significant drivers of strategic change within any industry (Downs et al., 2003).

Getting ready for a digital future is a difficult task. It requires organizational focus and the development of digital capabilities that are in sync with ongoing activities, people, culture, and structure all aligned toward a set of prioritized goals (Kane et al., 2016). Business value cannot be created unless the strategy, innovations, and structured business processes are aligned (Rosemann & de Bruin). This represents a

clear indication that a unifying process or model is needed to ensure the identification and implementation of innovations.

Maturity models can be used as a suitable mechanism to provide a flexible and contextual framework offering important guidance on the improvement to a variety of potential practices and processes that influence organizations ability to deliver value (Mullaly, 2006). As businesses across multiple industries transform to incorporate a digital orientation resulting in fundamental changes in operations and the way value is delivered to partners and customers. To be a digitally oriented organization requires an ability to identify, suggest, and track the impact of changes from processes, technologies, culture, and external disruptions. A digitally oriented organization must be willing to continually challenge the status quo, experiment often, and get comfortable with failure to meet the challenges of a constantly changing competitive landscape (Kane et al., 2016).

1.2 Introduction to the Problem

Knowing the overall maturity level of the process or capability alone will not provide the granularity needed to identify, assess, or suggest which innovations produce the greatest impact. Maturity models need to take into consideration an appreciation of context, and an understanding of the conditional variables that influence management practices and organizational execution. As suggested by Miles and Snow (1984) maturity models must acknowledge that fit is dynamic and constantly in motion, and does not represent static or Boolean capability.

(M. Mullaly, 2010) suggest that one of the greatest challenges to the evolution of maturity models from their current form, as they must recognize that changes in context must be reflected by changes in implementation to continue to ensure the realization of value. The general question for industry practitioners, is the are improvements in maturity progression coincide with actual organizational value. A study conducted by Ibbs and Kwak (2000), was not able to substantiate statistically relevant results indicating a correlation between maturity with organizational performance. M. Mullaly, 2010 asserts that specifying meaningful guidance to improve various organizational practices can generate differing levels of value. To realize this value requires a flexible and contextual framework that recognize multiple types of practices, processes, and a broad array of contextual factors that influence the overall organizations processes, technologies, and services delivered (Essmann & du Preez, 2009).

Current maturity models provide a status of what the process or capability was measured at; a snap shot in time that does not associate maturity progression with business outcomes. The need to incorporate a broader contextual understanding has been broadly called for in the literature (Engwall, 2003; Morris et al., 2006). Practitioners need a proactive means to identify, assess, and suggest differentiating innovations and the processes to leverage is a difficult challenge considering the multitude of variables that need to be considered. The focus of this study is to determine if a general Innovation Maturity Model can be extended to incorporate a

means to predict and measure innovation maturity progression aligned to business objectives.

1.3 Statement to the Problem

Industry practitioners need a generalized means to validate the contextual correlation between innovation maturity progression and business outcomes. Can a general approach be established to extend an innovation maturity model that provides the means to predict maturity progression to include potential innovation alternatives aligned to organizational objectives and desired outcomes?

Trying to determine which innovations and process changes to make is a very difficult. Trying to determine which innovations will have the greatest impact is compounded by the competing selection criteria, success thresholds, stakeholder perspectives, and context that defines success. Identifying what to assess, and how, becomes increasingly more complex as the work becomes more intangible and knowledge-based (Tuttle and Romanowski, 1985).

1.4 Purpose of Study

The purpose of the study is structured to test and quantitatively validate relationships or links that explain innovation maturity progression. The problem addressed within this study is associated with the need to determine which components of a maturity model drive innovation maturity progression. The research will isolate potential changes that will have the greatest overall impact on the business. The ability to determine which innovation maturity process or functional capability produces the greatest impact on desired organizational outcomes allows decision makers to focus on

changes that matter. The ability to generalize causation to financial impacts between maturity progression and business outcomes is outside the scope of this study.

1.5 Research Questions

The problem addressed within this study is associated with the need to determine which components of a maturity model drive innovation maturity progression. The following is a summary of the research questions to be addressed.

- What are the specific IMMe variables that influence maturity progression?
- What are the IMMe generalized business objectives and functional capabilities needed to define the criterion to evaluate and align business objectives to progression?
- Can a generalized model be developed to measure and predict innovation maturity progression?
- Are there different predictive models for each level of maturity?
- Can a set of regression models be established to verify maturity progression?
- Can the IMMe be used to link the rate of maturity progression to the overall business objectives

1.6 Chapter Summary

The difficulties to measure maturity progression arise based on the lack of contextual alignment between input and output variables used to measure maturity progression. The collection and synthesis of expert judgment are used to frame this study quantitatively. The literature review in Chapter 2 addresses the orientation of innovation strategies, an overview of general maturity models, and the use of multi-criteria approaches to establishing evaluative thresholds and boundaries. Organizational approaches for inspiring innovation have advanced over time and were assessed.

Chapter 2 Literature Review

The review of the literature consisted of over 160 primary and secondary sources. The majority of references were secondary sources from recent peer reviewed articles from scholarly journals, scholarly books, and dissertations. Primary sources came from business databases; specifically, dealing with maturity model development and measurement, innovation decisions, decision criteria, and semantic technologies. Topical areas of research included publications dealing with business transformation and how to address the rapid pace of change. Sources included books dealing with challenges, practices, and trends regarding innovation in the global economy and books addressing different dissertation methodologies.

2.1 Innovations

As business conditions and market trends shift, several innovative businesses and government organizations have produced exceptional results based on their integration and use of evolving innovations. In such a relentlessly competitive environment, companies must be capable of measuring their position in the market and their progress along a predefined strategy (T. Ryan 2010). The primary driving force for growth has been technology. Innovation means to manufacture something new or to operate in a new way. Innovation is crucial for creating and sustaining organizational competitive advantage (Dismukes, 2005).

Innovation management is a continuous and complicated process that pertains to a majority of a firm's activities and engages the significant part of firm's resources (Michnik, 2013). Innovation is the source of this evolution and revolution (Essmann &

du Preez, 2009). Thus, innovation is not only a current issue; it is a continuous one. According to Moore, “To innovate forever, in other words, is not an aspiration; it is a design specification. It is not a strategy; it is a requirement.” (Moore, 2005). Additionally, Moore equates enterprises and markets to nature, requiring constant evolution to maintain equilibrium, and sporadic revolution to create an advantage. This has been accomplished with the use of a business process also requires the incorporation of an organizational focus, as it cannot create business value without aligning itself with the business strategy of the organization (Rosemann & de Bruin, 2005). This represents a clear indication that a unifying process or model is needed to ensure the identification and implementation of innovations.

Identifying what to assess, and how, becomes increasingly more complex as the work becomes more intangible and knowledge-based (Tuttle & Romanowski, 1985). According to (Scott 2007) the overall acceptance of maturity models is expected to increase a prediction corroborated by the numerous proprietary models proposed by software companies and consultancies. Current literature also reports an increasing academic interest in maturity models (Becker et al. 2011). According to Essmann and Du Preez, organizational maturity and innovativeness were traditionally considered diametrically opposed, the assimilation of these two seemingly contradictory notions is fundamental to the assurance of long-term organizational prosperity. The use of maturity models is a tool to support the continued innovation development.

2.2 Maturity Models

According to Iversen et al., maturity models are commonly applied to assess the as-is situation, to derive and prioritize improvement measures, and to control progress (Iversen et al. 1999). Although the application of maturity models is increasing in quantity and breadth, the concept of maturity models is frequently subject to criticism (J. Pöppelbuß and Röglinger, 2011). Maturity models are increasingly popular frameworks for supporting assessment and guiding organizational improvement. The majority of maturity models have their roots in the quality management movement (Deming, 1982). Maturity models fundamentally characterize theories about how organizational capabilities evolve in a stage-by-stage fashion along a projected, desired, or logical maturation path (Gottschalk 2009). The initial concepts for maturity models were originally conceived by (Crosby, 1979). Crosby, who recommended a five-level framework by which to evaluate the quality of organizational processes.

Paulk et al. leveraged Crosby's work as a base to produce the Capability Maturity Model (CMM) for software engineering and development. The CMM became a widely adopted and used maturity model (Paulk et al., 1993). The CMM provided a means to assess across a variety of capability areas (Humphreys, 1992; Paulk et al., 1993) and influenced perspectives that maturity could be reflected by a number of levels of performance. This has become a deep-seated principle that better process would lead to better results. Maturity models are not without criticism. The constraining issues with maturity models are that the step by step process oversimplify reality and lack empirical foundation (de Bruin et al. 2005, McCormack et al. 2009). According to

Mettler and Rohner (2009), configurable maturity models should be structured to account for internal and external characteristics. The lack of configurable aspect may constrain a maturity model's applicability in its standardized version.

The majority of the early literature about maturity models advocated an assumption that increases in maturity lead to more consistent and successful outcomes. One of the first studies to assert a link between maturity and performance was conducted by (Kwak and Ibbs, 2000) but evidence of statistically significant correlation was not provided. Maturity models are credited with increasing the awareness and visibility of project management, but there is no sound research supporting their use as an improvement tool, or indicating that in their current form they are a means of realizing strategic advantage (Jugdev and Thomas, 2002).

Most maturity models define an organization's typical behavior for several key processes or activities at various levels of 'maturity' (Fraser et al., 2003). Many aspects of product development incorporate approaches to determine process or capability maturity, as part of an improvement framework (Dooley, Subra & Anderson, 2001). Maturity models provide an immediate snapshot of a state defining and prioritizing improvement measures.

The idea of maturity as a framework for guiding improvement has since been adopted by many other disciplines and subject areas, including strategic management, innovation, business process management, and leadership. The notion of a maturity framework offers the ability to evaluate and understand current, strategic, and desired

capabilities and how to determine the improvement activities that will enable the realization of those capabilities (Duncan et al., 1998).

J. Poeppelbuss et al. have asserted that researchers and practitioners in various fields were confirming underlying challenges based on the lack of empirical works to validate maturity models usefulness (J. Poeppelbuss et. al, 2011). An additional concern pertaining to the usefulness of maturity models are based on their limited extent specifically oriented towards a prescriptive set of properties that constrain application of maturity models and the lack of a clear distinction between the maturity model and the assessment model that is applied to evaluate the level of maturity. (M. Roeglinger, J. Poeppelbuss, J. Becker, 2012)

A driving need to master the process of innovation requires identifying the factors that support or hamper the achievement of innovations (L. Bassiti, 2016). A critical aspect towards success requires the ability to create a measurement model providing a useful basis to monitor and gauge innovation performance, detect faults and identify repairs, to improve the organization's capacity to realize the value of innovation consistently. Du Preez, and L. Louw stated that the common factor between successful innovators are, "a rigorous process for managing innovation, including a disciplined, stage-by-stage approval process combined with regular measurement of every critical factor, ranging from time and money spent to the success of new products in the market" (Du Preez, and L. Louw, 2008). The quality of the best opportunities is directly dependent on the success of idea generation because organizational resources are

limited and cannot be squandered on the development of unpromising ideas. (Girotra, Terwiesch, and Ulrich, 2010). Morris asserts that measuring innovation performance presents problems for the process itself, because innovation involves a venture into the unknown, and trying to pin these unknowns down too fast may make them harder to recognize and realize. (L. Morris, 2011). As noted by R. Adams, J., Bessant, and R. Phelps, empirical studies have shown that many organizations typically focus simply on the measurement of innovation inputs and outputs in terms of cost, speed to market and numbers of new products, and ignore the processes in-between (R. Adams, J., Bessant, and R. Phelps, 2006).

2.3 Multi-Criteria for Decisions

According to Wolfe, innovation is a complex and multidimensional phenomenon that requires a synthesized framework that represents an approach to incorporate the diversity in the various axis and attributes measured. (R.A. Wolfe, 1994). In summary, the multidimensional combination of all aspects that can provide a meaningful understanding of the cause-effect relationships underlying innovation activities is the result of more than just the inputs (resources invested); other measures of the processing should also be integrated.

In other words, only the combination of all aspects that can provides a meaningful understanding of the cause-effect relationships underlying innovation activities, since the real value of the outputs is the result of more than just the inputs (resources invested); other measures of the processing should be also integrated. This multidimensional approach to measurement has been found in other areas of

management to be an improvement on simple one-dimensional measures to include the capture of both short- and long-term aspects of value creation for an organization (R. Adams, J., Bessant, and R. Phelps, 2006).

In today's hectic business environment, the ability to properly select a set of innovation projects is a critical management function of the organization. To make the right decision, managers have to consider many conflicting objectives in a highly uncertain environment (J. Michnik 2013). The importance of innovation management is widely recognized among academics and practitioners, as the selection and use of innovations play a crucial role in building a sustainable competitive advantage stimulating sustained growth and profitability (M. Dodgson, D. Gann, and A. Salter, 2008).

Stewart provides an approach that combined scenario planning (SP) and Multi-criteria Decision Analysis (MCDA) as a decision aid to support innovation management. This effort demonstrated why SP supported innovation management in the following ways; (a) commonly used in strategic management, (b) offers a wide overview of uncertain and uncontrollable external factors which may impact on consequences of the strategic, (c) qualitative profile and is less demanding in strict assumptions (completeness) and parameter assessment (probabilities) (Stewart, 2005).

The decisions in the field of innovation management are considered as highly risky. This situation, therefore, requires the tools that can facilitate the decision making in an uncertain environment. J. Michnik proposed to classify innovation management

decision criteria into five categories: strategic, organizational, technological, financial and market. The approach to deal with these categories were accomplished in the following stages (J. Michnik 2013).

(1) The suitable set of criteria is developed on the base of main objectives and important strategic issues. Establish the weights that represent decision makers (DM) opinion on the relative importance of criteria.
(2) The limited number of scenarios (2-5) is evolved.
(3) Taking into account the rigid constraints, the preliminary set of potential alternatives is selected.
(4) In each scenario, the values of all criteria are assigned to alternatives. The values are taken from a predefined scale and can be assigned directly by DM or by experts.
(5) Evaluation of alternatives across scenarios (1st step of the SP+MCDA model)
(6) MCDA evaluation (2nd step of the SP+MCDA model).
(7) The completed analysis of the resulting ranking and recommended decision established.

According to A. Dadda, I. Ouhbi, multiple-criteria decision-making (MCDM) is a procedure that combines the performance of decision alternatives across several, contradicting, qualitative and quantitative criteria and results in a compromise solution (Dadda and Ouhbi, 2014). Relevant MCDM methods are often applicable, implicitly or explicitly, in various real-life problems and can be found in industrial activities where

sets of decision alternatives are evaluated against conflicting criteria (Triantaphyllou and Mann,1995).

MCDM methods are widely used across various industries. As described by A. Kolios et al., there are several MCDM methods used to cover the weighted sum and weighted product methods (WSM/WPM), the analytical hierarchy process (AHP), and the preference ranking organization method for enrichment evaluation (PROMETHEE), among others (Kolios et al., 2016). Additionally, as noted by Kabak and Dagdeviren, MCDM is very useful for policy making, new technologies and energy sources' evaluation, being capable of incorporating both technical and non-technical attributes, i.e., economic, influencing factors in the decision-making process (Kabak and Dagdeviren, 2014),.

The development of MCDM methods has been widely reported in the literature throughout the years, for example by (Peng et al., 2015), where different methods and their extensions, among others, were employed to solve a problem. MCDM methods have also been applied to various engineering problems due to their clarity and robustness after years of study (Lozano-Minguez, Kolios, Brennan, 2011).

Successful selection of the most appropriate multi-criteria methodology should consider a range of different perspectives to include all sides of the problem and, when necessary, consider inter-connections among the criteria. The interconnection between criteria is essential to developing useful and relevant maturity models. MCDM methods are used to structure the decision procedures, to demonstrate the trade-off among the

criteria. This helps decision-makers to consider, articulate and apply reliable judgments related to acceptable tradeoffs, when considering alternatives, to evaluate uncertainty and reasonably, to simplify negotiation and to keep a record of how decisions were made (Kahraman, Kaya, 2010).

2.4 Chapter Summary

Maturity models are an instrument to identify and measure business capabilities of an organization as introduced by Humphrey (1989). Maturity models represent a widely accepted practice as a means to evaluate the innovation proficiency of an organization that may range from an un-established process to a mature and adaptive process (Lawson and Samson, 2001). The proliferation of various maturity model frameworks has evolved since Humphrey introduced the model in 1989. The majority of the authors of published innovation maturity models based their models on literature reviews of the innovation process (Essmann and du Preez, 2010; Kim Man, 2005; Lawson and Samson, 2001) and lack validated evidence from the direct application be practitioners.

No known empirical studies were found that has constructed an IMMe based on the insights and response to identify which innovation maturity model components and variables drive maturity progress aligned to business objectives and outcomes. Development of an IMMe using direct input from industry practitioners attempts to addressed this gap in the literature.

Chapter 3 Methodology

The problem addressed within this study is associated with the need to determine which components of a maturity model drive innovation maturity progression. The general issue with innovation maturity models is that knowing the overall maturity level of the process or capability alone will not provide the granularity needed to identify, assess, or suggest which innovations produce the greatest impact. The maturity model approach arrives at measures of maturity based on well-defined plateaus of capability in multiple subject areas (Dayan and Evans, 2006). According to several literature sources, there is a need to incorporate a broader contextual understanding of the maturity models and outcomes (Engwall, 2003; Morris et al., 2006).

This chapter begins with an overview of the research approach which discloses the underlying methodology. The following sections provide a description of the study participants, survey instrument, secondary data, and method used to weight collected data used in this study. These initial sections provide the necessary basis needed to establish a generalized baseline and operational description of the research variables and the subsequent data analysis. The chapter will conclude with a review of the critical explanatory variables and the constraints considered to establish validity and reliability.

3.1 Research Approach

The research was structured to test and quantitatively validate relationships or links that explain innovation maturity progression. The study was deductive in nature because it aimed to determine which components and attributes explained maturity progression. The research approach was based on collecting and generalizing responses

from subject matter experts (SMEs). The goal of applying structured expert judgment techniques is to enhance rational consensus. (Cooke and Goossens, 2004). Expert judgment has always played a significant role in science and engineering. Increasingly, expert judgment is recognized as just another type of scientific data, and methods are developed for treating it as such.

The data collected from experts will be used to establish a discrete set of prioritized criteria and alternatives. The use of multi-criteria classification and sorting methods were used to create a generalized innovation maturity baseline. When considering a discrete set of alternatives response choice and ranking are based on relative judgments, and consequently, the evaluation result depends on the considered set of alternatives.

3.2 Research Hypothesis

The study was not limited to innovation maturity models. To ensure IMMe generalization, various maturity models from the business process, project management, or knowledge management domains were included to understand maturity progression. The hypotheses that were defined for this research are depicted

in table 3-1.

Table 3-1 IMMe Research Hypothesis

Research Item	Hypothesis	Analytical Method
H_1	There are specific attributes that drive maturity progression.	Multi-variate regression Principal Component Regression
H_2	Each maturity level has a different progression model.	Multi-variate regression Principal Component Regression
H_3	A generalizable model can be used to predict innovation progression.	Multi-variate regression Principal Component Regression
H_4	The components of the IMMe can be used to link the rate of maturity progression to the overall business objectives	Correlations
Q_1	What are the generalized and prioritized: • Business Objectives • Functional Categories and Attributes	Multi-criteria ranking

The first and second hypothesis was built upon the findings of previous studies such as; (Müller-Prothmann and Stein, 2011) and (Brookes, Butler, Dey, and Clark, 2014). These efforts established maturity models that can be used to evaluate organizational innovation capabilities and their innovation process that deal with changes in markets and the company's business environment as the basis for assessment. They are related and incorporate empirical studies on the application or evaluation of maturity models. The third and fourth hypothesis is focused on the determination of the existence of evidence of a maturity model's practical utility. The works of (Rosa, Silva 2015) established a meta model framework that helps to manage the complexity of business transformation maturity while isolating critical attributes. Previous works (Rohloff 2010) indicated that limited empirical evidence exists of the value of maturity models

producing measured outcomes. The research question about the generalized business objectives and functional categories are used to determine weighted criteria used to evaluate case study innovation portfolios. This specific effort provides the bridge needed to establish a defined connection to maturity progression and business outcomes.

3.3 Participants

The studies participant pool consists of experts in Innovation Management and Information Technologies. The studies participants work in various organizations across the United States spanning commercial and federal business domains. The experts that participated all have a minimum of 12 years of experience in one or more of the following roles; organizational executive, functional director, or subject matter expert in Information Technology.

The desired sample size for the study was 120 participants, and 90 agreed to participate. The following table provide the specifics of actual study participants.

Table 3-2 Participant Pool

Participant Category	Sent	Received
Executives	25	17
Industry Experts	65	55

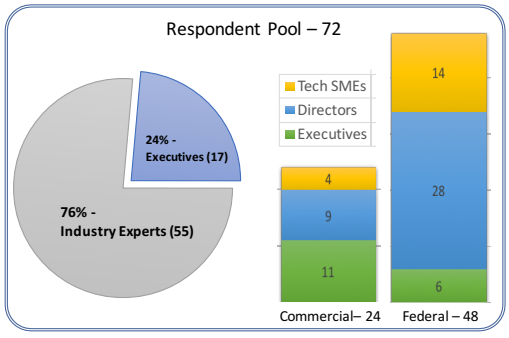


Figure 3-1 Participant Details

All study participants were directly involved and familiar with their organization's innovation strategies, innovation selection, and decision processes that directly impact their respective organization's ability to produce measurable results. An automated survey tool (Qualtrics) was used deliver and collect SME responses and opinions via online interaction. The research survey was used to establish a generalized maturity baseline and functional innovation criteria. Selected participants from commercial and federal industries signed an informed consent agreement to participate. Acknowledgment of this form validated the voluntary nature of the study. The identity of the participant and survey responses were kept confidential and safeguarded.

Access to an IMMe secured survey portal was only granted to participants who signed the informed consent agreement. All participants were notified by e-mail with instructions and deadlines pertaining survey availability. A three-week period was established to collect SME survey responses. Study participants were assigned an identifying alphanumeric code to prevent association between an individual's identity and the responses received. No identifying information was associated with the completed survey.

3.4 Procedures

The first step was to evaluate existing maturity progression models. Works from (Essmann, du Preez 2010) and (Rosa, Silva 2015) discussed a set of procedures for the design of maturity models that were appropriately leveraged. The second step was to formulate a survey to elicit the perspectives of SME participants regarding innovation processes, capabilities, and desired expectations without leading them toward a specific

response or ranking associated with specific maturity levels. The final survey for this quantitative study sought to determine the maturity levels of specific innovation processes and capabilities identified as best practices required to facilitate innovation identification and integration to support business objectives. An excerpt of the IMMe survey is provided in the Appendix.

The IMMe survey organized into five categories. Each category was structured to measure an aspect of innovation maturity. All participants received the same set of questions, and the questions were formulated to eliminate bias. Consistency in the questionnaire provided credibility and dependability of the data collected and analyzed. Survey questions were evaluated on a 5-point scale to produce an overall response score. Study participants were provided an opportunity to identify and rank maturity processes, business objectives, and functional capabilities. The projected results of the IMMe survey will be used to establish a generalized maturity baseline and convergence of opinion. Participants were provided an opportunity to identify any critical items overlooked in the initial survey and to review the final model that identified and ranked the innovation maturity processes and generalized business objectives. The following were the five categories evaluated:

1. Innovation Strategy – the process used to establish the organizational intention and exceptions (desired outcomes) via innovation
2. Innovation Lifecycle – the process used to plan, execute, or change the innovation portfolio
3. Innovation Alternatives – the process used to establish and comply with decision criteria

4. Functional Innovation Categories and Attributes – capability criteria that define the innovative function, capability, or service needed to support specific organizational objectives
5. Respondent Profile – market domain, organizational role, and experience

In addition to the SME survey, three sets of innovation portfolios (case studies) were also used to rate, align, and evaluate innovation maturity progression leveraging the generalized innovation categories and attributes derived from the SME questionnaire. The following diagram list the set of steps to execute the IMMe study.

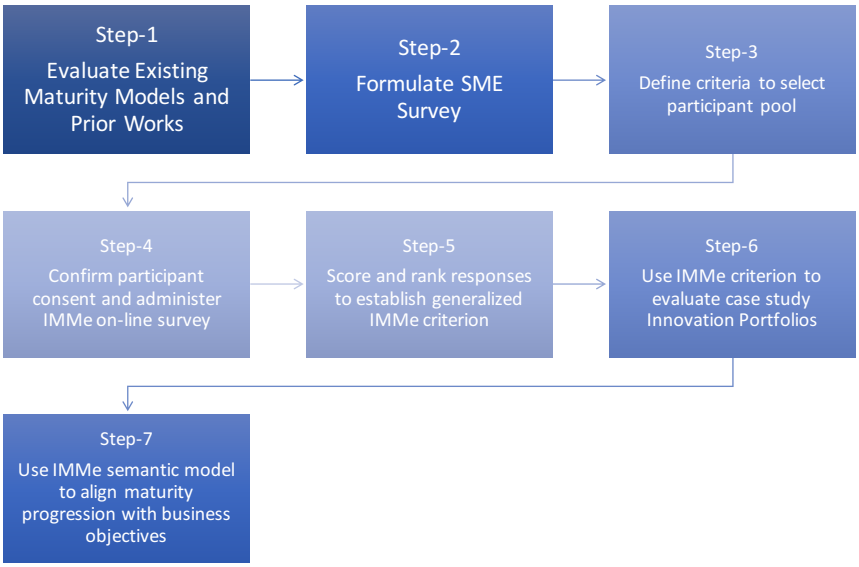


Figure 3-2 Research steps in the development of the extended innovation maturity model (IMMe).

The third step to define participant selection criteria was described above in the participant section. Step four validated informed consent and access to the IMMe secure portal was granted based on the acknowledgment of voluntary consent. Steps five and six were focused on organizing collected data, scoring responses, and semantic mapping of generalized data derived from the IMMe survey. These steps were specifically structured to emphasize objective measurements to support numerical

analysis of data collected. The ability to empirically determine causation directly tied to the business outcome was beyond the present scope of the IMMe study.

3.5 Validity and Reliability

Content validity was used to assess internal validity. Internal validity assesses if the instrument produces results that are purposeful (Cooper and Schindler, 2008). The IMMe survey categories and items are decidedly common and consistent with other maturity model assessment categories found in the literature. According to (Creswell, 2008a) potential risks to external validity affect the ability to "draw correct inferences from the sample data to other persons, settings, and the past and future situations."

This studies reliability was analyzed using Cronbach's alpha. Reliability is the consistency of results (Creswell, 2008b). Coefficients in the .65-.85 range are considered respectable (Creswell, 2008b). The computed Cronbach's alpha for this study was .92 standardized and .78 raw. The design of this study is readily repeatable.

3.6 Data Analysis

The following describes three specific tests conducted as part of this research. The first test verified normality. The Kolmogorov-Smirnov (KS) test was used to assess normality of the distributions in the collected IMMe survey data. This test provides a reliable assessment of normality when small samples are involved (Cooper and Schindler, 2008). The alpha used to test normality was set at .05. The second and third tests were based on multivariate regressions and component analysis. These tests provide a means to assess the relationship between the dependent variable (maturity progression levels) and various independent variables that explain variance. The IMMe

variable selection process was based on a backward variable elimination process. Backward variable elimination enters all of the variables in the block in a single step and then removes them one at a time based on removal criteria. If the produced regression model did not meet goodness-of-fit statistics, it was degraded.

The software used for the analyses was Statistical Analysis System (SAS) version 7.11 add-in for MS Excel. The results of these analyses will be reported in chapter 4. Based on the results, the interpretation of results will be covered in chapter 5.

3.7 Strengths and Limitations

The use of expert judgment and opinion has both strengths and limitations. The application of this approach appeals to the professional temperament of the respondents. This type of survey technique allows study participants to respond without compromising anonymity and confidentiality. The use of Bayesian belief nets for managing expert judgment, and modeling reliability was incorporated to overcome some of the limitations of standard reliability (Sigurdsson, Walls, Quigley 2001). A limitation of this research design is the inability to generalize causation to financial impacts between maturity progression and business outcomes. The collection of financial information was outside the scope of this study. Additionally, based on the size and categorization of the participant pool, this research may not support generalization of results specifically to commercial or federal industry segments.

Chapter 4 Analysis

This study identifies which innovation maturity components and variables are responsible for maturity progression. The ability to determine which innovation maturity process or functional capability produces the greatest impact on desired organizational outcomes allows decision makers to focus on changes that matter.

The ability to improve process or capability maturity alone will not ensure valued business outcomes. Many individuals over the past 10-15 years have published and developed general innovation maturity models (Lawson & Samson, 2001; Essmann & du Preez, 2010; Müller-Prothmann & Stein, 2011; Brookes, Butler, Dey, & Clark 2014). This study also includes three applied case studies to verify the usefulness of the proposed IMMe.

The applied aspect of the study seeks to establish a set of additional maturity model components that provide the ability to align maturity progression with business objectives and priorities. The ability to assess and establish a maturity level merely provides a status at a particular point in time. Based on the current state of literature there lacks very little empirical evidence which correlates maturity progression directly to desired organizational outcomes. The additional maturity components provide an approach to bridge a gap identified in the literature and recognized by the industry. The IMMe is structured to measure maturity progression in context to business outcomes. The IMMe addresses a gap, it provides an approach to align innovation progression with

organizational objectives and priorities. More importantly, a set of innovation alternatives can be delineated to support ongoing management decisions.

4.1 Data Collection Summary

This section provides a review of the data collected and description of the relevant statistical analysis performed in conjunction with that data. The data collection summary entails a review of the survey responses representing the independent variables in this study. The detailed statistical analysis performed validated the normality of the independent data, followed by a detailed examination of the hypotheses associated with the four research questions.

The intent of the study is to identify a set of additional components that can support decision-makers in identifying and selecting key activities and projects that not only increase maturity progression but align with business objectives and priorities. The study is divided into four parts. The decomposition of the innovation maturity processes was structured to reveal the granularity needed to determine maturity boundaries and progression thresholds. The following are the four parts of the study: (P1) the collection of SME judgment to establish a maturity baseline of innovation processes, investment levels, and timing; (P2) the collection of SME opinion to identify and rank generalized business objectives and functional capabilities; (P3) use generalized data from P2 as criterion to align and evaluate each case study's innovation portfolio. This step will determine the maturity progression impact of specific innovations, and innovation categories; (P4) use the IMMe semantic model to assess contextual alignment between innovation progression levels, business objectives, and

projected impact. This step provides a set of suggested innovation alternatives that have the greatest overall impact.

Each part of the study is structured to isolate the variables that significantly affect maturity progression. There were 120 SME's invited to participate, and 72 responses were received. There was a total of 8 responses removed from the analytical set (3 – incomplete responses and 5 – responses were considered as outliers). This study leverages three categories of data (survey responses, applied case study, and derived data from the IMMe semantic model. The following diagram Figure 4-1 depicts the organizational flow of data for each part of the study used to support analysis. The ability to empirically establish a measured correlation between maturity progression and business outcomes was outside of the study's scope (limited time and lack of financial data).

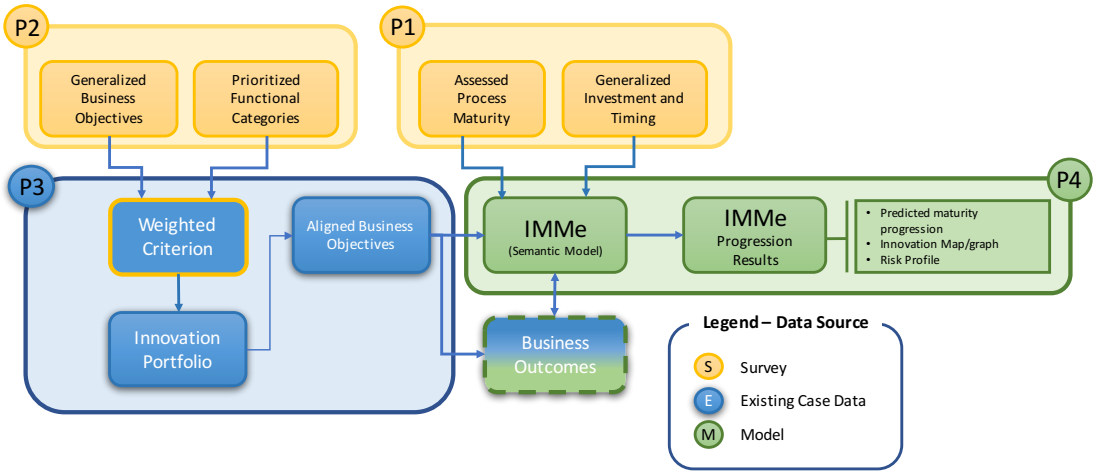


Figure 4-1 IMMe Data Overview and Flow – this structure provides a means to segregate information for generalization and reuse. This framework provides a means to account for organizational differences while decoupling dependencies. Each component can be independ

The survey was structured to collect five sets of data. A total of 57 questions were organized into five survey sections. The five IMMe survey sections are depicted and Figure 4-2. The process assessment questions collected data to establish an initial innovation maturity self-assessment and measure innovation process characteristics of strategy, lifecycle, decision criteria, and investment levels. Each question was scored on a five-point scale. The second survey category collected data about the type and number of innovations that make up the respondent's innovation portfolio. There were three innovation categories defined. The third category established the study participants innovation investment profile, and the time it takes to realize the value of innovation. The last two categories provided SME's with an opportunity to identify and rank business objectives and capabilities. The data from this section was used to establish the criterion to evaluate innovation alternatives with contextual alignment to business objectives and prioritized capabilities.

Figure 4-2 IMMe survey sections that were used to collect SME input to assess maturity

4.2 P1 – Innovation Maturity Baseline

The P1 phase of the study covered the first three sections of the IMMe survey. The survey responses established a generalized innovation maturity baseline. This part of the study focused on the respondent's perspective about their organization's overall innovation processes, investment level, and time it takes to realize value. The survey questions were structured to assess and characterize each respondent's overall innovation maturity composed of strategy, lifecycle, decision criteria, timing, and quantity of innovations in specified categories. Table 4-1 provides a general overview of the survey categories addressed by SME's.

Table 4-1 Part-1 IMMe Survey Details – Each question was scored on a 5-point scale. The collected data used to generalize maturity progression boundaries and thresholds. More importantly, the data was used to identify which variables account for progression movement.

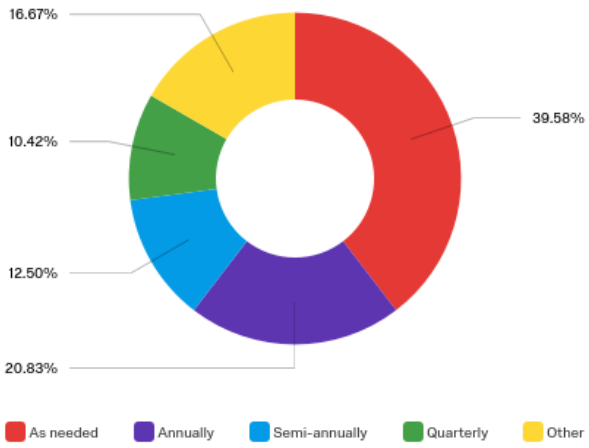
Survey Topic	Variable Name	Variable Type	Source
Maturity Level	SelfAssess_ML	Fixed	Question 30
	Overall_ML	Fixed	Average of maturity level (strategy, life-cycle, decision, and timing)
	Strategy_ML	Scored	Question (49, 52,53,54)
	LifeCycle_ML	Scored	Question (31, 32, 41, 45,47, 48, 50)
	Decision_ML	Scored	Question (32, 46, 48, 49, 57)
	Timing_ML	Scored	Question (42, 43, 44)
Investment	Invest_percent	Fixed	Question 56
Innovation Type	Innov_Total	Fixed	Question 33 & 56
	Innov_Core	Fixed	Question 33
	Innov_Enabler	Fixed	Question 33
	Innov_Acellerant	Fixed	Question 33
Time_2_Value	TV_Current	Fixed	Question 42
	TV_Desired	Fixed	Question 43

This part of the study collected data about 12 specific variables that shape innovation maturity. The generic decomposition of the innovation maturity process into the four components provides a means to establish the granularity needed to understand maturity progression boundaries and thresholds. A summary of the actual IMMe survey is provided in the appendix. The following sections will provide a description and summary of gross results of each survey section.

4.2.1 Survey Topic – Strategy

The innovation strategy questions were used to determine the organizations' value of innovation positioning and planning in support of prioritized objectives. The following are summarized net results about the strategy questions. Each strategy question was scored on a 5-point scale and averaged to determine the maturity level for the strategy variable. The strategy defines the organization overall innovation direction and key objectives and milestones.

Field	Min	Max	Mean	Std Deviation	Variance
How often is the Innovation Strategy updated? - Selected Choice	1.00	5.00	2.44	1.50	2.25



Other
No cadence
Only when change PM,s
Haven't seen one at work
Monthly
Continously as required
Continually
Sporadically, as needed or requested. There is no consistent scheduled refresh
Too late - waytoo late

Figure 4-3 Strategy Response Summary – This shows the total percentages of the selected time frame to update the Innovation Strategy

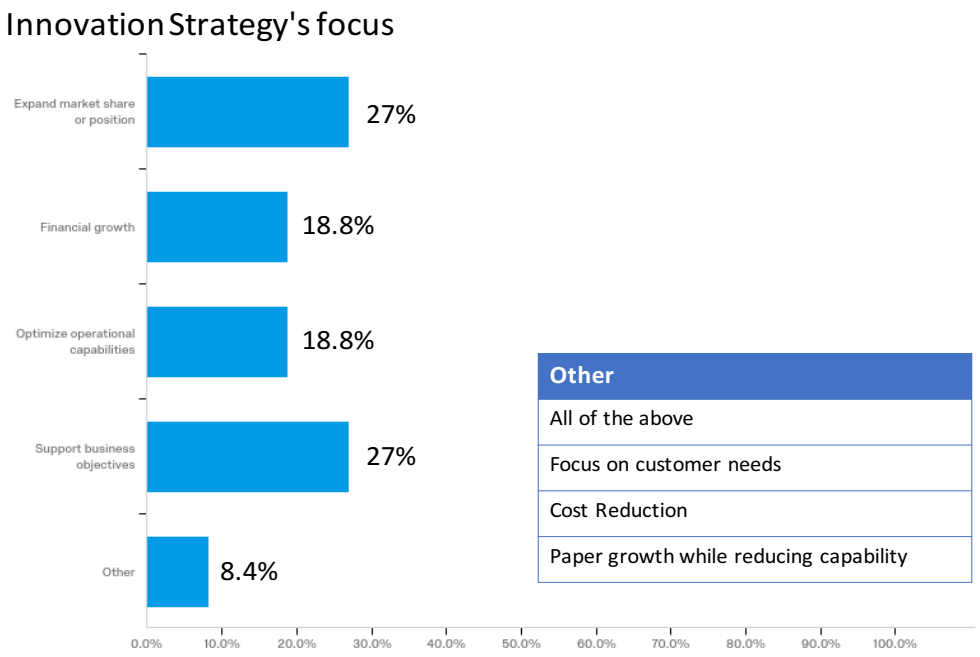


Figure 4-4 Strategy Response Summary - This provides a summary of the preferred focus of the Innovation Strategy.

4.2.2 Survey Topic – Lifecycle

The innovation life cycle questions were used to determine the respondent's perspective of their organization's ability to manage, change, and execute innovation activities. Knowing the lifecycle maturity level establish the potential range and boundaries relating to the organization's ability to execute the innovation strategy, plans, and projects. Each lifecycle question was scored on a 5-point scale and averaged to determine the maturity level for the lifecycle variable.

Table 4-1 Lifecycle Response Summary (a) - This provides the net percentages about the methods used to manage the organization's innovation lifecycle.

The item that best describes respondents' organization innovation life-cycle.

Answer	%
Organizational innovation decisions are not coordinated and the execution of cross-functional teams lack consistency and limited use of best practices	34.88%
Manual execution -- Innovation portfolios defined, formalized roles, basic processes defined, and control gates used to deliver innovation projects	37.21%
Semi-automated processes used to establish clear direction, metrics, and ownership needed to drive consistent innovation execution	23.26%
Automated work-flows that incorporate best practices while enforcing approved governance to empower all levels of the organization (experiment, change, or terminate)	4.65%

Table 4-2 Lifecycle Response Summary (b) - This provides the net percentages about overall organization's innovation lifecycle.

The item that best describes respondents' organization's overall Innovation Life-cycle.

Answer	%
Project execution is inconsistent and the ability to effectively respond to market changes constrained	25.58%
We have documented life-cycle processes focused on conservative investments resulting in gradual and predictable growth	27.91%
We have an automated means to launch planned innovations with confidence that include breakthrough innovations that delivers revenue growth	2.33%
Our innovation pipeline is not clearly defined nor communicated and we occasionally miss market windows and margin targets.	34.88%
The organization has a limited set of innovation processes, but it is not required for company success	9.30%

Table 4-3 Lifecycle Response Summary (c) - This provides the net percentages about the criteria incorporated in the innovation lifecycle process.

The decision criteria incorporated into the innovation lifecycle

Category	Always	Count	Sometimes	Count	Never	Count
Purchased	28.57%	12	18.83%	29	10.53%	2
Consumed as a service	16.67%	7	21.43%	33	15.79%	3
Integrated	19.05%	8	20.13%	31	21.05%	4
Built	28.57%	12	18.18%	28	15.79%	3
Terminated	7.14%	3	21.43%	33	36.84%	7
Total	Total	42	Total	154	Total	19

Field	Minimum	Maximum	Mean	Std Deviation	Variance
Purchased	1.00	3.00	1.77	0.52	0.27

Table 4-4 Lifecycle Response Summary (d) - This provides the net percentages about the level of experimentation incorporated in the innovation lifecycle process.

The level of experimentation incorporated in the innovation lifecycle.

Answer	%
Not incorporated	34.88%
Allowed but there are consequences pertaining to failure	16.28%
Encouraged at all levels of the organization with an understanding that failure can be just as valuable as success	20.93%
Experiments are explicitly identified and approved by leadership	27.91%
Total	100%

4.2.3 Survey – Decision Criteria

The innovation decision criteria questions were used to determine what type of criteria is used to make innovation decisions. The ability to consistently make decisions based on pre-defined criteria is an essential characteristic of a mature organization's ability to accommodate rapid shifts in their market segments. The following are

summarized net results of the decision criteria questions. Each question was scored on a 5-point scale and averaged to determine the decision criteria maturity level.

Table 4-5 Decision Criteria Summary (a) - This provides the net percentages that identify the primary decision driver to select and manage innovation items.

Method used to prioritize innovations.

Answer	%
Based on the value provided to client	22.92%
Based on desired operational capabilities	25.00%
To drive financial return	27.08%
To establish market leadership	16.67%
Other	8.33%
Total	100%

Field	Min	Max	Mean	Std Deviation	Variance
Select the item that best describes how innovations are prioritized. - Selected Choice	1.00	5.00	2.90	1.45	2.09

Other
Safest, proven. Clearly defeats the purpose of innovation.
Combination of value to client, financial return, and market opportunities
Cost Reduction
Perceived Value to stockholders

Table 4-6 Decision Criteria Summary (b) - This provides the net percentages that identify decision categories used to select and manage innovation items.

The method preferred to select innovations

Answer	%
Specifically based on the personalities and politics within senior Leadership	18.60%
Explicit to financial characteristics	20.93%
Based on an alignment between business objectives, culture, and client impact	48.84%
Based on measurable criteria and thresholds linked to specific organizational objectives and desired outcomes	11.63%

Field	Min	Max	Mean	Std Deviation	Variance
The method preferred to select innovations	1.00	4.00	2.53	0.92	0.85

Table 4-7 Decision Criteria Summary (c) - This provides the net percentages that identify decision categories used to select and manage innovation items.

The selected item that best describes the organization's flexibility to accommodate evolving business conditions.

Answer	%
No flexibility	2.33%
Limited flexibility – manual process – limited view of proposed impact of change or associated dependencies	76.74%
Mature and repeatable processes used to assess impacts and dependencies	11.63%
Automated processes that incorporate predictive and anticipatory analysis to proactively suggest changes	9.30%
Total	100%

Field	Min	Max	Mean	Std Deviation	Variance
Select the item that best describes the organization's flexibility to accommodate evolving business conditions.	1.00	4.00	2.28	0.66	0.43

4.2.4 Survey Topic – Time to Value

The time to value questions were used to determine the how much time it typically takes the organization to realize value from the innovation. Knowing the timing maturity level establish the potential range and boundaries relating to the organization's ability to execute the innovation strategy, plans, and projects. Each timing question was scored on a 5-point scale and averaged to determine the maturity level for the time to value variables.

The time (number of weeks) expended by your organization to accomplish the following innovation Lifecycle phases

Field	Min	Max	Mean	Std Deviation	Variance
Concepts	1.00	42.00	14.38	9.22	85.10
Selection/approval	1.00	36.00	11.85	9.81	96.23
Experiment/prototypes	0.00	52.00	13.41	10.63	113.07
Initial pilot	0.00	33.00	14.15	9.02	81.31
Packaged production	0.00	52.00	18.16	14.69	215.92

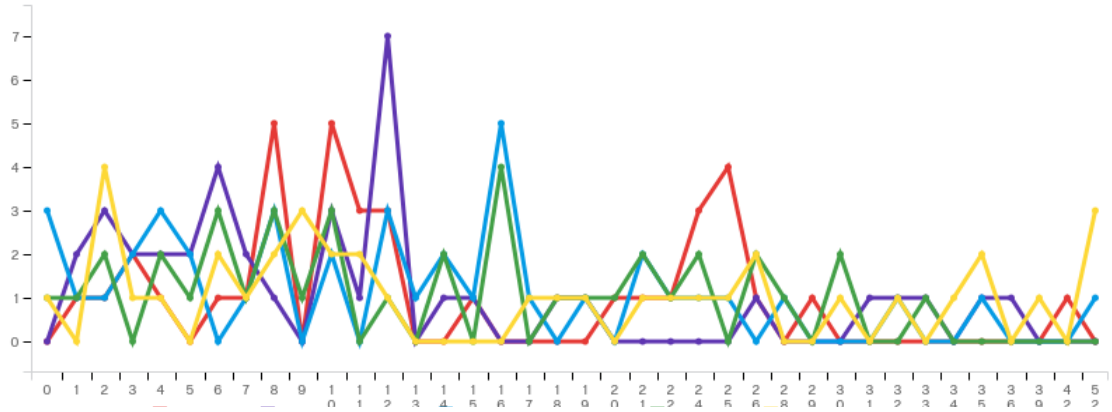
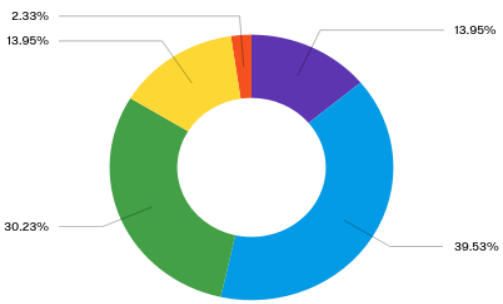


Figure 4-5Timing Summary-a - This provides the net percentages that identify the amount of time it takes per phase of the innovation lifecycle. This data is used to establish boundaries and thresholds about maturity progression.

The time it takes the organization to currently realize the desired value of approved innovation projects (from inception to implementation)

Answer	%
With in 2-3yrs	13.95%
18-24 months	39.53%
9-15 months	30.23%
Within 16-25 weeks	13.95%
Less than 16 weeks	2.33%
Total	100%

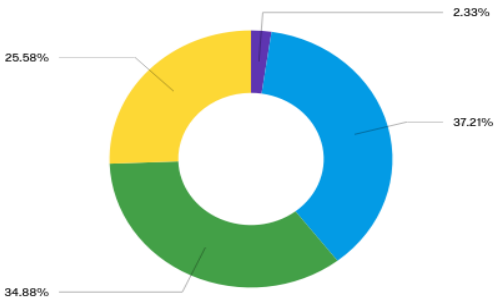


Field	Min	Max	Mean	Std Deviation	Variance
How long does it take your organization to realize the desired value of approved innovation projects (from inception to implementation)?	1.00	5.00	2.63	1.18	1.40

Figure 4-6 Timing Summary-b - This provides the net percentages that identify the amount of time it takes to realize the business value from an implemented innovation. This data is used to establish boundaries and thresholds about maturity progression.

The desired time-frame you believe your organization/client needs to strive for to realize measurable business outcomes based on implemented innovations?

Answer	%
18-24 months	2.33%
9-15 months	37.21%
Within 16-22 weeks	34.88%
Less than 16 wks	25.58%
Total	100%



Field	Min	Max	Mean	Std Deviation	Variance
What's the desired time-frame you believe your organization needs to strive for to realize measurable business outcomes based on implemented innovations?	1.00	5.00	3.44	1.28	1.64

Figure 4-7 Timing Summary-c - This provides the net percentages that identify the desired time frame respondents would like to achieve to realize the value from an implemented innovation. This data is used to establish boundaries and thresholds about maturity progression.

4.2.5 Survey Topic – Innovation Categories

The innovation category questions were used to determine how many of the current and projected innovation per category. Innovations in each category have a different value to the organizations based on established strategy and priorities. Knowing if you have innovations in each category and how they are related to the strategy expands the potential set of innovative alternatives to choose from in the event the organization has to accommodate market segment disruptions. Each innovation category was scored on a 5-point scale and averaged to determine the maturity level for the innovation item variables.

The number of the current and projected innovations are in the following categories

Field	Min	Max	Mean	Std Deviation	Variance
Core – This type of innovation provides fundamental capabilities needed to maintain essential levels of operational efficiency	0.00	31.00	11.13	7.68	59.00
Enablers – This type of innovation is structured to provide optimized capabilities that allows the organization to do more or new things	1.00	30.00	10.55	7.09	50.20
Accelerators -- This type of innovation is structured to address unmet demands or establish new business models – market disruptor's	0.00	35.00	10.40	8.71	75.86

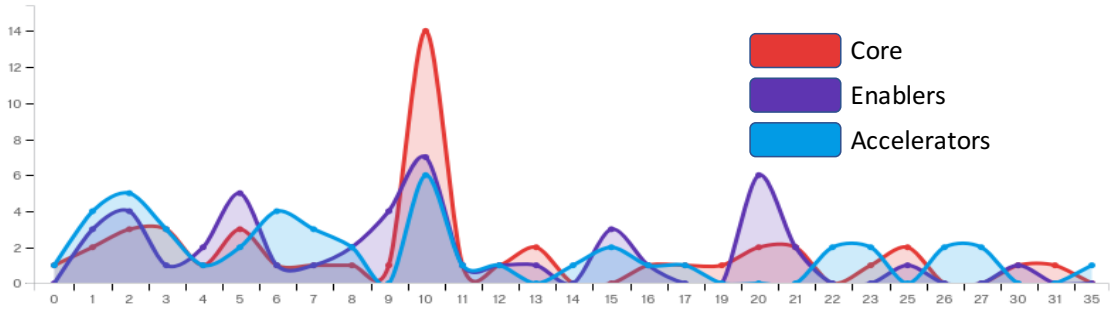


Figure 4-8 Innovation Category Summary - This provides the net percentages and distribution of innovations per category. This helps to determine if the organization has enough innovations in a specific category aligned with objectives and priorities. This data is used to establish boundaries and thresholds about the number of innovations needed to move maturity progression.

4.2.6 Survey Topic – Investment

The investment questions were used to determine the level of invest available to implement innovations. This data is leveraged to determine if the lack of investment impact the realization of innovations. Investment variable is used to define the potential range and boundaries relating to the organization's ability to execute the innovation strategy, plans, and projects. Each investment question was scored on a 5-point scale and averaged to determine the maturity level for the investment variable.

The % of the annual budget allocated to the realization of innovations

Field	Min	Max	Mean	Std Deviation	Variance
% of annual budget allocated for innovation	0.00	35.00	7.68	7.07	49.94

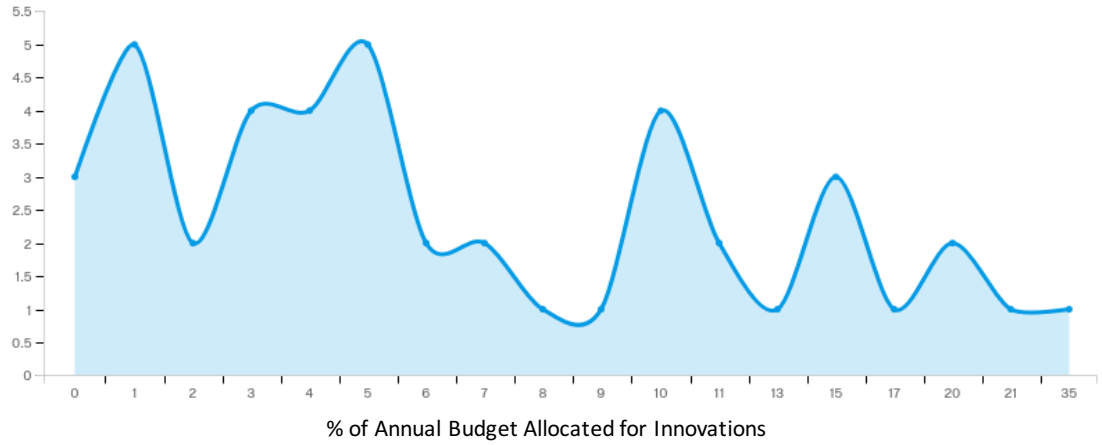


Figure 4-9 Investment Summary - This provides the net percentages and distribution of % of Annual Budget allocated for innovation development. The study will use this profile to determine which % of Innovation budget moves innovation maturity progression. This data is used to establish boundaries and thresholds about allocated budget and innovation result.

4.2.7 P1 Survey Summary

The set of data analyzed for the P1 phase of the study consisted of 64 acceptable SME responses. The survey responses were scored and tabulated with Qualtrics. The resulting tabulated data were tested for normality. Table 4-2 provides a summary of the Kolmogorov-Smirnov normality test performed. Eleven of the twelve tested variables were validated as normal distributions. The one exception was the current time to value variable. Based on the normal shape of the histogram and box plot having no outliers' this variable was not removed.

Based on the verification of normality the P1 phase of the study is complete. P1 defines the primary variables to be analyzed. The IMMe data set was structured to analyze the data from an aggregated or decomposed orientation. The use of the

aggregated variables and their corresponding components provide the granularity needed to isolate which variables are responsible for maturity progression.

Table 4-8 Test of Normality Summary – this table provides a summary of the Kolmogorov-Smirnov normality test. Two variables p-Value was less than 0.05. The histogram of the Current Time to Value and Desired Time to Value variables depicted a normal distribution, therefore, this variable was not removed.

	Basic Measures		rmality - Kolmogorov-Smirnov	
	Mean	Std Deviation	D - Statistic	p Value
SeflAssess_ML	2.8209	1.0851	0.1237	0.095
Overall_Process_ML	2.6965	0.6317	0.1076	0.150
Strategy_Process_ML	2.9957	0.6846	0.1254	0.088
LifeCycle_Process_ML	2.3584	0.6707	0.0988	0.150
Decision Process_ML	2.8057	0.8349	0.0769	0.150
Investment_ML	3.0832	1.0172	0.1274	0.079
InnovCore_ML	2.8906	1.0476	0.1185	0.132
InnovEnabler_ML	2.7465	1.1070	0.0982	0.150
InnovAcellerant_ML	2.6047	1.1073	0.0943	0.150
TotalQty_Innovations	32.2326	18.8993	0.0908	0.150
TimeValueCurrent_Mths	14.8675	7.7347	0.0943	0.150
TimeValueDesired_Mths	10.6500	4.2583	0.1011	0.150

4.3 P2 – Business Objectives and Functional Ranking

The P2 phase of the study collected the SME's selection and ranking of business objectives, functional categories, and attributes. The results of P2 provided a generalized set weighted criteria that can be used to evaluate and rank innovation items and categories. The use of the generalized criterion provides an initial interface to align business objectives and functional capabilities. This provides a means to structure an initial interface that supports the ability to associate maturity progression in context to business outcomes.

The first part of P2 asked respondents to select at least three of the eight listed business objectives. The eight business objectives were obtained from several studies.

The following figure 4-13 depicts the eight generalized business objectives and their ranking. The top three business objectives selected were; service excellence, cyber protection, and digital transformation. The study participants were also provided an opportunity to identify a user defined business objective. There was only four user defined business objectives; vendor partnership, future sales offerings, Anticipatory Analysis, and improved user experience (UX).

Table 4-9 Business Objective Generalization – This provides a summary of the selection count per business objective and ranking. The data provides a generalized means to evaluate innovation portfolios. As business objectives evolve the ranking and weighting can be adjusted, and the evaluated innovation items can be dynamically re-aligned to reflect the new weighting.

Answer	%	Count
Service Excellence	20.3%	31
Profitable Growth	15.0%	23
Process Optimization	13.7%	21
Market Share	8.5%	13
Digital Transformation	17.0%	26
Cyber Protection	15.7%	24
Adaptive Government	9.8%	15
Total	100%	162

Business Objective Generalization		
Ranking	Weighting	Business Objective
1	5	Service Excellence
2	4	Digital Transformation
3	3	Cyber Protection
4	3	Profitable Growth
5	2	Process Optimization
6	2	Adaptive Government
7	1	Market Share
8	1	Other

The second part of P2 asked respondents to select and prioritize capabilities and attributes for three functional categories. The three functional categories were; Infrastructure and Technologies, Applications and Data, and Process and Governance. Each functional category consisted of eight capabilities obtained from literature. The study participants were also given an opportunity to identify any additional capabilities. Based on the selected capability the respondent was then provided an opportunity to rank the specific attributes of that capability. The ranking of each capability attribute was assessed but was not needed to determine which IMMe component was needed to

predict innovation maturity progression. The functional categories were scored and ranked using a multiplicative method. The multiplicative method provided a means to distinguish between the total count of a specific choice. The respondents ranking for each functional capability were scored based on a 5-point model. The first choice was 5 points; the 2nd choice was 4 points; the 5th choice was 1 point. The resulting score was used to establish rankings. The three tie breakers were; total count, the total count of choice-1, and the total count of choice-2.

The following tables 4-10 thru table 4-12 provide a summary of the functional capability ranking for each category. Generalized ranking of the functional categories provide a common means to map and measure innovations in context to business objectives and eventually business activities.

Table 4-10 Infrastructure and Technology ranking – this represents the summarized SME perspective and evaluated rankings. The results indicate that Cyber Protection capabilities are the most desired functional innovation within the Infrastructure and Technology category.

Infratructure and Technology Ranking

		1st Choice			2nd Choice			3rdChoice			4th Choice			5th Choice				
#	Question	1	Count	Score	2	Count	Score	3	Count	Score	4	Count	Score	5	Count	Score	Total Count	Total Score
1	Cyber Protection	37.50%	12	60	21.88%	7	28	25.00%	8	24	15.63%	5	10	0.00%	0	0	32	122
2	Digital Transformation	44.83%	13	65	17.24%	5	20	24.14%	7	21	13.79%	4	8	0.00%	0	0	29	114
3	Hybrid Technologies	21.43%	6	30	50.00%	14	56	7.14%	2	6	21.43%	6	12	0.00%	0	0	28	104
4	Digital Workplace	12.50%	3	15	8.33%	2	8	50.00%	12	36	25.00%	6	12	4.17%	1	1	24	72
6	Management Platform	11.11%	2	10	33.33%	6	24	11.11%	2	6	33.33%	6	12	11.11%	2	2	18	54
7	User Defined	35.71%	5	25	11.11%	4	16	28.57%	3	9	21.43%	2	4	14.29%	0	0	14	54
5	Composable Services	0.00%	0	0	16.67%	3	12	22.22%	4	12	55.56%	10	20	0.00%	0	0	18	44
8	IoT	10.00%	1	5	10.00%	1	4	40.00%	4	12	30.00%	3	6	10.00%	1	1	10	28

Infrastructure/Technology Ranking	
Mean	74
Standard Error	12.40967365
Median	63
Mode	54
Standard Deviation	35.09985755
Sample Variance	1232
Kurtosis	-1.672999542
Skewness	0.269784222
Range	94
Minimum	28
Maximum	122
Sum	592
Count	8
Confidence Level(95.0%)	29.34421526

Mean	74.000
Confidence Level(95.0%)	29.344
Lower Bound	44.656
Upper Bound	103.344

Table 4-11 Process and Governance ranking – this represents the summarized SME perspective and evaluated rankings. The results indicate that Service excellence is the most desired functional innovation within the Process and Governance functional category.

Process and Governance Ranking

		1st Choice			2nd Choice			3rdChoice			4th Choice			5th Choice				
#	Question	1	Count	Score	2	Count	Score	3	Count	Score	4	Count	Score	5	Count	Score	Total Count	Total Score
1	Service Excellence	34.62%	9	45	23.08%	6	24	30.77%	8	24	7.69%	2	4	3.85%	1	1	26	98
7	EA Standards	37.50%	9	45	29.17%	7	28	12.50%	3	9	20.83%	5	10	0.00%	0	0	24	92
2	Workforce Optimization	36.36%	8	40	9.09%	2	8	31.82%	7	21	22.73%	5	10	0.00%	0	0	22	79
4	Change Mgt	16.67%	3	15	22.22%	4	16	22.22%	4	12	38.89%	7	14	0.00%	0	0	18	57
5	Agile Acquisition/Contracting	7.14%	1	5	35.71%	5	20	28.57%	4	12	28.57%	4	8	0.00%	0	0	14	45
6	Orchestrated Work-flow	0.00%	0	0	38.46%	5	20	38.46%	5	15	15.38%	2	4	7.69%	1	1	13	40
3	Innovation Mgt	9.09%	1	5	27.27%	3	12	0.00%	0	0	63.64%	7	14	0.00%	0	0	11	31
8	User Defined	33.33%	2	10	16.66%	1	4	33.33%	2	6	16.66%	1	2	0.00%	0	0	6	22

Process/Governance Ranking	
Mean	58
Standard Error	10.10304056
Median	51
Mode	#N/A
Standard Deviation	28.57571396
Sample Variance	816.5714286
Kurtosis	-1.590966244
Skewness	0.311793682
Range	76
Minimum	22
Maximum	98
Sum	464
Count	8
Confidence Level(95.0%)	23.88989472

Mean	58.000
Confidence Level(95.0%)	23.890
Lower Bound	34.110
Upper Bound	81.890

Table 4-12 Applications and Data ranking – this represents the summarized SME perspective and evaluated rankings. The results indicate that Continuous Dev/Ops is the most desired functional innovation within the Applications and Data functional category.

Applications and Data Ranking																
		1st Choice			2nd Choice			3rdChoice			4th Choice			5th Choice				
#	Question	1	Count	Score	2	Count	Score	3	Count	Score	4	Count	Score	5	Count	Score	Total Count	Total Score
5	Continuous Dev/Ops	34.48%	10	50	13.79%	4	16	34.48%	10	30	10.34%	3	6	6.90%	2	2	29	104
4	Data Architecture	33.33%	7	35	19.05%	4	16	23.81%	5	15	19.05%	4	8	4.76%	1	1	21	75
6	Data Services	13.64%	3	15	31.82%	7	28	13.64%	3	9	40.91%	9	18	0.00%	0	0	22	70
1	Application Architecture	21.05%	4	20	36.84%	7	28	31.58%	6	18	10.53%	2	4	0.00%	0	0	19	70
7	Anticipatory Analytics	20.00%	3	15	13.33%	2	8	26.67%	4	12	33.33%	5	10	0.00%	0	0	14	45
3	Composite Applications	12.50%	2	10	12.50%	2	8	6.25%	1	3	56.25%	9	18	6.25%	1	1	15	40
2	Autonomic Intelligence	0.00%	0	0	62.50%	5	20	25.00%	2	6	12.50%	1	2	0.00%	0	0	8	28
8	User Defined	50.00%	4	20	25.00%	2	8	25.00%	2	6	0.00%	0	0	0.00%	0	0	8	34

Apps/Services Ranking	
Mean	58.25
Standard Error	9.1236545
Median	57.5
Mode	70
Standard Deviation	25.80559186
Sample Variance	665.9285714
Kurtosis	-0.398272544
Skewness	0.591398819
Range	76
Minimum	28
Maximum	104
Sum	466
Count	8
Confidence Level(95.0%)	21.57401469

Mean	58.250
Confidence Level(95.0%)	21.574
Lower Bound	36.676
Upper Bound	79.824

The preceding tables represent the rankings of the specific functional categories. The following table presents a consolidated ranking for all 24 functional capabilities between the three categories.

Table 4-13 Consolidated Functional ranking – this represents the summarized SME perspective and evaluated rankings of all 24 functional capabilities. The results indicate that Infrastructure and Process capabilities have the highest generalized ranking.

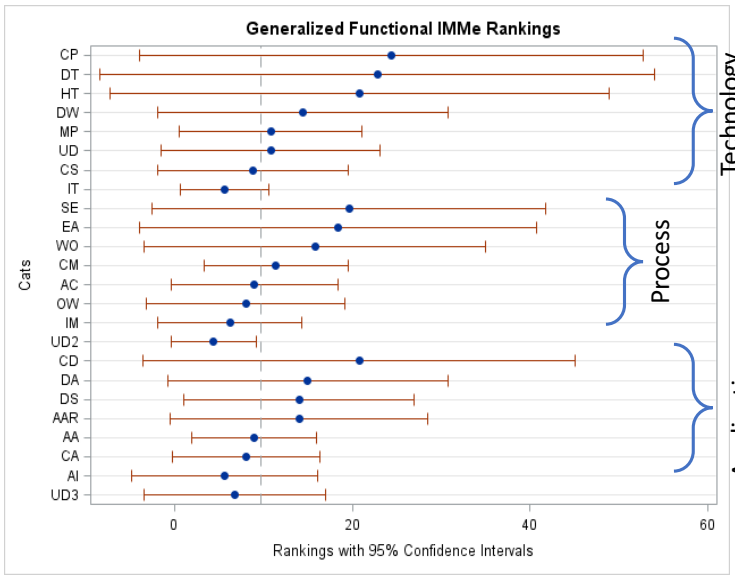
Ranking	Weighting	Functional Domain	Functional Category	Total Count	Total Score
1	5	Inf/Tech	Cyber Protection	32	122
2	5	Inf/Tech	Digital Transformation	29	114
3	4	Apps/Data	Continuous Dev/Ops	29	104
4	4	Inf/Tech	Hybrid Technologies	28	104
5	4	Proc/Govrn	Service Excellence	26	98
6	4	Proc/Govrn	EA Standards	24	92
7	3	Proc/Govrn	Workforce Optimization	22	79
8	3	Apps/Data	Data Architecture	21	75
9	3	Inf/Tech	Digital Workplace	24	72
10	3	Apps/Data	Data Services	22	70
11	3	Apps/Data	Application Architecture	19	70
12	2	Proc/Govrn	Change Mgt	18	57
13	2	Inf/Tech	Management Platform	18	54
14	2	Inf/Tech	User Defined	14	54
15	2	Apps/Data	Anticipatory Analytics	14	45
16	2	Proc/Govrn	Agile Acquisition/Contracting	14	45
17	2	Inf/Tech	Composable Services	17	44
18	1	Apps/Data	Composite Applications	15	40
19	1	Proc/Govrn	Orchestrated Work-flow	13	40
20	1	Apps/Data	User Defined	8	34
21	1	Proc/Govrn	Innovation Mgt	11	31
22	1	Inf/Tech	IoT	10	28
23	1	Apps/Data	Autonomic Intelligence	8	28
24	1	Proc/Govrn	User Defined	6	22

Consolidated Ranking	
Mean	63.41666667
Standard Error	6.071111407
Median	55.5
Mode	104
Standard Deviation	29.74225024
Sample Variance	884.6014493
Kurtosis	-0.919047653
Skewness	0.484190332
Range	100
Minimum	22
Maximum	122
Sum	1522
Count	24
Confidence Level(95.0%)	12.55905082

Mean	63.417
Confidence Level(95.0%)	12.559
Lower Bound	50.858
Upper Bound	75.976

The Based on the small sample size used to create the generalized functional rankings, the use of confidence intervals was used to establish an additional ranking

perspective. The following figures and tables depict 95% confidence intervals for each functional category. Table 4-10 provides the reordered rankings that account for confidence intervals.



Adjusted Rank	Functional Category	Code
1	Hybrid Technologies	HT
2	Cyber Protection	CP
3	Digital Workplace	DW
4	Workforce Optimization	WO
5	Management Platform	MP
6	Service Excellence	SE
7	Application Architecture	AAR
8	Anticipatory Analytics	AA
9	Composable Services	CS
10	Innovation Mgt	IM
11	Orchestrated Work-flow	OW
12	Autonomic Intelligence	AI
13	Digital Transformation	DT
14	Continuous Dev/Ops	CD
15	EA Standards	EA
16	Data Architecture	DA
17	Data Services	DS
18	Change Mgt	CM
19	User Defined	UD
20	Agile Acquisition/Contracting	AC
21	Composite Applications	CA
22	User Defined-3	UD3
23	IoT	IT
24	User Defined-2	UD2

Figure 4-10 Adjusted Generalized Rankings based on confidence intervals

The P2 phase of the study established a set of prioritized functional capabilities and generalized business objectives. This data is used as the criteria to evaluate the three innovation case study portfolios. Consolidated Functional ranking – this represents the summarized SME perspective and evaluated rankings of all 24 functional capabilities. The results indicate that Infrastructure and Process capabilities have the highest generalized ranking. The data from P2 provides a means to establish a controlled environment needed to evaluate modeled changes.

4.4 P3 – Innovation Portfolio Evaluation and Ranking

The P3 phase of the study leveraged the results of P2 to evaluate and rank innovation items from three different cases. This part of the study was able to leverage three distinct innovation portfolios. The case study innovation portfolios were provided by three of the study respondents. Two from the federal segment and one from the commercial segment. Each of the innovation portfolios was assessed, and a total of 136 distinct innovation items were evaluated and ranked using the generalized criterion from the P2 phase of the study. Additional clarifying attributes were defined to expand fidelity of rankings. There were six attributes used to evaluate and rank each innovation item. Only four of the six case study attributes were measured, innovation classification, implementation status, acquisition status, and business objective. A 5-point scale was used to measure each case study attribute. The following table is an example that shows how each item was evaluated and ranked.

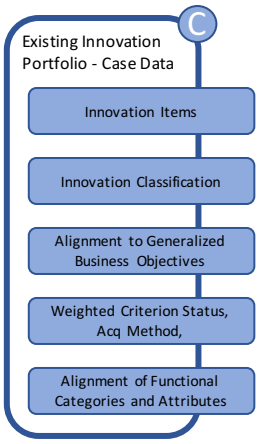


Figure 4-11 IMMe case data evaluation sections used to evaluate innovation items.

Table 4-14 Innovation Case Study Evaluation – this provides an excerpt from the completed innovation portfolio evaluation. Each innovation item scored and ranked based on calculated score. Each innovation

item can be sorted to provide additional granularity. This organizes the set of innovations and how it is aligned to the business.

Case ID	Item Name	Capability Domain	Classification	Capability Name	Classification Weighting	Innovation Status	Inv Status Weighting	Acquisition Type	Acquisition Weighting	Business Objective	Bus Obj Weighting	Innovation Score
Case_1	Dev Ops and Test Plan	Enabler	Apps/Data	Continuous Dev/Ops	4	Development	3	Integrate	4	Digital Transformation	4	15
Case_1	Windows 10 and O365 Migration	Core	Infrst/Tech	Digital Workplace	3	Test	4	Integrate	4	Digital Transformation	4	15
Case_1	Hosting Consolidation and Convergence	Enabler	Infrst/Tech	Digital Workplace	3	Development	3	Consumption	5	Profitable Growth	3	14
Case_1	AWS Service Portal - POC	Core	Apps/Data	Application Architecture	3	POC	2	Consumption	5	Digital Transformation	4	14
Case_1	Cyber Security Plan	Core	Infrst/Tech	Cyber Protection	5	Development	3	Leverage	3	Cyber Protection	3	14
Case_1	Automated Service Models	Accelerant	Infrst/Tech	Digital Transformation	5	Concept	1	Leverage	3	Service Excellence	5	14
Case_1	Business Intelligence (Cognos)	Enabler	Apps/Data	Data Services	3	Development	3	Integrate	4	Profitable Growth	3	13
Case_1	Integrate Commercial Cloud Services	Enabler	Infrst/Tech	Digital Workplace	3	Concept	1	Integrate	4	Service Excellence	5	13
Case_1	On-Premis Private Cloud	Core	Infrst/Tech	Composable Services	2	Development	3	Integrate	4	Digital Transformation	4	13

Table 4-15 Innovation Case Study Clarifying Attributes – these are the additional attributes used to add some additional fidelity to the innovation rankings. The tables with the dashed-boarders were not included in the case study evaluation. These were defined to establish a means to rate impact and contextual alignment with business objectives and activities.

Acquisition Status	
Acq_Status Type	**Weighted Value**
Consumption	5
Leverage	4
Integrate	3
Buy	2
Build	1

Acquisition attribute define the method used to acquire the evaluated innovation. Consumption is lowest cost and risk and Build is highest cost and risk

Innovation Status	
Innov_Status Type	**Weighted Value**
Operational	5
Test	4
Development	3
POC	2
Concept	1

Innovation Status attribute describes lifecycle status of the innovation. The weighting characterizes the level of measurable impact on the actual business objective.

Investment Allocation	
Invest_Status Type	**Weighted Value**
Process	5
Innovation	4
Time to Realize	3
Workforce	2
TBD	1

Investment attribute defines the area of investment allocation. This attribute was not included in the study evaluation.

Business Impact	
BusImpact_Status Type	**Weighted Value**
Essential	5
Innovation	4
Time to Realize	3
Workforce	2
TBD	1

Business Impact attribute defines the level of impact the innovation is projected to produce. This attribute was not included in the study evaluation.

P3 Criterion Summary – The P3 phase of the study used the results of P2 to score and evaluate each innovation portfolio item from the three case studies. This phase of the study organized the set of innovation items in context with aligned business

objectives and priorities. Additional weighted attributes were defined to establish a means to rate impact and contextual alignment with business objectives and activities. The successful completion of P1, P2, and P3 of the study established verified data sets. The data collected and scored has been contextually aligned with the generalized innovation processes, business objectives, and prioritized functional capabilities. At this stage of the study, the analysis can begin.

4.5 Analysis

The objective of the analysis phase is to determine which IMMe variables drive innovation maturity progression, but more importantly, isolate and predict which change will have the greatest impact to move innovation progression that's directly associated with prioritized business objectives. There were three analytical tests performed; multivariate regression, principal component regression, and correlation assessment. Each test performed provided different but complementary perspectives to develop insight. The following sections provide a summary of the three analytical tests performed.

The multivariate regression tests were performed first. The regression tests isolated the IMMe variables that account for the change in the maturity level. The regression iterations were done in a stepwise process. The removal of variables was principally based on the t statistic and estimated coefficient. The following tables summarize three sets of regressions; IMMe maturity level baseline, IMMe Progression, and IMMe Business Alignment.

The IMMe baseline identifies the basic variables that denote a general maturity level. The variables selected for this regression all represented aggregated variables. This provides a very simple model to determine an initial IMMe baseline. The following table 4-16 and figure 4-11 summarizes the IMMe baseline.

Table 4-16 IMMe Maturity Baseline – This provides a summary of the regression results. The aggregated process maturity level and Time to Value variables were the variables of interest. The Process and Time to Value variables have a definite correlation.

Test Type: Multivariate Regression				
Test Name: IMMe ML Baseline				
Pr > F	0.0000	R^2	0.9021	
Corrected Total	63	Adj R^2	0.8754	
Dependant Variable	Explanatory Variables Selected		Pr > |t|	Significant Variable
SelfAsses_ML	Process_ML		0.0000	
	TotalNum_Innov_ML		0.7020	
	Investment_ML		0.3415	
	TimeToValue_ML		0.1546	
Note: Started with 16 explanatory variables and reduced to 4 for simplicity				

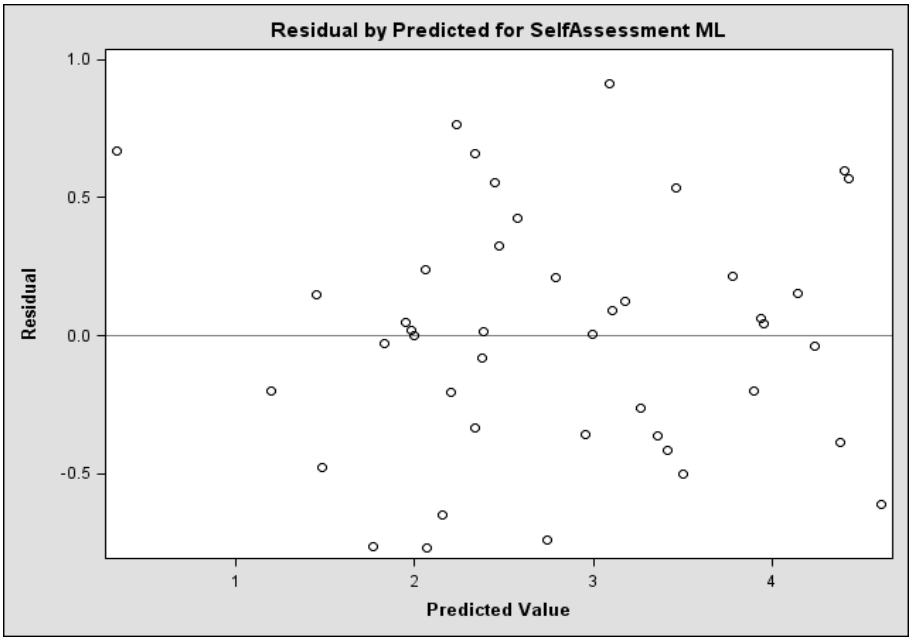


Figure 4-12 IMMe Baseline -- residual analysis confirms normality

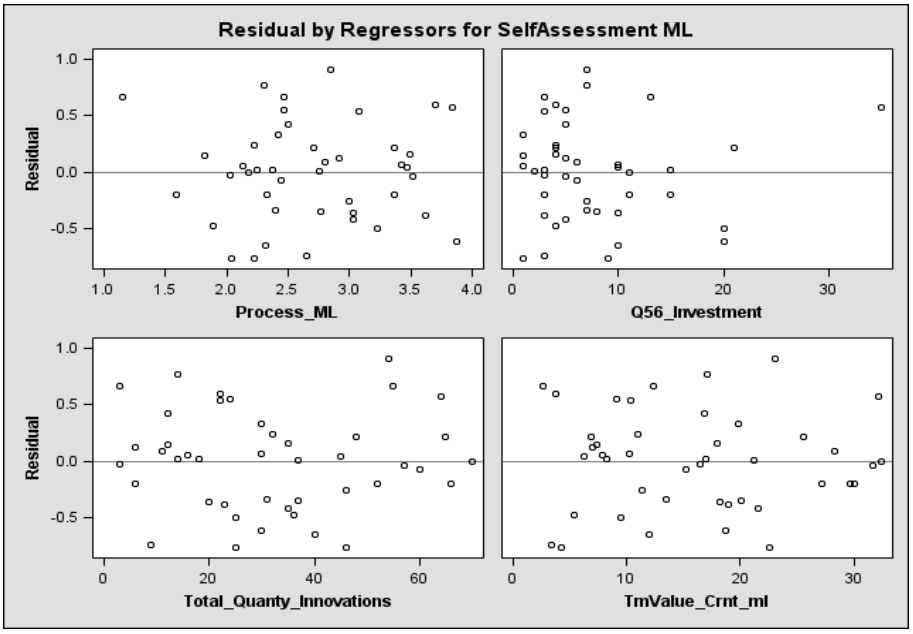


Figure 4-13IMMe Baseline -- residual analysis confirms normality of data used in regression

The IMMe baseline regression model can provide a predicted overall maturity level, but it does not have the granularity to determine what to change to drive maturity progression. The next regression test provides the details needed to determine which IMMe variable can influence maturity progression.

The IMMe initial progression model identifies the detailed variables that influence maturity progression. The variables selected for this regression were the decomposed variables of process and innovations. This provides a means to determine what part of the process or the total number of innovations per category influence maturity progression. The following table 4-17 and figure 4-12 summarizes the IMMe initial progression model.

Table 4-17 IMMe Progression model – This provides a summary of the regression results. The decomposed process and innovations variables show that strategy, lifecycle, and decision process are significant variables that influence initial maturity progression. The number of innovations in the enabling category indicates a slight influence.

Test Type: Multivariate Regression				
Test Name: Test Name: Initial IMMe Progression				
Pr > F	0	R^2	0.9426	
DF	63	Adj R^2	0.9184	
Dependant Variable	Explanatory Variables Selected		Pr > |t|	Significant Variable
ProgressionA_ML	Strategy_ML		0.0019	
	LifeCycle_ML		0.0162	
	Decision_ML		0.0000	
	QtyCoreInnv_ML		0.5832	
	QtyEnblrInnv_ML		0.1774	
	QtyAcclInnv_ML		0.4012	
	Investment_ML		0.4534	
	TimeToValue_ML		0.0008	
Note: Started with 16 explanatory variables and reduced to 8 -- the decomposed process and innovations were used instead of the aggregted variable from baseline regression				

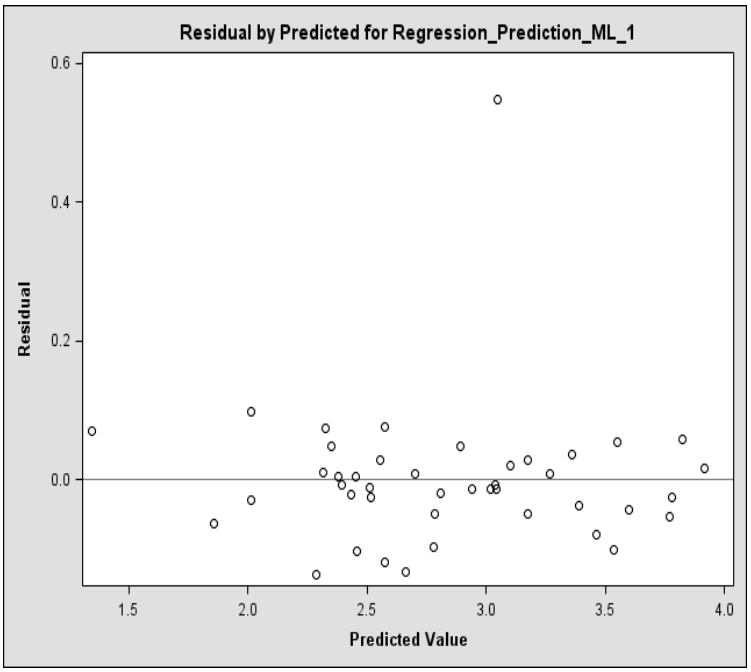


Figure 4-14 IMMe Initial Progression Residuals—analysis confirms data normality

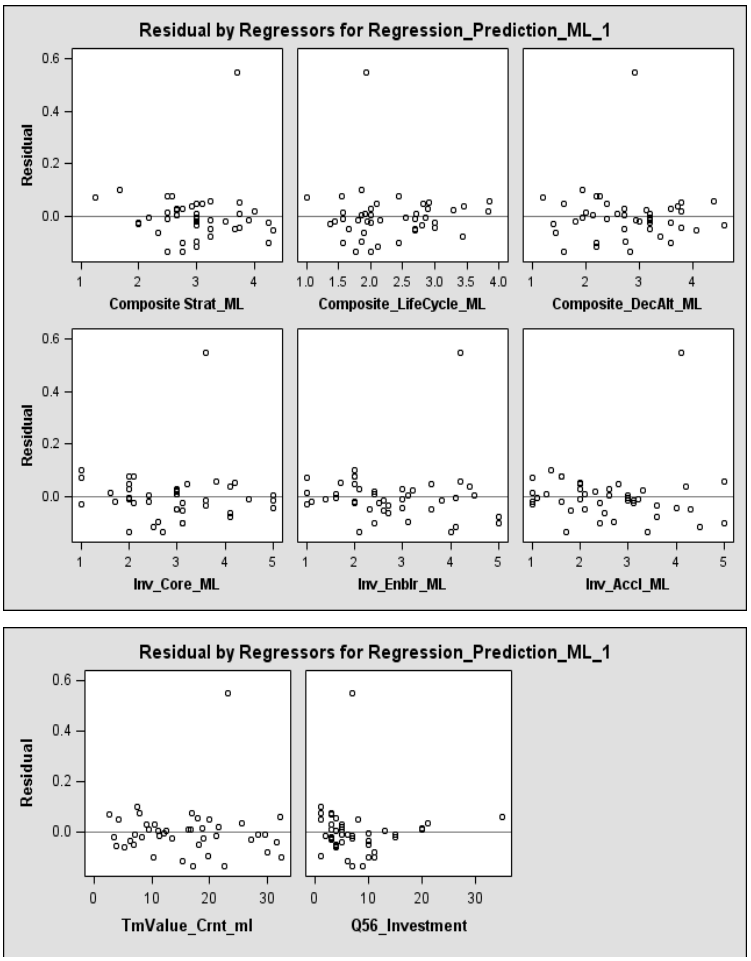


Figure 4-15 IMMe Initial Progression Residuals—analysis confirms data normality

The IMMe initial progression model can provide a predicted maturity level based on the specific changes to the process components or the number of innovations defined per innovation category. This model lacks the granularity to determine what to change to impact business objectives. The next regression test provides the details needed to determine which IMMe innovations or process changes can influence maturity progression. The potential changes would be aligned to the prioritized business objectives and functional capabilities. The following table 4-18 summarizes IMMe business alignment.

Table 4-18 IMMe Business Alignment model – This provides a summary of the regression results that incorporate business alignment and innovation portfolio assessment. This regression shows the impact of evaluated innovation items and categories. – This model extends the initial IMMe progression model by incorporating the alignment of business and functional rankings.

Test Type: Multivariate Regression				
Test Name: IMMe Business Alignment				
Pr > F	0.0000	R^2	0.9571	
DF	133	Adj R^2	0.9547	
Dependant Variable	Explanatory Variables Selected		Pr > |t|	Significant Variable
ProgressionB_ML	InnvItemCat_ML		0.0000	●
	InnvItem_ML		0.2330	◆
	Qty_InnvCat_ML		0.0000	●
	TotalQty_Innv_ML		0.0000	●
	BusObj_Wght		0.0210	●
	Class_Wght		0.2167	◆
	TimeToValue_ML		0.0000	●
Note: Started with 14 explanatory variables and reduced to 7 for simplicity				

This model incorporated the evaluation and alignment of business objectives and functional rankings per case study innovation items. This showed how the predicted maturity level could change with the focus of supporting prioritized business. The next section provides a summary of the principal component analysis. These tests were used to validate the selection of variables used for regression. More importantly, the principle component provides a clear indication of variance accounted for. The following tables provide a summary of the three principal component test accomplished.

Table 4-19 PC Summary for IMMe Baseline – This provides a summary that identifies how many principal components were kept and the amount of variance explained. This also validated the selection of variables used for regression.

PC Test -- IMMe ML Baseline - 14 variables				
Eigenvalues of the Correlation Matrix				
# Components Retained	Eigenvalue	Difference	Proportion	Cumulative Variance
1	7.12454389	5.19784681	0.5089	0.5089
2	1.92669708	0.53712773	0.1376	0.6465
3	1.38956935	0.37879645	0.0993	0.7458
4	1.01077291	0.05686801	0.0722	0.8180
5	0.95390490	0.43628765	0.0681	0.8861
Note: The following variables had the largest Eigenvector per component; Process, Invt_ML, Qty_Core, TotQty_Innv, TmValue_ML				

Table 4-20 PC Summary for IMMe Progression – This provides a summary that identifies how many principal components were kept and the amount of variance explained. This also validated the selection of variables used for regression.

PC Test -- IMMe Progression - 14 variables				
Eigenvalues of the Correlation Matrix				
# Components Retained	Eigenvalue	Difference	Proportion	Cumulative Variance
1	5.89802318	3.48065822	0.4213	0.4213
2	2.41736496	1.00254375	0.1727	0.5940
3	1.41482121	0.29775269	0.1011	0.6950
4	1.11706852	0.15314940	0.0798	0.7748
5	0.96391912	0.38867502	0.0689	0.8437
Note: The following variables had the largest Eigenvector per component; Strat_ML, Dec_ML, Core_ML, Enblr_ML, Accl_ML, TmValue_ML, and TmValueDesired_ML				

Table 4-21 PC Summary for IMMe Business Alignment – This provides a summary that identifies how many principal components were kept and the amount of variance explained. This also validated the selection of variables used for regression.

PC Test -- IMMe Business Alignment - 13 variables				
Eigenvalues of the Correlation Matrix				
# Components Retained	Eigenvalue	Difference	Proportion	Cumulative Variance
1	4.25973377	1.30515665	0.3277	0.3277
2	2.95457712	1.05381329	0.2273	0.5549
3	1.90076383	0.53392657	0.1462	0.7012
4	1.36683726	0.51523453	0.1051	0.8063
5	0.85160273	0.04993663	0.0655	0.8718
6	0.80166609	0.27441061	0.0617	0.9335
Note: The following variables had the largest Eigenvector per component; Clas_Wght, InnvStat_Wght, Acq_Wght, BusObj_Wght, Innv_Item_ML,				

4.6 Summation of analysis

Based on the analysis completed the data identifies specific variables that influence innovation maturity progression. The model established to predict the basic IMMe maturity baseline simply requires four variables. The model is significant, and the R^2 is 0.902. The data shows that the aggregated variables about the overall processes, the number of innovations, time to value, and the investment level is good enough to establish an initial IMMe maturity baseline. This initial model does not provide the granularity needed to identify the type of changes that would produce the greatest IMMe progression.

Based on the completed analysis of the study's data sets; the following objectives were addressed:

(1) A generalized and prioritized set of business objectives and functional capabilities were used as the criterion to align and evaluate each case study innovation portfolio,

(2) The results of various regression and principal component tests verified specific variables that influence innovation maturity progression.

(3) Three generalizable models were produced to predict maturity progression at different levels of granularity. The test to determine if the models were different at each level of maturity were inconclusive. The current IMMe data set did not have enough observations per level to evaluate confidently.

(4) The IMMe business progression model was significant and demonstrated that the incorporation of business objectives, innovation priorities, and status of the innovation verified the means to link innovation maturity progression to business objectives.

The following table provides a summary of the analysis

Table 4-22 Summation of Analysis – Each study question has been addressed and supported based on the analytical test performed with an acceptable level of confidence and significance.

Research Item	Hypothesis	Analytical Results
H_1 – Fail to Reject	There are specific attributes that drive maturity progression.	Regression models verify the specific IMMe variables that influence maturity progression
H_2 – Fail to Reject	Each maturity level has a different progression model.	Three significant models developed to predict different levels of progression granularity. The current IMMe data set did not have enough observations per level to confidently evaluate.
H_3 – Fail to Reject	A generalizable model can be used to predict innovation progression.	IMMe generalized business objectives and functional capabilities ranking created as criterion to evaluate case data to align business objectives to progression
H_4 – Fail to Reject	The components of the IMMe can be used to link the rate of maturity progression to the overall business objectives	A significant regression model with a R^2 of 0.9 established and tested with case data.
Q_1 – ✓	What are the generalized and prioritized: • Business Objectives • Functional Categories and Attributes	Multi-criteria ranking established for business objectives and functional capabilities

Chapter 5 Discussion

Maturity models provide a perspective to understand the evolution of continual change. What's mature for one organization does not always apply to a different organization. Maturity models need to take into consideration an appreciation of context, and an understanding of the contingent variables that influence change and execution (Mullaly 2014). The criteria that define business objectives and prioritized functional capabilities is different for every organization. The IMMe progression is a composite measure that includes variables that link process and capability maturity to prioritized business objectives. The IMMe provides an initial framework to associate maturity progression to business objectives and desired outcomes.

Based on the analysis of the data, there are three significant findings. The three key findings were; initial verification of IMMe components via the case study, the lack of maturity level boundaries and thresholds, verified the IMMe as a useful framework to bridge a gap to associate innovation maturity progression to business objectives and desired outcomes. The following sections provide a brief discussion of the key findings.

5.1 IMMe case study discussion:

Three innovation portfolios were used to verify the IMMe progression model. The use of the generalized business objectives and prioritized functional capabilities provided common criteria and a controlled means to evaluate three different innovation portfolios. Applying the generalized criterion to the test cases, verified the potential effect of the overall maturity progression. There were three distinct things that the case study revealed:

(1) If the initial aggregated process maturity level was less than 2.2, changes focused on innovations had a nominal effect on the overall progression. At the lower levels of IMMe progression, changes in strategy and decision maturity levels moved the overall IMMe progression level between 2-6%. Keeping all other variable constant and simulating changes in maturity process, the IMMe progression level would go up. When the process maturity reached 3.2, the ability to influence IMMe progression tapered.

(2) The weighting attributes used to score the innovation items from case study portfolios provided an unexpected finding. The data showed that the evaluated innovation item maturity scores were lower than expected. The intent of the evaluation was the alignment and linkage between business objectives and prioritized capabilities. When the weighting attributes were applied, a level of realism was revealed. (a) Core innovations were operational but were acquired via build and typically provided capabilities at maturity level 2 or 3. (b) Enabling innovations were scored the highest because they were oriented towards capabilities at level 3-5, the innovation status scores were level 2-4, and the acquisition status was level 3-5. This indicates a shift to consuming capabilities instead of building them. (c) Accelerant innovations were scored the lowest because they were typically oriented towards capabilities at level 4-5, the innovation status scores were level 1-2, and the acquisition status was level 1-3. This provided the details to validate why accelerants do not directly influence the overall IMMe progression. The thing of value about accelerant innovations is that they represent a set of innovative alternatives to select from to drive or accommodate market disruptions.

Table 5-1 Innovation Evaluation Attributes – the innovation status and acquisition attributes were used to score case study innovation items. The additional attributes were used to provide some additional fidelity.

Innovation Status	Weighted Value
Operational	5
Test	4
Development	3
POC	2
Concept	1

Acquisition Status	Weighted Value
Consumption	5
Leverage	4
Integrate	3
Buy	2
Build	1

(3) Individual innovations items alone did not have a direct influence on the overall IMMe progression. Establishing a set number of rated innovations per innovation category (i.e. core, enabler, or accelerant) indicates an influence on progression. The value is not the quantities of innovations but the establishment of prioritized innovation sets. The IMMe prioritized innovations incorporate criterion of prioritized capabilities, business objectives, and status all linked to prioritized business objectives. This effort helps to establish a contextual connection to maturity progression to outcomes. The IMMe data model provided a method to simulate the impact of little changes addressing the broader context of business outcomes. Regardless of potential maturity progression, the ability to select changes that have the greatest impact on desired outcomes is the real business value. The IMMe data model provides the ability to change weighted factors and priorities to see the shift in prioritization to include awareness of the IMMe maturity progression. This is a simple example of addressing concerns expressed in the literature (M. Mullaly 2008).

5.2 Maturity boundaries and Thresholds:

One of the initial objectives of the study was to use the IMMe to determine specific boundaries and thresholds between each maturity level. Moreover, the effort to

determine the precise boundaries and thresholds for maturity progression was the wrong question. The definitions that define those maturity levels are so unique to build a model would not be purposeful. Additionally, the statistical analysis to validate progression boundaries and thresholds was inconclusive. The IMMe predictive models provided a broader utility than expected. The fact that the IMMe does not explicitly define maturity boundaries and thresholds is a good thing. This allows for the continual change in the criteria that define success. As suggested by Miles and Snow (1984) maturity models must account for fit and adapt and not represent static or Boolean capability. If the question was; what do I have to do to get to maturity level-3, the IMMe will not delineate specific activities to progress to a specific level. The IMMe provides a predictive model that allows the user to focus on changes that will have the greatest overall impact. Having the ability to understand which variables can move progression is more important. The predictive model allows the user to see the potential effect of changes.

5.3 A Bridge to Linking Progression to Desired Outcomes:

A bridge to link business objectives and innovation maturity progression to business outcomes can be established. The case study application provided a means to verify that the IMMe does have generalized applicability for commercial or federal organizations. Based on the data collected and analysis performed the components the IMMe allow users to measure the net changes needed to support the desired outcome. The IMMe can provide three levels of measures; (a) a simple approach to establishing a baseline and an initial innovation maturity progression measure for awareness using

aggregated and decomposed variables, (b) ability to isolate the specific variables that have the greatest overall impact. The data collected and analyzed verified specific variables that influence maturity progression, more importantly, it identified which variables did not directly influence progression. The verification of variables that affect maturity progression (c) A generalized data model to manage the relationships and dependencies between independent IMMe components and criteria. The IMMe data model is a simple structure to manage criteria changes. Maturity is a never-ending endeavor; it is constantly evolving. The IMMe has a built-in method to account for independent changes, relationships, and impact on innovation evaluation scores and maturity levels that impact the overall progression objectives. The measured progression is always aligned with the business objectives and desired outcomes.

5.4 Study Limitations:

Study results are tempered and constrained with limitations, many of which inspire further research: First, the IMMe framework is based on the underpinning of existing literature. The questions that defined expert judgment survey may propagate bias based on those maturity model-related requirements and criticism that have been documented and published. In order to operationalize the IMMe framework's usefulness and applicability, collaborative discussions should be held with business leaders, maturity model users, and developers from both industry and academia.

Another limitation of this study is the use of generalized business objectives and prioritized capabilities. The use of generalized criterion was beneficial to verify IMMe components within in a controlled environment. Every organization will have a unique

set of business objectives and prioritized capabilities; the study does not account for that difference. The IMMe needs to be field tested to validate the findings of this study before a general assertion can be established.

The most significant limitation of this study is that the results cannot be used to establish a definitive correlation or causation between IMMe progression and business outcomes. The study did not collect financial data, details about innovation development and operations costs, nor the business impacts attributed to innovation capabilities. If this type of data could be collected and analyzed, it would provide an opportunity to assess maturity progression with the correlation to business outcomes empirically.

5.5 Future Research:

This study established an initial framework to predict and measure innovation maturity progression in the context of business objectives. The lack of existing empirical research in this area makes it a very bountiful topic for future examination. Future research should be directed towards: (1) conduct empirical studies with practitioners to demonstrate the validity and usefulness of the IMMe. This would provide valuable data needed to validate correlation and causation between maturity progression and actual business outcomes; (2) execute and expanded industry surveys to gain further insight into the factors contributing or hindering the use of contextual properties. This will establish additional contextual details between the general components that define maturity models; (3) establish IMMe progression benchmarks based on organizational size, industry, and value impact. This would provide meaningful and relevant guidance

to improve applicability for industry practitioners improving a broader usefulness; (4) prototype a semantic tool that simplifies the ability to integrate and discovery dynamic relationships that impact maturity progression alternatives. This provides a means to account for and deal with the pace of change that is driven by constant disruptions in various market

5.6 Conclusion:

This study established and verified an initial framework to predict and measure innovation maturity progression in the context of business objectives. The main contribution provides practitioners with relevant and useful insight to identify and select changes that have the greatest impact to produce business outcomes. The IMMe addresses the relationships between process maturity, business criterion, and innovation maturity while planning and implementing business transformation. A lot of small changes focused in the right direction matters.

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Appendix A – IMMe Survey

Innovation Maturity Assessment - V1.0

Q2 Dear Respondent, This survey is being conducted by Melvin Kinnebrew Jr., a doctoral student at George Washington University (GWU). The purpose of this study is to elicit expert opinion and judgment to create a baseline of generalized weighted factors and discrete criteria to frame innovation decision alternatives. Study results will be used to create an extended Innovation Maturity Model (IMMe) that can be used to minimize unintended impacts from reactionary innovation decisions. The developed IMMe will be used to complement organizational decision processes that drive transformational changes and business outcomes. The following survey includes questions that ask you to describe your opinion pertaining to suggested innovation criteria, innovation life-cycle maturity, and thresholds needed to drive innovation realization. You will also be asked to describe your opinions about the effectiveness of an innovation strategy, any hardships you experienced, and any approaches used to resolve challenges. The survey also includes demographic questions about your experience, organizational role, the current market/business domain you support, and the level of influence you have to identify or drive change. The total amount of time you will spend to complete this survey is 15 minutes. By completing this survey, you are indicating your willingness to participate in this study. If you decide to participate, your responses will be anonymous, that is recorded without any identifying information that is linked to you. If you have any questions regarding this survey, please contact Melvin Kinnebrew at mkinnebrew@gwu.edu. Sincerely, Melvin Kinnebrew Jr. Doctoral Student Engineering Management and Systems Engineering George Washington University

- ❍ I agree (4)
- ❍ I do not agree (5)

Condition: I do not agree Is Selected. Skip To: End of Survey.

Q51 INNOVATION STRATEGY - The intent of this category is to assess your perspective pertaining to your organization's or your client's Innovation Strategy. Knowing the maturity level of the strategy helps establish the potential range and boundaries of the potential innovation decisions that an organization can select from.

Q52 How often is the Innovation Strategy updated?

- ❍ As needed (1)
- ❍ Annually (2)
- ❍ Semi-annually (3)
- ❍ Quarterly (4)
- ❍ Other (5) _____

Q53 Select the item that best describes the type of participation in the development of the Innovation Strategy?

- ❍ Ad-hoc participation (1)
- ❍ Top-down – driven by leadership (2)
- ❍ Bottoms-Up – driven by staff (3)
- ❍ Participative – includes input from multiple areas of the organization, clients, partners, and academia (5)
- ❍ Other (4) _____

Q54 Select the item that best describes the Innovation Strategy's focus?

- ❍ Expand market share or position (1)
- ❍ Financial growth (2)
- ❍ Optimize operational capabilities (3)
- ❍ Support business objectives (4)
- ❍ Other (5) _____

Q56 How much of the annual budget is allocated to the realization of innovations?

_____ % of annual budget allocated for innovation (1)

Q57 Select the item that best describes how innovations are prioritized.

- ❍ Based on the value provided to client (1)
- ❍ Based on desired operational capabilities (2)
- ❍ To drive financial return (4)
- ❍ To establish market leadership (5)
- ❍ Other (3) _____

Q30 INNOVATION ALTERNATIVES -- The intent of this category is to gather your opinions and perspective pertaining to your organization's/client's process to establish innovation alternatives. Knowing the maturity level of Innovation Alternatives, provides a means to establish the potential ranges and boundaries pertaining to the set of pre-defined innovation alternatives to select from.

Q31 Select the item that best describes your organization/clients' innovation pipeline?

- ❍ Notionally defined – not managed (1)
- ❍ Formally defined but manually managed (2)
- ❍ Collaboratively defined, actively managed, and controlled with repeatable processes (3)
- ❍ Automated work flows used to assess and change innovation items based on predictive analysis and trends (4)

Q32 Select the item that best describes the method or tool used to manage innovation alternatives?

- ❍ Manual - based on leadership experience – tacit knowledge (1)
- ❍ Spreadsheets (2)
- ❍ Databases – Portfolio manager (3)
- ❍ An automated tool to track and manage innovation meta data (ontology) used to proactively suggest innovation alternatives (4)
- ❍ Automated work flows that supports decision processes (5)

Q33 Based on the current innovation pipeline ---- how many of your organization/client innovations can be classified to deliver capabilities in the following categories?

_____ Core – This type of innovation provides fundamental capabilities needed to maintain essential levels of operational efficiency (1)

_____ Enablers – This type of innovation is structured to provide optimized capabilities that allows the organization to do more or new things (2)

_____ Accelerators -- This type of innovation is structured to address unmet demands or establish new business models – market disruptor's (3)

Q34 Innovation Capability Categories and Attributes (decision criteria) -- This section consist of two parts: PART-1 Provides an opportunity to select or define preferred business objectives for your

organization/client. PART-2 Provides an opportunity to select or define specific functional capability categories and their attributes used to delineate the innovation selection and evaluation criteria.

Q35 Select the Business Objectives that apply. You have an option to define two specific business objectives if they are not listed. Please select at least 3 items and no more than 5 items.

- ❑ Process Optimization (1)
- ❑ Profitable Growth (2)
- ❑ Market Share (3)
- ❑ Digital Transformation (4)
- ❑ Service Excellence (5)
- ❑ User Defined (6) _____
- ❑ Cyber Protection (7)
- ❑ Adaptive Government (8)
- ❑ User Defined (9) _____

Carry Forward Selected Choices - Entered Text from "Select the Business Objectives that apply. You have an option to define two specific business objectives if they are not listed. Please select at least 3 items and no more than 5 items."

Q36 Please prioritize in order of importance 1 being the most important (move items up or down to position based on preference)

_____ Process Optimization (1)
_____ Profitable Growth (2)
_____ Market Share (3)
_____ Digital Transformation (4)
_____ Service Excellence (5)
_____ User Defined (6)
_____ Cyber Protection (7)
_____ Adaptive Government (8)
_____ User Defined (9)

Q3 Select four of the following infrastructure/technology capability categories based on your organization/clients preference. You have an option to specify specific categories

- ❑ Hybrid Technologies (1)
- ❑ IoT (2)
- ❑ Digital Workplace (3)
- ❑ Digital Transformation (4)
- ❑ Composable Services (5)
- ❑ User Defined (6) _____
- ❑ Cyber Protection (7)
- ❑ Management Platform (8)
- ❑ User Defined (9) _____

Carry Forward Selected Choices - Entered Text from " Select four of the following infrastructure/technology capability categories based on your organization/clients preference. You have an option to specify specific categories "

Q4 Please prioritize in order of importance 1 being the most important (move items up or down to position based on preference)

_____ Hybrid Technologies (1)
_____ IoT (2)
_____ Digital Workplace (3)
_____ Digital Transformation (4)
_____ Composable Services (5)
_____ User Defined (6)
_____ Cyber Protection (7)
_____ Management Platform (8)
_____ User Defined (9)

Display This Question:
If Select four of the following infrastructure/technology capability categories based on your organi... Hybrid Technologies Is Selected

Q5 Prioritize the list of attributes for Hybrid Technologies -- You have an option to add two specific attributes

_____ Decoupled IaaS (1)
_____ S/W defined Enclaves-Zones (2)
_____ Interchangeable Platforms (3)
_____ Management Platform (4)
_____ Orchestrated Catalog (5)
_____ User Defined (6)
_____ User Defined (7)

Display This Question:
If Select four of the following infrastructure/technology capability categories based on your organi... IoT Is Selected

Q6 Prioritize the list of attributes for IoT -- You have an option to add two specific attributes

_____ APIs (1)
_____ Autonomic Sensors (2)
_____ Logic Gateway (3)
_____ Context Broker (4)
_____ User Defined (5)
_____ User Defined (6)

Display This Question:
If Select four of the following infrastructure/technology capability categories based on your organi... Digital Workplace Is Selected

Q7 Prioritize the list of attributes for Digital Workplace -- You have an option to add two specific attributes

_____ Unified Comms (1)
_____ Mobile Device Mgt (2)
_____ Collaboration (3)
_____ Messaging (4)
_____ User Defined (5)
_____ User Defined (6)

Display This Question:

If Select four of the following infrastructure/technology capability categories based on your organization/clients preference. You have an option to specify specific categories Digital Transformation Is Selected

Q8 Prioritize the list of attributes for Digital Transformation -- You have an option to add two specific attributes

_____ Synthesizing insights (1)
_____ Agile Business Models (2)
_____ Ecosystem Partners (3)
_____ Innovation Pipeline (4)
_____ User Defined (5)
_____ User Defined (6)

Display This Question:

If Select four of the following infrastructure/technology capability categories based on your organi... Composable Services Is Selected

Q9 Prioritize the list of attributes for Composable Services -- You have an option to add two specific attributes

_____ Incremental consumption (1)
_____ Progressive discovery (2)
_____ Reliable messaging (3)
_____ Independent specifications (4)
_____ User Defined (5)
_____ User Defined (6)

Display This Question:

If Select four of the following infrastructure/technology capability categories based on your organi... Cyber Protection Is Selected

Q10 Prioritize the list of attributes for Cyber Protection -- You have an option to add two specific attributes

_____ Threat Detection/Remediation (1)
_____ Cyber Intelligence (2)
_____ Adaptive Compliance (3)
_____ Security as a Service/Platform (4)
_____ User Defined (5)
_____ User Defined (6)

Display This Question:

If Select four of the following infrastructure/technology capability categories based on your organi... Management Platform Is Selected

Q11 Prioritize the list of attributes for Management Platform -- You have an option to add two specific attributes

_____ Situational Awareness (1)
_____ Broker Services (2)
_____ Orchestrated Catalog (3)
_____ Dynamic Service Models (4)
_____ User Defined (5)
_____ User Defined (6)

Q12 Select four of the following process/governance capability categories based on your organization/clients preference

- ❑ Service Excellence (1)
- ❑ Workforce Optimization (2)
- ❑ Innovation Mgt (3)
- ❑ Change Mgt (4)
- ❑ Enterprise Architecture/Standards (5)
- ❑ User Defined (6) _____
- ❑ Agile Acquisition/Contracting (7)
- ❑ Orchestrated Work-flow (8)
- ❑ User Defined (9) _____

Carry Forward Selected Choices - Entered Text from " Select four of the following process/governance capability categories based on your organization/clients preference "

Q13 Please prioritize in order of importance 1 being the most important (move items up or down to position based on preference)

_____ Service Excellence (1)
_____ Workforce Optimization (2)
_____ Innovation Mgt (3)
_____ Change Mgt (4)
_____ Enterprise Architecture/Standards (5)
_____ User Defined (6)
_____ Agile Acquisition/Contracting (7)
_____ Orchestrated Work-flow (8)
_____ User Defined (9)

Display This Question:
If Select four of the following process/governance capability categories based on your organization/... Service Excellence Is Selected

Q14 Prioritize the list of attributes for Service Excellence

_____ Internal Audits (1)
_____ Customer Experience (NPS) (2)
_____ Issue/Resolution Mgt (3)
_____ Collaborative Feedback (4)
_____ User Defined (5)

Display This Question:
If Select four of the following process/governance capability categories based on your organization/... Workforce Optimization Is Selected

Q15 Prioritize the list of attributes for Workforce Optimization

_____ Training/Certification (1)
_____ Analytics (2)
_____ Retention Mgt (3)
_____ User Defined (4)
_____ User Defined (5)

Display This Question:
If Select four of the following process/governance capability categories based on your organization/... Innovation Mgt Is Selected

Q16 Prioritize the list of attributes for Innovation Mgt

_____ Orchestrated Work-flow (1)
_____ Assessment and Analytics (2)
_____ Intellectual Property (3)
_____ Testbed and Tools (4)
_____ User Defined (5)
_____ User Defined (6)

Display This Question:
If Select four of the following process/governance capability categories based on your organization/... Change Mgt Is Selected

Q17 Prioritize the list of attributes for Change Mgt

_____ Automated Work-flow/Governance (1)
_____ Asset control (2)
_____ Communication/Collaboration (3)
_____ Configuration Standards (4)
_____ User Defined (5)
_____ User Defined (6)

Display This Question:
If Select four of the following process/governance capability categories based on your organization/... Enterprise Architecture/Standards Is Selected

Q18 Prioritize the list of attributes for Enterprise Architecture/Standards

_____ Standards/Best Practices (1)
_____ Automated Work-flow (2)
_____ Extensible Models (3)
_____ Analytics/Tools (4)
_____ User Defined (5)
_____ User Defined (6)

Display This Question:
If Select four of the following process/governance capability categories based on your organization/... Agile Acquisition/Contracting Is Selected

Q19 Prioritize the list of attributes for Agile Acquisition/Contracting

_____ Procurement Forecasting (1)
_____ Solicitation Mgt (2)
_____ Contracts Mgt (3)
_____ Automated Work-flows (4)
_____ User Defined (5)
_____ User Defined (6)

Display This Question:

If Select four of the following process/governance capability categories based on your organization/... Orchestrated Work-flow Is Selected

Q20 Prioritize the list of attributes for Orchestrated Work-flow

_____ Tailorable Models (1)
_____ Delegation Thresholds (2)
_____ Compliance (3)
_____ Analytics (4)
_____ User Defined (5)
_____ User Defined (6)

Q21 Select four of the following application/data technology capability categories based on your organization/clients preference

- ❑ Application Architecture (1)
- ❑ Anticipatory Analytics (2)
- ❑ Autonomic Intelligence (3)
- ❑ Data Architecture (4)
- ❑ Continuous Dev/Ops (5)
- ❑ User Defined (6) _____
- ❑ Data Services (7)
- ❑ Composite Applications (8)
- ❑ User Defined (9) _____

Carry Forward Selected Choices - Entered Text from " Select four of the following application/data technology capability categories based on your organization/clients preference "

Q22 Please prioritize in order of importance 1 being the most important (move items up or down to position based on preference)

_____ Application Architecture (1)
_____ Anticipatory Analytics (2)
_____ Autonomic Intelligence (3)
_____ Data Architecture (4)
_____ Continuous Dev/Ops (5)
_____ User Defined (6)
_____ Data Services (7)
_____ Composite Applications (8)
_____ User Defined (9)

Display This Question:

If Select four of the following application/data technology capability categories based on your orga... Application Architecture Is Selected

Q23 Prioritize the list of attributes Application Architecture

_____ Usability (1)
_____ Strong cohesion / low coupling (2)
_____ Security Standards (3)
_____ Scalability (4)
_____ User Defined (5)
_____ User Defined (6)

Display This Question:

If Select four of the following application/data technology capability categories based on your orga... Anticipatory Analytics Is Selected

Q24 Prioritize the list of attributes Anticipatory Analytics

_____ Process real-time data feeds (1)
_____ Merge past and present (2)
_____ Adaptive Learning model (3)
_____ Meta Data standards (4)
_____ User Defined (5)
_____ User Defined (6)

Display This Question:

If Select four of the following application/data technology capability categories based on your orga... Autonomic Intelligence Is Selected

Q25 Prioritize the list of attributes Autonomic Intelligence

_____ Self-learning (1)
_____ Self-healing (2)
_____ Policy and Rules (3)
_____ Optimization (4)
_____ User Defined (5)
_____ User Defined (6)

Display This Question:

If Select four of the following application/data technology capability categories based on your orga... Data Architecture Is Selected

Q26 Prioritize the list of attributes Data Architecture

_____ Data standards (1)
_____ Models (semantic, logical, physical, etc) (2)
_____ Policies (3)
_____ Mapping/Integration (4)
_____ User Defined (5)
_____ User Defined (6)

Display This Question:

If Select four of the following application/data technology capability categories based on your orga... Continuous Dev/Ops Is Selected

Q27 Prioritize the list of attributes Continuous Dev/Ops

_____ Quality Assurance (QA) (1)
_____ Platform Services (2)
_____ Automated Governance (3)
_____ Training (4)
_____ User Defined (5)
_____ User Defined (6)

Display This Question:

If Select four of the following application/data technology capability categories based on your orga... Data Services Is Selected

Q28 Prioritize the list of attributes Data Services

_____ Orchestrated work-flows (1)
_____ Testbed (2)
_____ Packaging (3)
_____ Code/build (4)
_____ User Defined (5)
_____ User Defined (6)

Display This Question:

If Select four of the following application/data technology capability categories based on your orga... Composite Applications Is Selected

Q29 Prioritize the list of attributes Composite Applications

_____ Service Bus (1)
_____ Component Catalog (2)
_____ Design Patterns (3)
_____ Service Models (4)
_____ User Defined (5)
_____ User Defined (6)

Q40 INNOVATION LIFE-CYCLE -- The intent of this category is to establish your opinion and perspective pertaining to your organization/client's ability to manage, change, and execute innovation activities. Knowing the maturity level of the innovation life-cycle helps to establish the potential range and boundaries pertaining to the organization's ability to execute the innovation strategy, plans, and projects

Q41 Select the item that best describes your organization/client innovation life-cycle.

- ❍ Organizational innovation decisions are not coordinated and the execution of cross-functional teams lack consistency and limited use of best practices (4)
- ❍ Manual execution -- Innovation portfolios defined, formalized roles, basic processes defined, and control gates used to deliver innovation projects (3)
- ❍ Semi-automated processes used to establish clear direction, metrics, and ownership needed to drive consistent innovation execution (2)
- ❍ Automated work-flows that incorporate best practices while enforcing approved governance to empower all levels of the organization (experiment, change, or terminate) (1)

Q42 How long does it take your organization/client to realize the desired value of approved innovation projects (from inception to implementation)?

- ❍ With in 2-3yrs (1)
- ❍ 18-24 months (2)
- ❍ 9-15 months (3)
- ❍ Within 16-25 weeks (5)
- ❍ Less than 16 weeks (4)

Q43 What's the desired time-frame you believe your organization/client needs to strive for to realize measurable business outcomes based on implemented innovations?

- ❍ 18-24 months (1)
- ❍ 9-15 months (2)
- ❍ Within 16-22 weeks (4)
- ❍ Less than 16 wks (5)

Q44 How much time (number of weeks) does your organization/client spend in each of the following innovation Life-cycle phases

_____ Concepts (1)
_____ Selection/approval (2)
_____ Experiment/prototypes (3)
_____ Initial pilot (4)
_____ Packaged production (5)

Q47 Select the item that best describes your organization/client overall Innovation Life-cycle.

- ❍ Project execution is inconsistent and the ability to effectively respond to market changes constrained (1)
- ❍ We have documented life-cycle processes focused on conservative investments resulting in gradual and predictable growth (2)
- ❍ We have an automated means to launch planned innovations with confidence that include breakthrough innovations that delivers revenue growth (3)
- ❍ Our innovation pipeline is not clearly defined nor communicated and we occasionally miss market windows and margin targets. (4)
- ❍ The organization has a limited set of innovation processes, but it is not required for company success (5)

Q45 Does your innovation life-cycle incorporate decision criteria to determine if a potential innovation should be:

	Always (1)	Sometimes (2)	Never (3)
Purchased (2)	❍	❍	❍
Consumed as a service (3)	❍	❍	❍
Integrated (5)	❍	❍	❍
Built (1)	❍	❍	❍
Terminated (4)	❍	❍	❍

Q46 Select the item that best describes how your organization/client selects innovations?

- ❍ Specifically based on the personalities and politics within senior Leadership (1)
- ❍ Explicit to financial characteristics (2)
- ❍ Based on an alignment between business objectives, culture, and client impact (3)
- ❍ Based on measurable criteria and thresholds linked to specific organizational objectives and desired outcomes (4)

Q48 Select the item that best describes the organization's/client's flexibility to accommodate evolving business conditions.

- ❍ No flexibility (1)
- ❍ Limited flexibility – manual process – limited view of proposed impact of change or associated dependencies (2)
- ❍ Mature and repeatable processes used to assess impacts and dependencies (3)
- ❍ Automated processes that incorporate predictive and anticipatory analysis to proactively suggest changes (4)

Q49 Which of the following categories are measured by the Innovation Life-cycle? - select all that apply

- ❑ Client or market adoption (1)
- ❑ Financial return (2)
- ❑ Operational capabilities (3)
- ❑ Business/mission outcomes (4)
- ❑ No categories measured (5)

Q50 How is experimentation incorporated in the innovation life-cycle?

- ❍ Not incorporated (1)
- ❍ Allowed but there are consequences pertaining to failure (2)
- ❍ Encouraged at all levels of the organization with an understanding that failure can be just as valuable as success (3)
- ❍ Experiments are explicitly identified and approved by leadership (4)

Q69 What is your current role?

- ❍ Executive Leadership (1)
- ❍ Line of Business Director (2)
- ❍ Program Director (3)
- ❍ Technical Leadership (4)
- ❍ Other (5)

Q60 How long have you been in your current role?

- ❍ Less than 1 yr (1)
- ❍ 1-3 yrs (2)
- ❍ 3-7 yrs (3)
- ❍ 7-15 yrs (4)
- ❍ More than 15 yrs (5)

Q61 Which domain do your focus on?

- ❍ Commercial Services (1)
- ❍ Public Sector Services (2)
- ❍ Product Development (3)
- ❍ Non-Profit (4)
- ❍ Other (5)

Q62 If you would like a follow-up pertaining the completed assessment, please provide the following:

Name (1)
E-Mail (2)

Q63 Your participation is greatly appreciated, once again thank you.