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Exploring Factors Influencing Information Technology Portfolio Selection Process in Government-Funded Bioinformatics Projects

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Walden University
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Abstract

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MS, Regis University, 2007

MS, Colorado Technical University, 2007

BS, Strayer University, 1999

Dissertation Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Philosophy

Management

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Abstract

In 2012, the National Cancer Institute's (NCI) Board of Scientific Advisors (BSA) conducted a review of the Center for Biomedical Informatics and Information Technology's (CBIIT) bioinformatics program. The BSA suggested that the lack of a formal project selection process made it difficult to determine the alignment of projects with the mission of the organization. The problem addressed by this study was that CBIIT did not have an in-depth understanding of the project selection process and the factors influencing the process. The purpose of this study was to understand the project selection process at CBIIT. The research methodology was an exploratory case study. The data collection process included a phenomenological interview of 25 managers from program management, engineering, scientific computing, informatics program, and health sciences. The data analysis consisted of coding for themes, sensitizing, and heuristic coding, supported by a theoretical framework that included the technology acceptance model, the program evaluation theory, and decision theory. The analysis revealed the need for formal project portfolio governance, the lack of a predefined project selection process, and that the decision-making process was circumstantial. The study also revealed six major themes that affected the decision-making process: the CBIIT mission, the organizational culture, leadership, governance, funding, and organizational change. Finally, the study fills the gap in the literature regarding the project selection process for government-funded initiatives in information technologies. This study may contribute to positive social change by improving the project selection process at CBIIT, allowing for the effective use of public funds for cancer informatics researchers.

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Dedication

I want to dedicate this dissertation to my wonderful family, Walky, my lovely wife, and our children, Bilerkis, Caitlyn, Aibblyn, Braulio, and Erik. Thank you guys for your patience; I know I took many hours that otherwise we would have spent together. I also want to dedicate this work to the Almighty, who gave me the strength to see my work to completion. You pick the name that better fits your background or beliefs; Allah, Christ, Krishna, Lambda, the Universal Consciousness, Yehovah, Elohim.

Acknowledgments

There are so many people who deserve acknowledgment—family members, friends, and colleagues. Of course, due to space limitations, I cannot cite everyone here, but keep in mind that you are also acknowledged, and I express my gratitude for your continuous support and encouragement. I would like to thank my dissertation committee chair, Dr. Robert DeYoung; without your encouragement and supervision I was not going to be able to make it. You kept me on track and encouraged me during times when the task became challenging. Also, I would like to thank Dr. Wells, who, along with Dr. DeYoung, encouraged me during the most difficult periods of this endeavor.

My appreciations to Dr. John Nirenberg and Dr. Raghu Korrapati, my dissertation committee members, for the time you took to review my work and for your participation in my dissertation oral defense. A great token of appreciation to Dr. Warren Kibbe, Director for the Center for Biomedical Informatics and Information Technology at the National Cancer Institute. Your support and permission to conduct my research in your organization are greatly appreciated; I hope this study can contribute to your vision of a better CBIIT for the benefit of all cancer patients.

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Chapter 1: Introduction to the Study

Health informatics and biomedical informatics projects inherit the risks of failure common to information technology projects. In particular, government IT initiatives confront many challenges. Funding challenges, outsourcing challenges, and problems related to research and development practices are very common (Arshad, Idrus, & Ahmad, 2012; Kwak, Liu, Patanakul, & Zwikael, 2014).

Biomedical informatics is a multidisciplinary field that focuses on the use of IT and biomedical data to create knowledge that can assist in scientific research. The scope of biomedical informatics extends across the human health spectrum, from molecular biology to entire human populations. Many theories and fields inform biomedical informatics, including computing, algorithms, mathematics, data mining, and the human genome (Ness & Wizemann, 2012). When applied to oncology-specific research, biomedical informatics is concerned with creating knowledge to advance cancer research at the molecular level, including an understanding of cell biology, genomics, and gene mutations, to mention a few.

Biomedical informatics allows researchers to manage, analyze, and disseminate the vast amount of data generated by processes such as gene sequencing. The list of initiatives related to this field in cancer research and other health-related research grows exponentially every year (Shortliffe & Cimino, 2013). Organizations undertaking government-funded biomedical informatics projects must exercise caution when selecting initiatives to ensure the best return on investment of taxpayers' dollars.

Finding ways to be more efficient in managing IT in government is necessary for obtaining meaningful results. Given the potential impact of biomedical informatics in the fight against cancer, identifying and managing factors that could increase the effectiveness of these programs is imperative (Ness et al., 2012).

Kundra (2010), the first Chief Information Officer at the White House, asserted the importance of IT for serving the American people. He recognized that the federal government has spent more than $600 billion on IT in the past 10 years and has had minuscule results compared to the IT accomplishments of the private sector. In 2009, as part of the American Reinvestment and Recovery Act, the U.S. Congress appropriated $20 billion for health IT (Kaplan & Harris-Salamone, 2009; Park, Lee, & Kim, 2015).

Following the parameters established by the U.S. Congress, the National Cancer Institute (NCI) embarked on the challenge of identifying potential bioinformatics projects. The NCI's primary obstacle was executing such initiatives within the time stipulated by Congress for the use of stimulus funds. Notably, the NCI Center for Biomedical Informatics and Information Technology (CBIIT) initiated a large number of bioinformatics development projects as part of its cancer Biomedical Informatics Grid (caBIG) program. The majority of these projects resulted in products that the cancer research community only minimally adopted. Among the reasons for the adverse outcome of these projects is that many of the projects in the project portfolio at CBIIT did not fit the needs of the users Califano, Chinnaiyan, Duyk, Gambhir, Hubbard, Lipman, Harris, C. L. (2011)

This misalignment with users' needs is an indication that the selection process was ad hoc or intuitive instead of systematized (Bibles & Bivins, 2011; Califano et al., 2011). A negative impact on return on investment due to a misalignment of the IT portfolio with the mission of the organization is not uncommon in the private sector (Constino, Di Gravio, & Nonino, 2015). In the public sector, the effect of such a misalignment has more than just financial implications; this type of miscalculation has an adverse impact on social and scientific investments as well (Kundra, 2010; Seeber, 2011). The case of CBIIT is an opportunity for in-depth, qualitative understanding of the portfolio selection process.

Chapter Organization

Chapter 1 contains a detailed background of the study, the statement of the problem, and the purpose of this qualitative exploratory case study (Yin, 2014). The chapter includes objectives, scope, and an introduction to the data collection approach. The chapter continues with an introduction of the research questions and a description of the nature of the study, including the rationale for a qualitative exploratory case study. I discuss the importance of adopting both conceptual and theoretical frameworks to guide the study. The theoretical framework section introduces the theories framing the study, namely, decision theory (Hansson, 2005), the technology acceptance model (Davis, 1989), and program evaluation theory (Scriven, 1998). Other items covered in this chapter are definitions, the assumptions made in the study, scope and delimitations, and limitations of the study. The chapter concludes with the significance of the study and chapter summary.

Background of the Study

In 2011, the NCI Board of Scientific Advisors (BSA) identified 32 projects in the CBIIT life sciences project portfolio. The cancer community only minimally adopted these projects (Califano et al., 2011). As the BSA explained: "The majority of the 32 Bench-to-Bed research tools developed by caBIG under contracts with commercial or academic investigators have had very limited usage and, as a result, have not generated significant impact in the scientific community" (as cited in Califano et al., 2011, p. 7). As of 2011, CBIIT has retired the caBIG program and replaced it with the National Cancer Informatics Program (NCIP). There is no evidence that the new program uses anything other than an intuitive, ad hoc approach to project selection. An intuitive approach to project selection does not consider the effect that the selection process has on the rate of adoption of the projects. According to Seeber (2011) and Pinto (2012), a strategic approach to the project selection process might yield a portfolio of projects with a higher rate of adoption. Teller, Under, Cock, and Gemuden (2012) emphasized the need for formalization between projects and project portfolio management; the authors considered the formalization as a factor influencing the success of the projects in the portfolio, while Jerbrant and Gustavsson (2013) recognized the need for awareness and a better understanding of project portfolio management and its dependency on efficient project selection.

The Economist Intelligence Unit (2011) identified the need for value creation in government projects, the need for intelligent project selection, and the challenge of considering the input of diverse stakeholders. The U.S. government recognized the need

for a better project selection process in presidential directives such as Office of Management and Budget (2006) Circular A-11 Part 7 and Section 300 on planning, budgeting, acquisition, and management of capital assets. Institutions such as the Project Management Institute (PMI) have proposed elements to consider in the selection process, including (Kodukula, 2014; PMI, 2013):

- Ranking potential projects by value and benefits
- Appraisal of risk
- Inventory of resource availability and allocation
- Determination of optimal or acceptable size of the project pipeline
- Alignment of projects with strategic plans
- Balancing projects by purpose and benefits
- Balancing opportunity, benefits, and risks

These elements are essential in the selection process and commonly used in the private sector. Many government organizations in the United States, including CBIIT, use intuitive, ad hoc approaches (Califano, 2011; Cancer Informatics for Cancer Centers [CI4CC], 2013; Jigeesh, 2012). In 2012, the NCI established the NCIP Informatics Council to ensure strategic alignment of the biomedical informatics programs and to advise CBIIT on the prioritization of projects (CI4CC, 2013). Nevertheless, the NCIP Informatics Council has not addressed the problem of creating a formal project selection process or the use of intuitive, ad hoc approaches. One of the goals of this group was to "support the definition of informatics requirements and priorities in particular domains"

(NCI: Center for Bioinformatics and Information Technologies, 2012, p. 1). The council did not provide specific guidance for the evaluation of new initiatives.

The purpose of this qualitative exploratory case study was to obtain an in-depth understanding of the project selection at CBIIT. To acquire such an understanding, one must approach a qualitative exploratory case in a phenomenological way, investigating the phenomenon as experienced by the participants and through the researcher's reflection. Phenomenological reflection on themes helps balance the research context (Flick, 2014; Manen, 2014). The need for this study was driven by the need to utilize public funds better in programs supporting the use of IT in scientific research, and the need to fill the gap in the literature about project selection process in government funded IT initiatives.

Need for the Study

The necessity of this study was twofold. First, the study was necessary based on the NCI BSA report (Califano et al., 2011) on CBIIT's project portfolio. That report found that many of the projects in the CBIIT portfolio did not align with the needs of the community. The report also indicated that CBIIT did not use a formal selection process to determine which projects to include in the portfolio. Second, this study fills a gap in the literature related to the project selection process in government-funded software development initiatives. Previously researchers had provided only general recommendations and did not consider the unique factors that affect government-funded initiatives. Project management standards such as the PMI Project Portfolio Management Standard (PMI, 2013) do not address this issue.

Silva, Guo, Ma, Jiang and Chen (2013). described the difficulties in finding project selection criteria for government-funded technology R&D. According to the authors, unlike project selection in private sectors, which is based mostly on financial revenue, in government, the problem of defining selection criteria is simultaneously more difficult and discussed less often. The literature on projects based on financial return on investment, such as projects in the private sector, is extensive. According to Nassif, Filho, and Nogueira (2013), the selection criteria include public policies and social benefits or social return on investment the literature is scarce.

Problem Statement

Many studies have depicted the benefits of using sound approaches to project selection in project portfolio management (Abbasinjahromi & Rajaie, 2012; Binneman & Steyn, 2014). Previous research has not addressed the reason that, given the benefits of a formal project selection process, project-based public institutions have only minimally adopted formal project selection processes (Nassif et al., 2013; Parker, Parsons, & Isharyanto, 2015).

The problem I investigated in this study was that the NCI CBIIT was not using a formal project selection process for its bioinformatics project portfolio. The lack of such a process had resulted in a choice of projects that may not align with CBIIT's mission or the needs of the cancer research community (CI4CC, 2013; Hansen & Kraemmergaard, 2013). Consequently, the cancer research community did not adopt the products of these projects or shortly abandoned the use of such products, resulting in the loss of public funds (Califano et al., 2011). Researchers in management have long known that the lack

of a well-defined project selection process affects project portfolio management for many project-based organizations. In particular, the current project portfolio management literature has not addressed these issues in the context of government-funded initiatives. For this study, I assumed that the selection process influences project outcome and the performance of the overall project portfolio (Teller et al., 2012; Tofighian & Naderi, 2015).

Purpose of the Study

The purpose of this qualitative exploratory case study was to understand the project selection process at the CBIIT through a phenomenological approach. The research design followed a case study approach limited to the project selection process at CBIIT. The project selection process at CBIIT was the primary unit of analysis. Using a purposeful, nonrandom sampling, I recruited 25 people who participated in the project selection process at CBIIT. The population included members of CBIIT's program management, engineering, scientific computing, informatics, and health science groups.

Research Questions

The following research questions guided this study:

RQ1: How does CBIIT select projects for its project portfolio?

RQ2: What type of decision-making process guides the selection of projects in the CBIIT project portfolio?

RQ3: What environmental factors affect the decision-making process?

Theoretical Foundation

The theoretical framework helps inform the research design, including data collection strategy and data analysis, and aids in a further generalization of the results (Ravitch & Riggan, 2012; Yin, 2011). Three theories informed the current study: (a) decision theory (Hansson, 2005), (b) Davis's (1989) technology acceptance model, and (c) Scriven's (1998) program evaluation theory.

Decision Theory

Decision theory developed as an interdisciplinary subject; the theory incorporates economics, statistics, psychology, political sciences, social sciences, and philosophy. Decision theory addresses "goal-directed behavior in the presence of options" (Hansson, 2005, p. 6). Normative and descriptive methods influence and support decision theories. Normative decision theory refers to how people should make decisions while descriptive theory refers to how people actually make decisions. According to Hansson (2005), before applying decision theory, it is necessary to resolve issues of ethics and political norms. The normative issues relate to questions about how individuals act in the presence of uncertainty, such as cases where not enough information is available and how individuals coordinate decisions over time and in social settings.

Simon (as cited in Hansson, 2005) proposed a three-phase approach to decision-making: "occasions to make a decision; possible courses of action; and choosing among courses of action" (p. 10). Other important aspects of decision theory include the modern sequential models, nonsequential models, decision and value, and comparative value terms. Given that the process of project selection is a decision-making process, this

theory contributed to shaping the theoretical and conceptual frameworks of this study (Howard & Abbas, 2015).

Technology Acceptance Model

Davis (1989) developed the TAM as part of his doctoral thesis work at the MIT Sloan School of Management. The aim of TAM was to evaluate concepts that could predict user acceptance of information processing systems. According to Davis, the existing measuring tools were invalid in practice because they did not pertain to information systems. Davis hypothesized that the acceptance of an information system was the result of a response to external stimuli. Davis asserted that using the stimuli as a measurement would predict the acceptance or rejection of the system. He argued that such stimuli relate to the system's features and lead both to a user's motivation to use and actual use of the system.

Researchers have considered the TAM one of the predominant theories in predicting adoption of IT (Park, Rhoads, Hou, & Lee, 2014; Prieto, Miguelañez, & Peñalvo, 2015). Holden and Karsh (2010) argued that even when health informatics research focuses on design and implementation, it does not give enough importance to how the end users will react to the IT. The authors considered the implications of design and implementation of IT in health care versus the use of IT in health care as the definition of success regarding IT adoption (Holden & Karsh, 2010). Their study examined cases of underuse, resistance, workarounds, override, sabotage, and abandonment of health care IT systems after successful implementation phases. Holden and Karsh reviewed over 20 studies in which TAM was used in health care IT to predict

adoption and concluded that users increasingly portrayed TAM as a fitting method when applied to health care (p. 159). Pai and Huang (2011) reached the same results in a similar study using TAM as a conceptual model for determining users' intention to use health care information systems.

Program Evaluation Theory

Researchers developed program evaluation theory to evaluate the effectiveness of educational programs; such evaluation combines several theories, models, and strategies. Program evaluation theory started during the late 1960s and early 1970s with the contribution of Scriven, Pelham, and Worthen. Scriven and Worthen (as cited in Fitzpatrick & Sanders, 2012) defined evaluation as judging the value of something. Based on this description, the theory developed for the purpose of examining hypotheses and policies used in educational institutions. Tyler's (as cited in Alkin & Christie, 2013) contribution focused on progressive education; he described the need to check the effectiveness of organizations, pointing out needs for improvement. According to Alkin (2013), Tyler's work is the root of contemporary education and the precursor of the evaluation movement. His work is also the translation of evaluative theories in other fields, including policy and social program evaluation. Program evaluation includes entities such as products, services, and programs in an environment where politics, organizational culture, and conflicting stakeholders influence the decision-making (Mertens & Wilson, 2012).

This study used program evaluation theory in the context of decision management. Decision management is a decision-oriented approach based on

Stuffelbeam and Shinkfield's (2007) and Alkin and Christie's (2013) context, input, process, product (CIPP) model. The CIPP model addressed the need for a more holistic view of evaluation. Stuffelbeam recognized that assessment based purely on the measurement of objectives against performance was not enough. He believed that a comprehensive approach, including accountability, objectives, plans, activities, and record keeping, was necessary to meet public demand for information about the performance of public programs. Stuffelbeam defined evaluation as the process of delineating, obtaining, and providing useful information for judging decision alternatives (Alkin, 2013; Stuffelbeam & Coryn, 2014). Delineating, the first step in any evaluation model. involves outlining as much information as possible to inform the decision process. It includes posing the right questions and identifying the source of information. The remaining tenets involve obtaining the information from the source and providing the information to the decision-makers through an exhaustive process, including assuring that the information is available in a timely fashion to decision-makers (Stuffelbeam & Coryn, 2014).

In Chapter 2, I describe in detail the use of the theoretical framework within the conceptual framework used to shape this study. The theoretical framework is not a collection of methods and procedures employed in the study. Instead, the theoretical framework serves as a wireframe linking the research to a worldview or contextual paradigm (Anfara & Mertz, 2014).

Conceptual Framework

A conceptual framework is "simply the current version of the researcher's map of the territory being investigated" (Miles, Huberman, & Saldaña, 2014, p. 20). The conceptual framework describes the scope of the study, including exclusions from the study, and other concepts and how they affect the outcome of the study (Bloomberg & Volpe, 2012). Ravitch and Riggan (2012) defined a conceptual framework as "an argument about why the problem one wishes to study matters, and why the means proposed to study it are appropriate and rigorous" (p. 7). According to Ravitch and Riggan, a conceptual framework is composed of three main items: (a) personal interests of the researcher in the particular subject of research; (b) topical research, including literature, prior research, and publications on the topic; and (c) the theoretical framework or formal theory(s) that can inform the conceptual framework.

The conceptual framework for this qualitative study began with the following:

1. My interest in understanding the project selection process at CBIIT.
2. My proposition that the current process is ad hoc and intuitive.
3. The research questions:

    RQ1 How does CBIIT select projects for its project portfolio?

    RQ2 What type of decision-making process guides the selection of projects in the CBIIT project portfolio?

    RQ3 What environmental factors affect the decision-making process?

4. The proposition that projects at CBIIT would have a higher rate of adoption if the organization used a selection process informed by a framework based on the industry's project portfolio management standards.

A researcher must evaluate the conceptual framework as to learn more about the topic through the literature review, data collection, and analysis. A conceptual framework develops iteratively as a study progresses (Sitko, 2013). The literature review in Chapter 2 examines in greater detail the preliminary concepts, assumptions, ideas, and propositions described in this section are examined (Bloomberg & Volpe, 2012; Marshall & Rossman, 2011; Ravitch & Riggan, 2012). Figure 1 is a graphical representation of this early iteration of the conceptual framework.

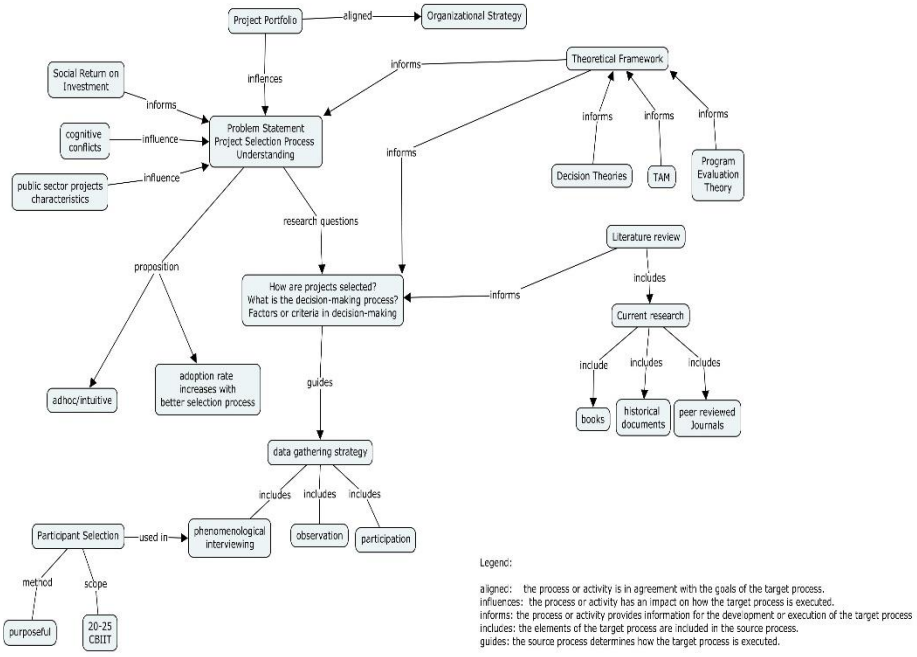

Figure 1. Information technology project portfolio selection process conceptual framework.

Nature of the Study

The purpose of this qualitative exploratory case study was to address a real-world problem by understanding in depth the phenomenon of study, in this case, the project selection at CBIIT. This understanding includes the contextual knowledge provided by the researcher, participants, and environment where the phenomenon occurs (Tracy, 2012). The strength of qualitative research resides in the ability of investigators to include self-reflectivity, context, and thick description of the phenomenon of study. Using a qualitative approach to understand the project selection process at CBIIT allowed me to gain insights that would not be possible otherwise. CBIIT is a large governmental organization with a complicated culture and constraints imposed by laws and regulations. Understanding how leaders make decisions is already a complex endeavor, and it becomes more difficult when adding cultural, political, and socioeconomic factors. Within the qualitative design, I proposed a single case study using an exploratory case design approach, as described by Yin (2011). A case study design is appropriate if the goal of the study is to understand and explain an individual phenomenon and if the researcher wants to obtain an in-depth description of the event. A case study is also advantageous if manipulation of participants, such as in experimental studies, is not possible and the researcher wants to include contextual conditions relevant to the phenomenon of study. Finally, a case study is an ideal choice if no clear boundaries exist between the phenomenon and the context (Yin, 2014). The exploratory case design approach allowed for better understanding of the phenomenon and assisted in the

development of analytical generalizations. The conceptual framework informs the overall approach to data collection and analysis.

Definitions

This study used the following terms as defined in this section.

Affective conflicts: Conflicts related to social relationships, especially in organizations where the issues become personal, and the focus shifts from solution seeking to assign blame (Rahim, 2011).

Attribute coding: Attribute coding is the process in which the researcher identifies keywords, categorized, grouped, and grouped into themes, leading to a theory. The keywords that represent characteristics of the data. Example: "I find the process of recruiting to be very tedious and superficial"—in this example, keywords such as *tedious and superficial* could be used as attribute codes (Saldaña, 2013).

Balanced decision quality: Where the decision-makers carefully consider all aspects surrounding an issue before making a decision (Gambrill, 2012).

Balanced intuition: Intuition resulting from a balance between reason, sensing, and experience (Nita & Solomon, 2015).

Bench-to-bedside research tools: Bench-to-bedside describes the process of using laboratory research results to develop new patient treatments. In the context of this study, this term refers to the bioinformatics research tools used to aid translational research (NCI, 2015).

Classical preference relation: The use of four possible cases when making a decision. The options to the decision-makers assume: *a* strictly preferred to *b* ($a \succ_i b$), *a*

and *b* are indifferent ($a \sim_i b$), *b* is strictly preferred to *a* ($a \prec_i b$) or *a* and *b* are not comparable (Bouyssou, et al., 2011).

Conflicting stakeholders: Conflicting stakeholders are those whose interest in a project is not in agreement with that of other stakeholders.

Decision-maker: In this study, the decision-maker is a project stakeholder with the authority to influence the course of the project. Commonly, the decision-maker is the project sponsor (the person funding the project) or the customer (Rantakari, 2014).

Dimensions of strategic orientation: Modes in which strategic orientation operates, including aggressiveness, analysis, defensiveness, futurity, proactiveness, and riskness. Strategic orientation is the way in which an organization position itself related to the use of its resources to attain organization's goals.

Extramural community: Community of cancer researchers outside of the NCI who receive any funding from the agency.

Fuzzy numbers: A number with an imprecise value, contrary to single-valued or ordinary numbers.

Fuzzy functions: A generalization function of a classic set in set theory.

Fuzzy utility functions: A utility function represents the preference and well-being of a consumer in making a decision. Fuzzy utility functions add the uncertainty or generalization aspects of fuzzy functions.

Informant feedback: The process by which participants in a qualitative study provide the researcher with information related to the accuracy in which the researcher

captured the participant's interpretation of the phenomenon of study. Informant feedback is also known as member check.

Interpretive devices: In qualitative research, interpretive devices are the processes used by the researcher to interpret the data, such as inductive and deductive reasoning, and theoretical grounding.

Intramural community: Institutes and centers dedicated to cancer research within the NCI such as the Center for Cancer Research (CCR) and Division of Cancer Biology (DCB).

Linguistic preference relation: The use of words in the natural language instead of numerical values as variables to form relationships to determine preferences of choice while making a decision.

Marginal utility: Meaning the same as in an economic context, the term marginal utility is used here to describe the gain or loss to the decision-makers based on their selection of available options when making a decision.

Phenomenology interviewing: A phenomenology interviewing approach is an open-ended, unstructured form of interviewing whereby the researcher attempts to understand the participants from their points of view or subjective understandings (Seidman, 2013; Vagle, 2014).

Cancer Biomedical Informatics Grid (caBIG): caBIG was an NCI Center for Bioinformatics program that existed from 2004 to 2012. It was created to mobilize digital capabilities for researchers to help accelerate scientific discovery and expand bioinformatics in cancer research (Buetow, 2008).

Phenomenological reflection: Phenomenological reflection is the process of reflecting on one's lived experience or phenomenon. Through the process of phenomenological reflection, a participant reconstructs the constitutive elements of his or her experience to give meaning to that experience (Seidman, 2013).

Predicting adoption of information technology : Within the TAM, predicting adoption of IT is the result of the observation of several concepts believed to influence the decision process. This prediction process assumes that if perceived usefulness, perceived ease of use, and attitude toward use are measured, these indicators can predict whether the end users will adopt or use a computer system (Davis, 1989).

Project portfolio alignment: Project portfolio alignment is the process of ensuring that the projects within a portfolio support the organization's strategic objectives.

Self-reflexivity: Self-reflexivity is the awareness of a researcher of her influence on the research process and the influence of the research process on the researcher (Gilgun, 2011a).

Spaces of fuzzy sets: The distance between functions in a fuzzy set. In set theory, the distance from a to b is defined as $|a - b|$, this concept is equally defined for fuzzy functions.

Structured project selection process: The project selection process refers to the procedures, including selection criteria, an organization will use to decide which projects or initiatives to add to its project portfolio (Pinto, 2012; Ma et al., 2012; Seeber, 2011). For the purpose of this study, a structured project selection process, as opposed to an ad hoc or intuitive process, will use established industry best practices and standards.

Successful project: For the purpose of this study, a successful project is a project whose resulting products (software, publication, or other artifacts) are adopted by the cancer research community and used at least through the product life cycles.

Assumptions

As the researcher, I made the following assumptions: (a) use of the site would be authorized; (b) participants would willingly participate in unstructured and open-ended interviews and provide accurate and sufficient information during the interviews; (c) for the study 25 participants would be available; (d) participants would have a range of knowledge, including oncology bioinformatics, project management in government, and cancer research; and (e) the results of this study could be generalized using an analytical and a naturalistic generalization approach. These assumptions were necessary to set expectations such as scope, required authorization, and permissions, and to ensure that the research follows a rigorous design.

Scope and Delimitations

The study focused on the project portfolio management selection process at the NCI CBIIT. The study included projects related to the NCIP. The population included only members at different levels of the CBIIT organization; the population did not include members of other NCI centers. From a conceptual and theoretical perspective, three theories were included decision theory(Hansonn, 2005), the TAM (Davis, 1989), and program evaluation theory (Scriven, 1998).

Limitations

For the study, I considered a single site: namely, the NCI CBIIT. The study included only 25 participants, selected using purposeful, nonrandom sampling including different organizational areas. The project did not have any sources of funding and participants participated voluntarily, with no expectation of financial gain. Participants received a $10.00 valued Starbuck gift card as a token of appreciation for their participation. Some of the participants refused to take the gift card due to their perception of conflicting interest.

Significance of the Study

The importance of this study resides in understanding the project selection process at CBIIT and the possibilities for analytical generalization to other, similar situations. As project management becomes more important in the public sector, the project selection process will continue to be a crucial factor (Hassanzadeh, Nemati, & Sun, 2014; Silva, Jian & Chen, 2014).

Significance to Practice

This study fills a gap in project management literature that relates to the project portfolio management and the project selection process in the public sector. In practice, project selection has been a challenge for many years, primarily because of its dependency on normative theories and deterministic approaches (Huang & Zhao, 2015; Kornfeld & Kara, 2013). Also, there is a gap between practice and theory. Practitioners tend to rely more on ad hoc, intuitive methods than on theoretical solutions. A better

understanding of the reality of public-sector project management allows practitioners to plug the gap between theory and practice (Briggs, 2014; Martinsuo, 2013).

Significance to Theory

Analysis of existing theories, including normative and descriptive theories, helps create and enhance theoretical constructs. Convergence of theory constructs in project selection has the potential to better address project-selection issues. One such construct is the TAM. In this study, I analyzed TAM concepts to determine whether they are influential in the selection process (Holden & Karsh, 2010; Mishra, 2014).

Significance to Social Change

A potential positive social change may be the improvement of the project selection process at CBIIT. Such development may allow for the funding of cancer research informatics projects that will help cancer researchers. The study could also contribute to the most efficient utilization of public funds that support cancer research. Finally, the study fills the gap in the literature regarding the project selection process at governmental organizations.

Summary and Transition

This chapter introduced the study and delineated unique challenges to IT projects in the public sector. Typical challenges include funding and outsourcing and the challenges imposed by R&D practices (Maheshwari, Jassen, & van Veenstra, 2011). The chapter included description of the need for finding better ways to manage public-sector IT initiatives (Ness et al., 2012), starting with the need for better selection of IT projects.

With this case study, I sought to understand the selection process as part of the project portfolio management at CBIIT, which currently utilizes an ad hoc or intuitive process.

This chapter provided an introduction, a background of the study, a problem statement, and the purpose of the study. The chapter also covered research questions; conceptual and theoretical frameworks; definitions; assumptions, scope and delimitations, and limitations of the study; and the significance of the study. Chapter 2 covers contemporary literature and research related to the project selection process.

Chapter 2: Literature Review

This qualitative exploratory case study addressed two problems. The first problem is that the NCI CBIIT does not use a systematic project selection process for its bioinformatics project portfolio. Apparently, the organization uses an intuitive or ad hoc approach to project selection. This approach results in a choice of projects that may not consider the mission of the organization and the needs of the cancer research community. Consequently, the cancer research community does not adopt CBIIT systems or abandons their use in a short period (Califano et al., 2011).

The second problem was the gap in the literature related to the adoption of formal IT project selection processes in the public sector. Many studies have demonstrated the benefits of using sound approaches to project selection processes (Jigeesh, 2012; Nassif et al., 2013). These studies did not address the reasons that the adoption of project selection processes is minimal in the public sector, given the benefits of a formal project selection process.

Purpose of the Study

The purpose of this qualitative exploratory case study was to understand the project selection process at the CBIIT through a phenomenological approach. The research design followed a case study approach limited to the project selection process at CBIIT. The project selection process at CBIIT was the primary unit of analysis. Using a purposeful approach to sampling, I recruited 25 people who participate in the project selection process at CBIIT. The population included members of CBIIT's program management, engineering, scientific computing, informatics, and health science groups.

The first objective of this study was to understand the selection process at CBIIT. I explored concepts such as the effect of normative behavior and subjective norms on decision-making. The second objective of the study was to fill a gap in the literature. Project portfolio management does not address the use of formal selection processes in government-funded projects in the United States (Nassif et al., 2013). The selection process comprised the steps that lead to choosing a project to include in CBIIT's portfolio. The research problem was the lack of a systematized project selection process; the impact of the problem is the execution of projects that generate solutions with low rates of adoption.

This review served to anchor the problem statement and research questions to the literature and other relevant studies on the topic (Yin, 2011). Bloomberg and Volpe (2012) used *the literature review* and *conceptual framework* as interchangeable terms. The conceptual framework described in this chapter guided me throughout this study. The conceptual framework should include concepts such as self-reflexivity, context, and think-description, which are important concepts in qualitative research (Tracy, 2012). Other concepts such as organizations and groups, government, nonprofit versus for-profit organizations, and concepts related to decision-making and technology acceptance deserved consideration in the overarching framework of this study.

The conceptual framework is the umbrella of the research. The framework draws on relevant theories, previous research, and the experience of the researcher. This overarching structure provides an understanding of the research problem, research questions, and their relationship to relevant conceptual constructs. This qualitative

exploratory case study presented the project selection process from a phenomenological perspective, attempting to understand how participants experience the process and how the process affects their day-to-day lives in the organization. Within the phenomenological tradition, the researcher must bracket the conceptual and theoretical frameworks during the data-collection phase. Bracketing or setting aside preconceived theories and concepts allows the participants to express their real feelings and experiences without filtering their answers. The conceptual and theoretical frameworks can also be used to assist with data analysis from the perspective of the theories and concepts (Manen, 2014; Vagle, 2014).

Literature Search Strategy

The search criteria used for this literature review included peer-reviewed journals, historical data related to the site of the study, and books. The databases used include the following: Academic Search Complete with full text, Emerald Management with full text, IEEE Xplore Digital Library, ProQuest Central, PubMed, SAGE Research Methods Online, and Science Direct. Keywords and phrases used in the search included *decision theory, project portfolio, technology acceptance, evaluation, decision management, project selection process, social return on investment, fuzzy numbers,* and *decision-making*. The study included the review of articles with sound arguments about the project portfolio management. I analyzed the articles for a sound approach to research, including research design, the methodology used, data collection and data analysis strategy, presentation of findings, and recommendations.

Theoretical Foundation

Three formal theories informed this study: Dewey's decision theory, Davis's TAM, and Scriven's program evaluation theory (as cited in Fitzpatrick et al., 2012; Mertens & Wilson, 2012).

TAM

Origin. Developed in 1985 by Davis as his doctoral thesis work at MIT Sloan School of Management, the purpose of the TAM was to measure how certain concepts could predict user acceptance of computers. According to Davis(1989), the existing measurement tools were invalid in practice and were not necessarily related to information systems. In his study, Davis hypothesized that the acceptance or use of an information system was the result of a response to external stimuli. According to Davis, these stimuli could be measured and used to predict acceptance or rejection of the system. The stimuli relate to the system's features and lead to the user's motivation to use the system and to the actual use of the system (Fador, 2014).

The work of Fishbein and Ajzen (2010), developers of the theory of planned behavior, roots the concepts of stimulus, motivation, and actual use. The theory of planned behavior states that believing in the likely consequences of behavior determines attitudes toward that behavior. Expectations or normative beliefs determine subjective norms. Moreover, beliefs related to potential facilitation or inhibitors determine perceived behavioral control (Ajzen & Sheikh, 2013). The theory of reasoned action suggests that the determination of behavior depends on an individual's intention to perform an act.

Intention to act is a function of the attitude toward the behavior and the subjective norm, where the best predictor is intention (Ajzen, 1991).

Davis (1989) refined the TAM with the purpose of developing an instrument to measure acceptance of computers by users based on specific concepts. The theory considers perceived usefulness, which is the perception that the technology will add some value or help in the performance of the task at hand. The theory also considers perceived ease of use, which directly affects the level at which the individual values usefulness. If the application is too difficult to use, its acceptance will be reduced even if its usefulness may be apparent. According to Davis, these two concepts are essential determinants of user acceptance.

To validate the construct, Davis (1989) conducted a study with 152 participants. The study yielded results that demonstrated statistical significance favoring perceived usefulness as having higher determinant (Davis, 1989). The self-efficacy theory supports Davis's selection of the two concepts affecting acceptance of the technology. Self-efficacy theory is described as "the judgment of how well one can execute courses of action required to deal with prospective situations" (Bandura, as cited in Davis, 1989, p. 321). Even when Davis did not find self-efficacy theory sufficient to explain acceptance in the area of IT, he agreed that the theory provided a theoretical perspective to the TAM (Ajzen, 2006).

Davis (1989) concluded that perceived usefulness and ease of use significantly correlated with system use. At the time, it was evident that further research was needed, including other concepts related to usefulness, ease of use, and technology acceptance.

The model is an adaptation of the theory of reasoned action to predict the acceptance of information systems, based on behavioral intention resulting from perceived usefulness and perceived ease of use.

Contributors. Davis and several other researchers have continued to advance the theory of planned behavior. Recent studies on the theory revealed that measuring effect does not necessarily improve the prediction of intention on behavior. Measures of the alternative to the behavior are significant in predicting the behavior. In the words of Ajzen and Sheikh (2013), "when people are directed to think about performing a behavior, their attitudes toward the behavior are determined by their readily accessible beliefs about the consequences of doing so" (p. 165). The result of this study had direct implications on the way TAM considers behavioral intention toward the use of technology. The result of the study created the opportunity to measure the level of influence that choices of technology have on the individual's intention to use the technology. Elaborations of the model include TAM2, the unified theory of acceptance and use of technology, TAM/task-technology fit model, and TAM3 (Dwivedi et al., 2012).

Theoretical proposition. Davis (1989) proposed a theoretically founded approach to the identification and explanation of factors involved in a user's acceptance of IT. Davis proposition explains the behavior of users toward the use of IT from a general perspective supported by existing theories. The TAM's main concepts are perceived usefulness and perceived ease of use.

The concept of perceived usefulness explains the "the degree to which a person believes that using a particular system would enhance his or her job performance" (Davis, 1989, p. 320). Perceived usefulness influences not only the perception of usefulness in regards to facilitating job-related tasks, but also the extent to which a technology benefits the domain that it supports. With perceived ease of use, the assumption is that, even if someone finds an application useful, his or her degree of adoption of that application will be influenced by how difficult or easy it is to use the application. Perceived usefulness and perceived ease of use individually affect attitude toward use indirectly, but together, they have a direct effect on the position of the user toward the use of the technology. Finally, perceived ease of use indirectly affects the behavioral intention to use, but perceived usefulness directly influences behavioral intention.

Ajzen (2015) considered perceived behavioral control, self-efficacy, and locus of control as influential components of the theory of planned behavior, which directly affects TAM and TAM2's behavioral intention to use. Another theory related to TAM is the expectancy-value theory. Expectancy-value explains why individuals accept or reject IT based on what the individuals expect to get out of the technology, and how much they value what they get (Bradley, 2012; Henning, Henning-Thurau, & Feiereisen, 2012).

Assumptions. The TAM inherits its assumptions from the theory of reasoned action and planned behavior. The model posits four assumptions:

- individuals are drawn toward the use of a technology if they perceive that the technology has a practical use (perceived usefulness or *PU*);

- there is a correlation between how useful the technology is and the level of effort involved in learning or using the technology, as well as an individual's attitude toward adopting it (perceived ease of use or *PEOU*);
- both perceived usefulness and perceived ease of use directly affect an individual's attitude toward the use of the system; and
- perceived usefulness directly correlates with behavioral intention.

The model assumes that perceived usefulness of the technology is primary; that is, the model assumes that an individual perceives usefulness before perceiving ease of use. Perceived usefulness determines whether a user will move forward to consider perceived ease of use (Bradley, 2012).

As the theory developed, the model incorporated many other assumptions. Ajzen (2014) considered knowledge an influential factor in planned behavior. According to Ajzen, under TAM, knowledge can be assumed to affect behavioral intention. Other factors that influenced TAM included culture (Baker, Al-Gahtani, & Hubona, 2012) and environment-based voluntariness (Wu, Zhao, Zhu, Tan, & Zheng, 2011). Voluntariness refers to an individual's freedom to choose whether to adopt an information system and contextual factors such as organizational factors affect this freedom of choice.

Application of the theory. The TAM is one of the most predominant models for predicting adoption in the field of IT (Park et al., 2014). TAM includes many modifications to fit different domains of IT adoption (Prieto et al., 2015). In health care informatics, Holden and Karsh (2010) argued that even when health IT research focuses on design and implementation, that research does not place enough importance on how

end users will react to the IT. Pai and Huang (2011) conducted a similar study, in which they used TAM as a conceptual model to determine users' intention to use health care information systems. Pai and Huang analyzed relevant studies, developed a questionnaire, and conducted a survey of hospital nurses, head directors, and related personnel. The result was a positive correlation between perceived usefulness, perceived ease of use, and the use of a health care system. This result validates the assumptions that information, service, and system quality influence intention to use a system through the constructs of perceived usefulness and perceived ease of use.

TAM was relevant to this study because I explored the data for an indication that TAM factors are influential in the project-selection process. Do perceived usefulness, perceived ease of use, and other similar factors from TAM affect participants' choice of projects in the project portfolio? I did not find studies in the literature suggesting the use of TAM in the project selection process.

Program Evaluation Theory

Origin. The program evaluation theory evaluates the effectiveness of educational programs. Program evaluation, which combines several theories, models, and strategies, started during the late 1960s and early 1970s with the contributions of Scriven, Worthen, Sanders, and Poham. Stuffelbeam and Coryn (2014) described evaluation as the process of delineating, obtaining, and providing useful information for judging decision alternatives, while Scriven and Worthen defined evaluation as judging the value of something (as cited in Fitzpatrick et al., 2012). Based on this description, researchers

developed theories to examine hypotheses and policies used in the operation of educational institutions.

Tyler's (1950) contribution, based on progressive education, describes evaluation as the need to check the effectiveness of educational programs. Tyler's model later generalized to any program. According to Alkin and Christie (2013), the evaluation movement considers Tyler's work as the root of contemporary education and the precursor of the evaluation movement. Tyler's work translates evaluation theories into other fields, including policy evaluation and social program evaluation. Alkin depicts program evaluation theory as a tree rooted by social accountability, social inquiry, and epistemology. The theory further branches out into three distinctive areas: use, methods, and valuing. The theory groups under each particular area forming the branches and leaves of the tree, depending on their levels of contribution (Alkin & Christie, 2013).

Theoretical proposition(s). The proposition of program evaluation revolves around three tenets: social inquiry, accountability, and control. The need for systematic and justifiable methods is the base of social inquiry when establishing accountability (Alkin & Christie, 2013). From these tenets, three branches evolved: social inquiry, evaluation, and evaluation theory for decision-making. Social inquiry in methodological research was influenced first by Tyler (1950) and later by Scriven (1998) and, Shadish, Cook, and Leviton (1991). The second branch, evaluation, establishes the role of the evaluator.

The work of Stuffelbem and Coryn (2014) influenced the evaluation theory for decision-making. Stuffelbeam's basic design describes six distinctive activities for an

evaluator: (a) focusing the evaluation, (b) collecting information, (c) organizing information, (d) analyzing information, (e) reporting information, and (f) administering the assessment, (2007). Worthen et al. (2004) asserted that the application of program evaluation is twofold. First, program evaluation can be applied in a formative context, whereby it helps improve a program. Second, program evaluation can be applied in a summative context, whereby it helps in the decision to initiate, continue, or abandon a program. The authors described program evaluation as having six purposes:

1. To contribute to decisions about program installations
2. To contribute to decisions about program continuation or expansion
3. To contribute to decisions about program modification
4. To obtain evidence to rally opposition to a program
5. To get evidence to gather support for a program
6. To contribute to the understanding of basic psychological and social processes

The major approaches to program evaluation include performance-objectives congruence approaches, decision-management approaches, judgment-oriented approaches, adversarial approaches, and pluralist-intuitionist approaches.

Performance-objectives congruence approaches. Originating with Tyler (1950), the performance-objective congruence approach to program evaluation determines the extent in attaining the goals of a particular program. Initially focused on education programs, the performance-objective congruence approach identifies broad goals and measures individual performance against those goals. The approach uses standardized measuring instruments; the evaluators compare each measurement to the

objectives for congruency. The evaluators handle any differences between the measurements and the objectives by adjusting the process and repeating the evaluation. Critics say that this approach lacks both an evaluative component to measure and assess objectives, and standards to judge differences in program performance when comparing measurements to the objectives of the program.

Decision-management approach. Is based on Stuffelbeam and Shinkfield's (2007) CIPP evaluation model. The CIPP model addresses the need for a more holistic approach to evaluation. Stuffelbeam and Coryn (2014) recognized that assessment based purely on the measurement of objectives against performance was not enough. A comprehensive approach, including accountability, objectives, plans, activities, and record-keeping**,** was necessary to meet public demands for information about the performance of public programs. Stuffelbeam's definition of evaluation encompasses all the criteria that a decision-making based model should address.

Adversarial approaches. Adversarial evaluation involves grouping divergent assessment practices that are adversarial in nature. In other words, adversarial evaluation refers to the practice of different evaluators presenting opposing views to challenge ingrained opinions. All participants can express their positions in a forum that includes the presentation of two or more sides of the issue. Practitioners in the field of justice commonly apply this concept, but its adaptation to any other context is possible (Preskill, 2015).

Judgment-oriented approaches. A judgment-oriented approach, which uses experts to judge a program, is the most common approach to evaluation. One such

judgment-oriented approach is Stakes's (1967) countenance model. This model promotes two major phases of formal assessment, description, and judgment. The description phase tries to understand the intended and actual outcomes of the program. The judgment phase explains the standards and procedures used to make the judgment before implementing them, to ensure that all stakeholders understand the evaluative statements.

The main criticism of the judgment-oriented approach is the potential for evaluators' bias. Bias renders participants' judgments merely conclusory opinions. Culture, politics, personal agenda, and environmental pressure influence participants' views and experiences. These factors impede an objective description of reality (Stuffelbeam & Coryn, 2014). Bias in the judgment-oriented approach is similar to the bias found in normative-theory approaches, where expert decision-makers are also stakeholders participating in the selection process (Rantatari, 2014).

Pluralist-intuitionist approaches. Under a pluralist-intuitionist approach, the evaluator has values and needs different from all stakeholders in a program. The purpose of this approach is to strike a balance between the evaluator's perspective and that of the stakeholders using intuition. Under this approach, decisions made by the decision-makers are influenced by the evaluator's perspectives.

Assumptions. There are many assumptions that relate to the approaches presented here. Performance-objectives congruence assumes the existence of a highly utilitarian philosophy and a linear approach to evaluation with little or no flexibility. The decision-management approach assumes that the audience includes people with the power to make or influence the decision. Alkin and Christie (2013) proposed four

assumptions to the decision-management approach: (a) evaluation is the process of gathering information; (b) information from the assessment will be used to make a decision about an alternative course of action; (c) the presentation of information from the evaluation to the decision-makers must be clear and concise, avoiding ambiguities or misleading statements; and (d) different kinds of decisions require different types of evaluation procedures. Another assumption presented by Alkin and Christie (2013) is that the evaluator will operate in one of the two models. The first model is prescriptive; it provides a set of rules, prescriptions, prohibitions, and guidelines to specify the proper parts of an evaluation. The second model is descriptive; it provides a set of statements and generalizations describing, predicting, or explaining assessment activities. The latter model supports the empirical or theoretical approach to evaluation. According to Alkin and Christie (2013), the second model is in its infancy and not ready for conducting research on assessment.

Application of the theory. Evaluation theory developed in the field of education and educational programs. The use of Evaluation theory evolved into other areas, including the assessment of public-funded programs. The Government Accountability Office (GAO) frequently uses and advances this theory. The mission of GAO includes the examination of the use of public funds, evaluation of federal programs, and program analysis. The agency also provides recommendations to help Congress make effective oversight, policy, and funding decisions (Chelimsky, as cited in Alkin & Christie, 2013). Stuffelbeam and Coryn (2014) recommended the expansion of the program evaluation theory for (a) scholars generating and testing predictions or propositions concerning

evaluative actions and consequences; (b) application to particular classes of program evaluation using criteria that can be applied to particular program and be generalized to other programs; (c) new ideas about evaluation utilizing experiential criteria or a heuristic approach to evaluation; and (d) using lessons learned from evaluation practices.

Decision Theories

Origin. The study of decision-making developed in the mid-twentieth century with influences from many disciplines, including mathematics, statistics, psychology, and social science.

Theoretical proposition(s). According to Hansson (2005), the decision-making process includes a behavior or motivation to accomplish a goal and the existing options available. There are two fundamental branches of decision theory: normative and descriptive theories. Hansson described the normative theory as a theory concerned with how people should make decisions from a rational perspective. The descriptive theory concerns how people make decisions in reality (Hansson, 2005). A normative decision-making theory adopts a top-bottom approach to decision-making: it prescribes the criteria that qualify a decision as rational or irrational, considering risk as a variation in the outcome of the decision. For a decision in which the value of the available options is the same, a normative approach considers the decision to be rational if the decision-maker chooses the option with the least outcome variance.

Contrary to the normative theory, descriptive decision-making theory adopts a bottom-up approach, starting with empirical analysis of the factors affecting the decision process. Mishra (2014) suggested that normative and descriptive approaches are

complementary. According to Mishra, to be effective, a decision theory should join the two approaches and provide a normative rationale for decision-making and a conceptual mechanism based on empirical observation of the decision maker's behavior. Mishra's rationale for the convergence of the two approaches is that it is not enough to consider the goal to enhance the outcome associated with the value of the decision. Perceptual and cognitive mechanisms are necessary to identify how decision-makers perceive and compare options.

The convergence of normative and descriptive approaches to decision-making makes sense in the context of this study. This approach suggests an effective way to find answers to the central research question related to the challenges in the implementation or adoption of a structured project selection process. Within normative and descriptive approaches, many classical theories of decision-making have been developed, including von Neumann and Morgenstern's expected utility theory and Kahneman and Tversky's prospect theory (as cited in Barberis, 2013).

Expected utility theory. The expected utility theory is a normative theory developed by von Neumann and Morgenstern (1944). Under the core function of the theory, one computes the utility of a decision outcome and multiplies it by the probability of that outcome. Expected utility theory predicts a decision-maker's desire to maximize utility in the form of satisfaction when making decisions. The theory utilizes a three-curve approach described as risk-indifference, risk-aversion, and risk-preference to quantify marginal utility. The risk-indifference curve is a linear relationship between marginal utility and maximum possible utility. The risk-aversion curve represents the law

of diminishing returns, where the unit of utility becomes of less value than the next unit. Finally, the risk-preferring curve represents a scenario in which each unit of utility is valued higher than the last (Mishra, 2014).

Assumptions. Von Neumann and Morgenstern (1944) proposed an expected utility theorem to demonstrate that an individual will always make choices to maximize expected utility when confronted with a decision-making problem. The axioms of this theorem that are related to rational decision-making are completeness, transitivity, independence, and continuity.

Completeness is the assumption that the individual has preferences that are well defined and that he or she is capable of deciding between two choices, including the cases of a tie in utilization levels.

Axiom: $\forall x1,x2 \in X$, $x1 \succ x2$; or $x2 \succ x1$ or $x1 \sim x2$

Transitivity assumes that the individual's decision according to the completeness axiom will be consistent.

Axiom: $x1 \succeq x2$ and $x2 \succeq x3 \rightarrow x1 \succeq x3 \; \forall x1, x2 \in X$

Independence is the assumption that, two agents joined by a third will present the same preference order as before the introduction of the third.

Axiom: $A \succeq B$, and let $t \in (0,1)$; then $tA + (1 - t)\, C \succeq tB + (1 - t)C$.

Continuity assumes that where there are choices A, B, and C, where $A \succeq B \succeq C$, there is a probability (P) that B is as good as pA + (1-P)C.

Axiom: $\forall x1,x2,x3 \in X$, $x1 \succ x2$ and $x2 \succ x3 \rightarrow \exists\, p \in [0,1] \ni x2 \sim [\, p: x1; 1 - p: x3]$

The satisfaction of the axioms determines the rationality of the decision-maker, and a utility function expresses his or her preferences (Fishburn, 1982; Karni, 2014).

Bernoulli (1954) previously posited the concept of expected utility. Bernoulli proposed the diminishing marginal utility of money. This characteristic can be applied not only to money but any utility, such as satisfaction, process improvement, and performance. To Bernoulli, a dollar is not worth a lot to a rich person, but it is worth a lot to a needy person. Bernoulli's assessment suggests that currency has value in addition to its absolute value and that additional value affects the decision outcome, this is true for things other than currency. The ris-averion, risk-indiference, and risk-preferene represent the concept of total value of a particular choice when making a decision, versus the choice perceived value. To Fishburn (1982), the importance of the expected utility theory is that it allows for the representation of preferences in a linear manner through the use of axioms.

Application of the expected utility theory. Concerning this case study, the application of expected utility theory represents a challenge in the project selection process. As the decision-makers consider the value of their choices in a rational manner, the larger the number of stakeholders, the harder it is to reconcile the views of stakeholders about expected utility. Kahneman and Tversky (1979) described expected utility theory as a model of rational choice with applications to descriptive models of behavior, but with deficiencies, such as the stakeholder's violation of axioms for their preferences.

Prospect Theory

Origin. Prospected theory started with Kahneman and Tversky's (1979) criticism of the expected utility theory. According to Kahneman and Tversky (1979), Prospect theory deals with the prospects of monetary outcomes and stated probabilities that extends to other choices.

Theoretical proposition(s). The theory includes two phases in the decision-making process, an early editing phase, and an evaluation phase. During the editing phase, the evaluator conducts an analysis of the different prospects. In the second phase, the evaluator evaluates the edited prospects to select the one with the highest-value.

These early decision-making theories such as prospect theory and expected utility theory have evolved into more complex applications that, unlike traditional mathematically based approaches, incorporate cognitive factors and other, more abstract concepts. Cognitive factors include: (a) fuzzy math and fuzzy logic (Nassif et al., 2013); (b) decision-making in risky and dynamic environments (Petit, 2012); (c) researcher's consideration of interdependency and synergies (Cho & Shaw, 2013); and (d) researcher's consideration of probability and uncertainty (Aliev, Pedrycz, & Huseynov, 2012).

Conceptual Framework

According to Miles et al. (2014), a conceptual framework represents the roadmap of the territory under investigation at any given time. It describes the study's scope, exclusions, constructs, concepts, and relationships (Bloomberg & Volpe, 2013). Ravitch and Riggan (2012) see the conceptual framework as the argument about the phenomenon

of study and as a tool for conducting the study adequately. A conceptual framework is a living tool that needs reevaluation as the study progresses (Gilgun, 2011b).

From a phenomenological perspective, the purposes of conceptual and theoretical frameworks are to: (a) guide the data-gathering process without imposing theories or concepts, providing questions for interviews that prompt participants toward the phenomenon without leading the participants toward any theory or concept in particular (Vagle, 2014); and (b) link the phenomenon of study to the background of the domain in question during the data analysis phase. The researcher brackets or set aside the conceptual and theoretical framework during the data-gathering phase to avoid any bias toward a normative theory approach. This approach allows a more descriptive theory-guided method, in which participants can freely express their experiences (Manen, 2014). This study assumed the following:

1. My interest in understanding the project selection process at CBIIT.
2. My proposition that the current process is ad hoc and intuitive.
3. The research questions

    RQ1 How does CBIIT select projects for its project portfolio?

    RQ2 What type of decision-making process guides the selection of projects in the CBIIT project portfolio?

    RQ3 What environmental factors affect the decision-making process?

4. The proposition that projects at CBIIT would have a higher rate of adoption if the organization used a selection process informed by a framework based on the industry's project portfolio standards.

The literature review identified several concepts worth incorporating into the conceptual framework for this study. Pendersen and Nielsen (2011) discussed the concept of a portfolio aligned with the organizational strategy. The authors also introduced the concept of cognitive conflicts that contribute to the complexity of the decision-making process in project selection and the balance between intuition and rationality.

The idea of social return on investment introduced by Millar and Hall (2013) gives practitioners a measurement criterion that, although difficult to establish, relates to the concept of return on investment in finance. Kwak et al. (2014) identified unique characteristics of projects in government. During data analysis, researchers can use the identified characteristics as analysis patterns. Public-sector project characteristics include:

1. Public-sector projects are most likely to pursue nonfinancial goals that benefit a community or social context.
2. These projects are susceptible to political dynamics and can become priorities or be irrelevant depending on the current administration's agenda.
3. Projects follow any mandated project-management process affected by governmental laws, rules, and regulations.
4. Many projects are very large and complex.
5. Projects are likely to have a long life cycle, which makes it difficult to measure performance or benefits.
6. Most projects in government deal with multiple stakeholders.

Literature Review

Gap in the Literature

There is abundant literature related to the project selection process for projects where the return on investment is purely based on financial reward (Nassif et al., 2013). But there is little in the literature, and nothing in the main project management body of knowledge, such as the PMI Project Portfolio Management Standard (PMI, 2013) or the PMBOK Government Extension (PMI, 2006), related to government-funded projects, where public policies and social return on investment are part of the selection criteria. The existing body of knowledge provides only general recommendations that do not consider the unique factors that affect government-funded initiatives.

Nassif et al. (2013) described the difficulties in finding a project selection and evaluation criteria for government-funded technology R&D. According to the authors, unlike private-sector project selection, which is based mostly on financial revenue, defining selection criteria for government projects is more difficult and less discussed. For projects based on financial return on investment, such as private-sector projects, the literature is extensive. If the selection criteria include public policies and social benefits or social return on investment, the literature is scarce.

The problem of project selection has been around for many years. In financial investment, as in other areas, organizations confront many challenges when deciding in which projects to invest (Martinsuo & Killen, 2014). In the private sector, profitability is the primary driver of project selection. Determining which projects are likely to have a profitable return on investment includes an analysis of economic conditions. This

determination also requires an analysis of technology trends for IT projects and the direction the specific organization is taking (Teller et al., 2012; Tavana, Keramatpour, Santos-Arteaga & Ghorbaniane, 2015).

In the not-for-profit and public sectors, additional decision criteria are important, including social return on investment, community value, impact on science, and other intangible and difficult-to-measure standards. Martinsuo (2013) asserts that even with the models and frameworks available, organizations still struggle to divide resources among projects, prioritize, and determine which projects best serve the objectives of the organization. According to Martinsuo, these difficulties stem from the fact that researchers have not been able to develop effective solutions to project portfolio management.

> The PMI (2013) defined project portfolio management as
>
> the coordinated management of one or more portfolios to achieve organizational strategies and objectives. It includes the processes by which an organization evaluates, selects, prioritizes, and allocates its limited internal resources to accomplish organizational strategies consistent with its vision, mission, and values. (p. 4)

Or, in other words, project portfolio management is "the centralized management of one or more portfolios that enables executive management to meet organizational goals and objectives through efficient decision making concerning one or more portfolios, projects, programs, and operations" (Kester, 2011; PMI, 2013, p. 28). The standard provided by

PMI is not prescriptive; rather, it is an overarching framework for the implementation of portfolio management.

The portfolio management standard includes several strategic processes that are relevant to this qualitative study. These processes include the development of a portfolio strategic plan, the definition of a portfolio roadmap, and the prioritization analysis process. These methods are all based on fundamental decision-making processes and are affected by what PMI calls Enterprise Environmental Factors, which include politics, budget constraints, and market conditions, among others. Through the development of a portfolio strategic plan, an organization evaluates its organizational strategy and investment decisions and determines how its portfolio of projects or products will meet its strategic goals. A portfolio roadmap provides the organization a timeline for the implementation of the components of the portfolio, as well as the component dependencies, conflicts, and gaps with the overall organizational strategy (PMI, 2013; Sanchez, Gastaud, & Sagardoy, 2014). The PMI standard does not mention the project selection process explicitly, but it discusses the processes in Portfolio Governance Management. In Portfolio Governance Management, a portfolio manager creates a qualified list of components to be evaluated, selected and prioritized. The PMI standard does not offer a prescriptive approach for how to execute these steps but suggests the use of decision support tools and models. The standard also suggests simulation techniques, prioritization algorithms, constraint management, and the capability and capacity modeling tools. Other project management standards such as PRINCE2 also fail to address the project selection process in government-funded initiatives.

Criteria influencing government-funded initiatives include; funds availability, funding cycles, community needs, alignment with organizational goals, and stakeholders' perceived needs among others. Stakeholders' perceived needs and organizational alignment are difficult criteria to satisfy adequately, given that a stakeholder perception may not reflect reality and may not align with the overall goal of the organization (Alsudiri, Al-karaghouli & Eldabi, 2013; Young et al., 2012). In a multiple-stakeholder environment, stakeholder perceptions conflict with others' perceptions, and some objective views or processes are needed to break any conflicts (Bible & Bivins, 2011; Christensen, 2013). More organizations are recognizing the need for a better selection process, but they do not necessarily recognize or consider the complexity and challenges of such a process (Christensen, 2011; PMI, 2013).

Studies in Project Portfolio Selection

Researchers continue to explore factors affecting the decision-making process from many angles, including cognitive issues, risk factors, uncertainty, and matters related to limited information (Petit, 2012). Aliev et al. (2012) summarized the challenges of current theories, including the limited capacity of mathematical methods to model human behavior. Another challenge is the assumption that a decision-maker will behave according to the classical views of theories such as expected utility theory. Under such theories, a decision-maker is motivated by self-interest, which leads to a rational choice given the probability of the outcomes.

Aliev et al. (2012) addressed issues of probabilities and the uncertainty faced by the decision-maker. The study considered the weaknesses of traditional decision-making

theories due to their dependence on analytical methods that require ideal human behavior patterns. The study includes the quantum decision theory approach, which describes decision-making as a complex process of human thinking.

The quantum decision theory explains the human decision-making concept using quantum theory principles. In quantum decision theory, the decision-maker's behavior is shaped and formalized by the state in which the decision-maker operates. An example of such states includes prospect states and strategic states. Yukalov and Sornette (2014) define prospect states, and strategic states as follows:

Prospect States: For prospect states π_j there exists a basic state $|\pi_j\rangle \in M$ which is a member of a larger space called mind space. The prospect state presents as an expansion of the basic space as $|\pi_j\rangle = \Sigma_n \alpha_{jn}|e_n\rangle$.

Strategic States: Describe decision makers as unique subjects and is a special fixed state $|s\rangle \in M$. Strategic states exist in the overarching mind space where they are used as a reference to represent the decision-maker's characteristics such as beliefs and habits. As a unique state it is represented as $|s\rangle = \Sigma_n \text{can}|e_n\rangle$.

The composition of these states includes the decision-maker's personal characteristics as in the example of strategic states. This approach generalizes objective probabilities to nonlinear subjective probabilities, thereby addressing the paradoxes of classical decision theories. According to Aliev et al. (2012), the weakness of this approach is that it expects the availability of perfect information to aid the decision-making process.

Because decision-making occurs in situations where the imprecise probability is the norm and not the exception, Aliev et al. (2012) proposed a theory that incorporates uncertainty about the uncertainties, or "uncertainty square" as they call it (p. 273). The authors attempted to address issues of imprecise probability as intrinsically or as a fuzzy component not dealt with by traditional decision theories. Traditional theories expect that events, utilities, relations, and constraints are describable in natural language, leaving any interpretations of imprecise probabilities to interval probability theory and fuzzy or linguistic probability theories. Aliev et al.'s (2012) proposed model has the following characteristics: (a) fuzzy sets, instead of the classical decision-making theory framework for the modeling of states of nature, outcomes, and actions; (b) consideration of imprecise probabilities instead of numerical distributions; (c) use of linguistic preference relation instead of classical preference relation;(d) use of fuzzy functions instead of real-valued functions to model utility functions; and (e) fuzzy number-valued measure instead of real-valued nonadditive probability.

The purpose of the study was to demonstrate fuzzy utility functions under an imperfect information framework (Aliev et al., 2012). The study suggested that when dealing with limited information and imprecise probabilities due to the influences of human judgment, perception, and emotions, the classical decision theory approach is not sufficient. Mishra (2014) also supports this concept in her consideration of normative versus descriptive approaches to decision-making theories.

Oral, Kettani, and Lang (1991) presented an application of expected utility and prospect theory in a study of compensatory versus noncompensatory approaches to

project selection in R&D projects. The study proposed a methodology for evaluation and selection of industrial R&D projects using an interrelated model. A compensatory model reduces a multidimensional evaluation process into a single dimension process through aggregation of value and trade-offs among the criteria, like in a cost/benefit analysis. This type of model anticipates a common preference among stakeholders that is the result or prior or spontaneous negotiation. The compensatory model aggregates the stakeholders' views and averages stakeholder preferences by modeling stakeholder weights assigned to each criterion.

The second model, a noncompensatory model, does not allow trade-offs or simply ignores them, and not all available information is used to support the decision process (Plataniotis, de Kinderen, & Proper, 2014). The proposed selection process model assumes the need to select one project out of a subset of projects competing for funding. In this model, all projects have their own potential merits, and an absolute appraisal scheme does not exist outside of the relative evaluation of different points of view; the only constraints are budgetary. Some of the challenges in the study conducted by Oral et al., were: (a) the macro-level nature of the study, i.e., considering projects at a sectoral or national level (Oral et al., 1991); (b) the fact that multiple stakeholders with different interests and viewpoints complicate the consensus process; (c) the fact that experts participating in the selection process were also stakeholders, which increased the chances of bias and conflict of interest; and (d) difficulties in selecting a set of criteria for evaluating the project and the fact that the level of importance given to each criterion varied across stakeholders.

Oral et al. (1991) proposed a selection method that estimates the weights representing the best interests of the stakeholders. Participants should avoid consensus based on with values influenced by their bias about the projects they favor and focus on the value assigned to the selection criteria. Rantakari (2014) rooted these issues of biases with the stakeholders holding of relevant information, and how they disperse the information within the organization, and the unknown motives of the stakeholders. Another issue rooted in stakeholders biases is the possibility for manipulation of information before decision-makers use it. Rantakari argued that in cases such as (a) $\forall Vji, Vki \in M, Vji = Vki$ for M in 1, 2,… n, and (b) where consensus is not reached, each stakeholder will favor his or her projects based on the belief that one's project will elicit more benefits for one's constituents.

In a similar study, Pendersen and Nielsen (2011) challenged the normative perspective of the portfolio decision-making process. They compared the rational and systematic approach to normative methods and the real-world experiences of people involved in project portfolio decision-making in organizations. Pendersen and Nielsen argued that even when project portfolio management provides techniques for aligning an IT project portfolio with organizational strategic goals and facilitates project selection, the application of project portfolio management is more theoretical than practical. They assert that practitioners find project portfolio management difficult to implement because of the lack of direction regarding how to deal with uncertainty and conflict.

Other problems identified by Pendersen and Nielsen study were: (a) too many projects, compared to available resources; (b) low value and strategically misaligned

projects; (c) poor coordination among projects; (d) lack of business management commitment; (e) lack of cross-functional working; and (f) resistance to change. The need to appear flexible and compliant with other departments and the selection of short-term projects at the expense of longer projects that strategically aligned with the mission and vision of the organization contributed to uncertainty and conflict.

Pendersen and Nielsen (2011) defined conflict in this context as the result of factors such as: competition for available resources to support projects, decision-making based on power, and manipulation of qualitative ranking methods that support decision-making. This definition is consistent with Rantakari's (2014) suggestion that stakeholders defend their pet projects to the extent that they manipulate information before it gets to decision-makers. Pendersen and Nielsen (2011) asserted that to understand the conflict that can arise during the decision-making process, it is necessary to integrate theories of conflict into the portfolio management selection process. Concepts such as consensus, cognitive conflicts, affective conflicts, and political behavior affect the decision-making process. According to Pendersen and Nielsen, even when quality information and expert judgment is available to decision-makers, if the consensus is lacking, the selection process is at risk. Oral et al. (1991) posit that agreement among stakeholders is the ideal and a fundamental factor that determines the success and quality of a decision. Oral et al., also emphasize how difficult it is to arrive at a consensus, especially if there is a large number of stakeholders and if stakeholders are also part of the decision-making process.

In theory, the decision-making process is guided by mathematical algorithms and formulas, processes, and procedures. This approach implies that the participation of

stakeholders is passive. In practice, making decisions in the project selection process is very dynamic and includes human judgment, perceptions, and emotions (Aliev et al., 2012; Mishra, 2014; Oral et al., 1991). According to Pendersen and Nielsen (2011), the quality of a decision depends on the cognitive capabilities of the decision-makers. A team with cognitive diversity is more efficient than one that lacks diversity. Cognitive conflicts affect the quality of a decision. Cognitive conflicts are challenging because they sometimes do not surface during the selection process, but rather manifest in subtle ways as affective conflict and self-interested political behaviors. Factors that contribute to uncertainty include changing business needs based on organizational changes, reduced quality of information (Pendersen & Nielsen, 2011; Jerbrant & Gustavsson, 2013), changes in leadership, and changes in the political and economic environment.

Four different groups participated Pendersen and Nielsen's multiyear study, which was arranged by IT organizations within municipalities. The municipalities had similar characteristics such as budget, organization, and political constraints. For two years, the researchers interviewed participants following the framework derived from the best practices and principles from the literature (2011). To validate the assessment framework used in the study, Pendersen and Nielsen incorporated participant's group discussion, consideration of the maturity in project portfolio management practices of participating organizations, and analysis of the findings related to rationality, uncertainty, and conflict among stakeholders (2011). Pendersen & Nielsen (2011), analyzed the municipalities' practices regarding definition of portfolio goals, how the organizations

created information related to alternatives to portfolio goals, and the application of decision rules in the selection process. The researchers found the following:

1. Related to defining portfolio goals:
    a. Business strategies were ambiguous.
    b. Municipalities neglected aligning goals with overall business strategy in favor of short-term goals.
    c. The political nature of participants' organizations made the definition of portfolio goals difficult.
2. Related to creating information about alternatives to goals and organizational changes:
    d. Strategies were general and ambiguous.
    e. Organizations were able to identify projects within the strategic plan, but they had difficulty ranking how well each project supported strategic goals.
    f. Priorities changed frequently, which created contention for resources.
    g. Project-related uncertainties further complicated organizational uncertainties such as ambiguous goals and potential future changes in administration and political environment
    h. The relationship between project portfolio and strategic goals was complex.
    i. The organizations used portfolio information for political purposes.
    j. The organizations lacked systematic quality control for project proposals.

3. Related to decision-making

Pendersen & Nielsen (2011), found a gap between the literature and practitioners. The literature suggests that decision-making should use rational models based on mathematical algorithms and follow detailed processes. The researchers found that in practice, IT managers were not willing to leave the decision-making process entirely to a programmable approach and ranked the rational model as less important than models based on intuition, experience, and understanding of organizational strategies and the political environment.

Study Recommendations

As a result of the study, to improve IT project portfolio management, Pendersen & Nielsen (2011), recommended using custom decision-making theories based on different decision-making styles. The method used would depend on the level of uncertainty in projects and the identification of dysfunctional factors throughout the implementation of theoretical constructs. Pendersen and Nielsen (2011) also recommended that participants in the selection process understand the relationship between the organizational strategy and the portfolio components. Finally, the researchers found that it was important to have cognitive diversification, balanced intuition, balanced decision quality, and a positive relationship among stakeholders.

Challenges that further complicated the decision-making process included the lack of financial benefits of the projects, the difficulties in measuring nonfinancial return on investment, and the character of the political environment. The extended product

lifecycle of government projects and a large number of stakeholders were other contributing factors to the challenges (Pendersen & Nielsen, 2011).

Project Selection Process in the Public Sector

The concept of return on investment in the private sector makes project selection a linear process. Although private-sector organizations consider many other criteria, return on investment is the primary concern. In the public sector, the primary concern is a social benefit, or what Millar and Hall (2013) call social return on investment. Social return on investment is determined by the net present value of benefits divided by the net present value of the investment (that is, social return on investment = net present value of benefits / net present value of the investment). The formula seems straightforward, but it is far from simple when considering the value of social enterprises versus the value of the investment as seen by the different stakeholders (Millar & Hall, 2013).

In an attempt to clarify this issue, Kwak et al. (2014) performed a study of 39 government projects, 18 in the United States, 15 in Australia, and 6 in the United Kingdom. The goal of the study was to understand the key characteristics of public-sector projects compared to private-sector projects. The researchers formulated the following research questions:

(a) What are the unique characteristics of government projects?

(b) What is the current performance status of managing government projects regarding cost, schedule, and other project-related factors?

(c) What are the common reasons for poor performance in managing government projects?

(d) How does the public sector address the impact of external issues?

Through interviewing and data analysis, Kwak et al. (2014) identified six key characteristics of public-sector projects:

1. Public-sector projects are most likely to pursue nonfinancial goals, that is, goals that represent benefits in a community or social context.
2. Public-sector projects are susceptible to political dynamics; they can become priorities or become irrelevant depending on the current administration's agenda.
3. Public-sector projects follow some mandated project management process. This process may be either ad hoc or structured, but it is affected by governmental laws, rules, and regulations.
4. Many public-sector projects are very large and complex.
5. Public-sector projects are likely to have a long life cycle, which makes it difficult to measure performance or benefits.
6. Public-sector projects deal with multiple stakeholders. These stakeholders bring a large variety of views about which benefits their constituents prefer and how they think a project will serve the community. These differences among stakeholders generate conflicting views, which need reconciliation.

Focusing on the project selection process, Nassif et al. (2013) propose a method using fuzzy logic to aid the decision-making process. Fuzzy logic responds to the rational inclination toward normative approaches to decision-making (Hansson, 2005). In fuzzy logic words such as low, medium, and high are expanded to include words such as

somewhat and very close. This expansion of the possibilities of expression better captures the essence of what participants experience.

Nassif et al. (2013) used fuzzy logic to consider projects' potential for success. The method consisted of the identification of projects and the association of the projects with the overall strategy. The model proposed by Nassif et al. (2013), also included the categorization of projects, the definition of linguistic and fuzzy functions, the definition of inference rules and function calculations, and the balance and prioritization the project portfolio. The model aimed to address issues with project selection found during the study. According to Nassif et al. (2013), the wrong project choice leads to an excessive number of projects, inappropriate projects, projects disconnected from the strategic objectives of the organization, and an unbalanced portfolio.

Another application of fuzzy logic is the Analytical Hierarchy Process (AHP) employed by Huang et al., (2008) to aid the project selection process in government-sponsored R&D projects. For decision-making where criteria are difficult to evaluate and where normative reasoning is not sufficient, AHP provides ways to extract decision-makers' preferences more naturally (Hansson, 2005; Aragones, Chaparro, Pastor & Pla, 2014).

Nassif et al. (2013) and Constantino et al. (2015) referred to the relationship between project selection and organizational strategic alignment or strategic planning. Strategic planning directly influences project selection; an organization should select its projects so as to align with the overall organizational strategy, this concept is supported by (Ciutiene & Neverauskas, 2011; DeFilippi & Roser, 2014). If there is a relationship

between strategic alignment, business strategy, and project portfolio, then understanding that relationship should help describe the relationship between project portfolio and strategic alignment. Meskendahl's (2010) presented the following propositions about project portfolio and strategic alignment with organizational goals:

1. Project portfolio success consists of the average single project's success, balance, strategic fit, and use of synergies among the projects in the portfolio. This last item is problematic considering that organizations focus more on the success of individual projects and rarely pay attention to the dynamics, dependencies, and interactions among projects (Cruz, Fernandez, Gomez, Rivera, & Perez, 2014).
2. The structuring of a portfolio must follow a consistent integration and formalization approach. A project portfolio is dynamic and must be structured so to be able to adapt to a changing environment.
3. There are three dimensions of strategic orientation: analytical posture, risk-taking posture, and aggressive posture. All three dimensions influence the structure of the portfolio.
4. Meskendahl (2010) goes further to suggest a dynamic similar to that of the systems theory concept of emergent properties, where the results of a well-managed portfolio surpass the results of managing each project individually. Along with strategic alignment, project's interdependency is gaining the attention of the project management research community at a rapid pace.

Portfolio management focuses on balancing resources with the demands of many projects. It is reasonable to maintain control of projects that otherwise may consume resources to the point of starving other projects. Alternatively, a portfolio manager may disrupt the completion of projects whose products are inputs to other projects (Cho & Shaw, 2013; Dutra, Ribeiro, & de Carvahlho, 2014).

Abbassi, Ashrafi, and Tashnizi (2013) proposed using a cross-entropy-based selection methodology for R&D portfolios that include project interdependencies. Based on a nonlinear mathematical programming method, the methodology uses a systematic process for selecting and adjusting R&D project portfolios. The method achieves organizational goals by aligning with the organization's strategic plan, minimizing portfolio risks, and considering project synergies.

Similar to Cruz et al. (2014), Meskendahl (2010) and Abbassi et al.'s (2013) approach follows a set of steps leading to a mathematical model: (a) research the project's categorization; (b) evaluate the criteria of the research projects; (c) construct the mathematical model; and (d) research the projects' evaluation and development of the project portfolio. One interesting aspect of the proposed model is the introduction of the cross-entropy algorithm to deal with project interdependencies and how the interdependencies of projects affect portfolio performance. The challenge to the cross-entropy solution is that it depends on the accurate assessment of key factors affecting the portfolio value, which is hard to establish or is not clearly defined. To address this issue, Riddell and Wallace (2011) proposed the integration of expert judgment with fuzzy logic

into decision-making criteria that are less than clear, as well as the incorporation of stakeholder preferences.

Most project selection processes are mathematically oriented. Many use a fuzzy approach to accommodate for less-than-exact criteria. The authors of all the studies reviewed agreed that the use of mathematical models to solve project selection issues is still a field of exploration. It has not been easy to find the optimal formula that can incorporate all criteria, especially fuzzy criteria (Abbassi et al., 2013; Cruz et al., 2014; Meskendahl, 2010). Focusing on the impact of synergy among projects in a portfolio, Tavana, Khalili-Damghani, and Sadi-Nezhad (2013) agreed with Abbassi et al. (2013) that there is a need to embrace conflicting fuzzy goals with imprecise priorities. The authors proposed a model based on technique for order preference by similarity to ideal solution (*TOPSIS*) to use with fuzzy preference relations. Fuzzy preference relations are a way of comparing and contrasting the decision-makers' fuzzy preferences and the goal of arriving at an optimal decision. Other similar studies and proposed frameworks include a multistage decision-making structure (Pendharkar, 2013) and a computational fuzzy logic with AHP (Khalili-Damghani & Sadi-Nezhad, 2012). Wei and Chang (2011) also combined fuzzy set theory and the multicriteria group decision-making method, and Bolat et al., (2014) added multiobjective decision analysis for the project selection approach.

This literature review is by no means an exhaustive review of all available knowledge, but rather a compendium of recent research in the area of project selection. The literature shows that the problem of selecting the optimal project portfolio is still

challenging (Jeng & Huang, 2015; Bina, Azevedoa, Duarte, Filho, & Massaguer, 2015). This problem corresponds to the subjective aspects of a decision-maker's preferences and the market, geographic, economic, and governmental factors, among others, that influence the decision process (Park et al., 2015; Materia, Pascucci, and Kolympiris, 2015). Part of the challenge is the normative nature of the methods proposed; only in the cases of fuzzy set-based methods are descriptive approaches partially considered (Bolat, Cebi, Temur & Otay, 2014).

Framing the Study

Analyzing the phenomenon of study starts with the problem statement. The problem this study will investigate is that the NCI CBIIT does not use a formal project selection process for its bioinformatics project portfolio. The lack of such a formal project selection process results in a choice of projects that may not align with the mission of the organization and the needs of the cancer research community (CI4CC, 2013). Consequently, the cancer research community does not adopt the products of these projects or abandons their use in a short period, resulting in the loss of public funds (Califano et al., 2011). The second problem addressed by this study is the gap in the literature about IT project portfolio management and the adoption of formal project selection processes in the public sector.

According to Aliev et al. (2012), the rigor required for normative methods and the unwillingness of decision-makers of relinquishing decision-making to a system of mathematical formulas alone are to blame for the lack of adoption of formal selection processes. The issues with normative approaches described in the literature review

include the need for accurate information on which to base the decision, formalization of the behavior of the decision-makers, imprecise probabilities influenced by human judgment (Mishra, 2014), the cognitive conflicts affecting quality of decision, changing business needs, poor quality of information, change in leadership, and the political and economic environment (Pendersen & Nielsen, 2011).

The program evaluation theory uses a systematized approach to program assessment that might benefit the project selection process. Given its roots in government-program evaluation, the theory focuses on the contribution to decisions about program initiation and the decisions about program continuation. For the purpose of this study, program evaluation theory contributes to the understanding of the psychological, social, political, and economic dynamics surrounding the project selection (Stuffelbeam & Coryn, 2014).

Framing the Research Questions

The following research questions guide this study

RQ1: How does CBIIT select projects for its project portfolio?

RQ2: What type of decision-making process guides the selection of projects in the CBIIT project portfolio?

RQ3: What environmental factors affect the decision-making process?

Aligning project selection with organizational strategies represents a challenge to the implementation of a formal project selection process. Environments where the strategic goals of the organization are ambiguous or not well understood accentuate the challenge (PMI, 2013). Another challenge is the fact that normative theories underlie the

techniques available to the project selection processes. These techniques are more theoretical than practical and are not necessarily well known by practitioners (Pendersen & Nielsen, 2011; Rantakari, 2014).

The public-sector decision-making process varies from that of the private sector. The public sector has many factors that make the project selection process more difficult; these factors include financial return on investment versus social return on investment, budget constraints, political agenda of the administration (Millar & Hall, 2013), limited information, ambiguous selection criteria, and a diverse range of stakeholders (Bible & Bivins, 2011; Martinsuo, 2013). Also, all organizations struggle to balance many projects with limited resources, but this issue worsens in the public sector (Bible & Bivins, 2011; Martinsuo, 2013).

How does the project selection process at CBIIT affect project outcomes? The selection process and the strategic goals of the organization are interdependent. Also, the success of the combined projects depends on the project–selection decisions (Hansson, 2005; Kodukula, 2014).

Why does CBIIT use the current selection process instead of a more structured process? The TAM and its derivative models may address this research question. Factors such as perceived usefulness and perceived ease-of-use could help explain the lack of a more structured selection process. If decision-makers find the process difficult, and they believe that an ad hoc and intuitive approach is easier, then they will select the path of less resistance (Fishbein & Ajzen, 2010).

Summary and Conclusions

The goal of this literature review was to understand the phenomenon of study from a conceptual and theoretical perspective. The review included current studies dealing with similar issues and their solutions and used the theories and perspectives from the literature review to frame the phenomenon and research questions. The phenomenon and research questions were theoretically framed using the three top theories that form the basis of the TAM: the theory of planned behavior, program evaluation theory, and decision theories. Through the literature review, a gap has been identified that relates to practical approaches in the adoption of the project selection process in the public sector (Pendersen & Nielsen, 2011; Rantalari, 2014). The following section presents 12 propositions that summarize the findings of the literature review. These propositions reflect the current state of the project selection process.

*Proposition 1***:** There is a direct link between the project selection process and the achievement of organizational strategies and objectives (PMI, 2013; Kaiser, Arbi & Ahlemann, 2015;).

*Proposition 2***:** The application of tools and techniques to the project selection process is more theoretical than practical. Practitioners find it difficult to implement the available methods, leaving organizations with the most practical option of using expert judgment and *ad hoc* approaches (Pendersen & Nielsen, 2011; Rantakari, 2014).

*Proposition 3***:** A problem exists related to project selection that has lingered for many years, and it is still relevant to the current organization (Martinsuo & Killen, 2014; Killen & Hunt, 2013).

*Proposition 4***:** The problem of project selection in the public sector has many factors that do not necessarily exist in the private sector, mainly related to financial return on investment versus social return on investment (Millar & Hall, 2013).

*Proposition 5***:** Organizations struggle to balance resources among projects. Limited information and ambiguous criteria do not help in the decision-making process. (Bible & Bivins, 2011; Martinsuo, 2013; Pajares & Lopez, 2014).

*Proposition 6***:** The selection process largely depends on decision-making processes, and the success of the portfolio depends on making the optimal decision (Hansson, 2005; Kodukula, 2014).

*Proposition 7***:** Most proposed solutions in the literature are normative. Normative approaches require mathematical models and precise information. Researchers recognize that convergence between the normative and descriptive approaches is necessary. The use of fuzzy logic begins to accommodate the need for exact information about decision-making in practice (Hansson, 2005; Mishra, 2014).

*Proposition 8***:** When confronted with rational decision problems, individuals tend to favor choices that maximize their expected utility (von Neumann and Morgenstern, 1944).

*Proposition 9***:** All studies reviewed agree on the basis of prospect theory (Barberis, 2013). Studies on evaluation methods included two phases of the project selection process: an early editing and evaluation phase, and an assessment phase to select the highest-value prospects. From there, the different evaluation methods departed,

introducing the use of different mathematical models, including fuzzy logic, and AHP, (Nassif et al., 2013; Petit, 2012).

*Proposition 10***:** Decision-making occurs in situations that include imprecise probabilities and limited information due to the influence of human judgment, perception, and emotions. In such circumstances, classical decision theories are not sufficient (Aliev et al., 2012; Mishra, 2014).

*Proposition 11***:** The project selection process faces issues related to macro-level projects, which expand to the sectoral and national levels; multiple stakeholders with different interests complicate consensus. Another issue is that experts who participate in the selection process may be stakeholders, which increases the chance of bias and conflict of interest. These issues make it difficult for decision-makers to construct a meaningful set of criteria to aid the decision process (Oral et al., 1991; Rantakari, 2014).

*Proposition 12***:** A gap exists between the literature about project selection decision-making and practitioners. The research promotes a decision process using rational mathematical models assuming the existence of accurate information and disregarding the complexity of ambiguous criteria. In the absence of a more flexible approach, practitioners prefer models based on intuition, experience, and understanding of the environment (Pendersen & Nielsen, 2011).

In this study I used a phenomenological reduction approach during data gathering to bracket any prior knowledge or biases I would introduce as the researcher. This approach allows for an unfiltered, qualitative process for interviewing participants

(Manen, 2014; Vagle, 2014). Chapter 3 provides details regaring the interiewing approach.

Chapter 3: Research Method

As described in Chapter 1, the purpose of this case study was to understand the project selection process at the CBIIT through the lens of a qualitative approach to inquiry. The study began with the proposition that projects at CBIIT would have a higher rate of adoption if the organization used a selection process informed by a framework based on the industry's project portfolio management standards and best practices.

Objectives

By understanding the project selection process, I as the researcher, first, can help the organization define and implement a more efficient process. A formal process would resolve the problems caused by the lack of a systematized process for project selection (Bible & Bivins, 2011; PMI, 2013). The second objective of the study was to fill a gap in the project management literature, specifically about the public sector. The extant literature did not address the use of a formal selection process in government-funded projects in the United States (Nassif et al., 2013). At this stage in the research, the project selection process includes the steps leading to CBIIT's choice of a project to undertake. The research problem is a lack of a systematized project selection process, and the impact of the problem is projects resulting in solutions with a low rate of adoption by the cancer research community.

The organization of this chapter is as follows. I explain the research design and the rationale for the selection of a qualitative approach, followed by the identification of the role of the researcher in the study. This chapter includes discussion of potential bias introduced by me as the researcher and the effect of me as the researcher on the site. The

impact of the site on the researcher and the implication of this impact for the study are also important (Miles et al., 2014). The chapter continues with the description of the methodology, strategy for participant selection, recruitment procedures, and instrumentation. Finally, the chapter describes the data collection strategy, data analysis procedures, and issues of trustworthiness.

Research Design and Rationale

The research design serves as the roadmap to guide the researcher through the study. The selection of a design depends on the problem statement and the research questions. For this study, a qualitative exploratory case study (Yin, 2011) was the most appropriate research design. A qualitative exploratory case study allowed me to study the phenomenon in real-world conditions and enabled the representation of study participants' views. Furthermore, a qualitative exploratory case approach covered the contextual conditions where the phenomenon or problem develops.

Role of the Researcher

For this study, I proposed a role similar to the observer-participant role described by Tracy (2012). Tracy described the role as a play participant. In this role, the researcher engages in some of the participant's activities, but his or her participation is improvisational, allowing the researcher to opt in and out of the participant's activities and maintain a skeptical position. In general, the role of the researcher in qualitative research is to conduct data collection, analysis, and interpretation. Unlike the quantitative tradition, where the role of the researcher is nonexistent, in qualitative research, the researcher is the instrument. It is important to reveal any biases and assumptions on the

part of the researcher early in the process to determine their influence on the data collection, analysis, and interpretation (De Semrik & Shkedi, 2014).

The following were my assumptions and biases, and the strategies that I used to manage them:

(a) I conducted the study at a site where I currently worked;

(b) I knew most of the potential candidates, and there were working relationships that could affect the behavior of the participants during the interviews; and

(c) I was familiar with the organization's operations.

To manage my assumptions and biases, I used a phenomenological approach to data collection. The phenomenological concept of bracketing helped me put aside my assumptions and biases during data collection and analysis (Manen, 2014). During observation, field notes were recorded and evaluated through a reflexivity approach. Gilgun (2011) defined reflexivity as the capability of the researcher to be aware of the influences that affect the research processes, as well as how the research processes and the site affect the researcher. I took caution to avoid recruiting participants with direct relationships to me, such as direct reports and family members. Other approaches to increasing credibility of the study included method triangulation using observation, interviews, and documentation. Similarly, to triangulate the data, participants' were selected from different parts of the organization, different roles, and different statuses. Finally, the use of audio recorded interviews allowed for confirmation of transcript materials.

Methodology

This methodology section describes the research approach for this qualitative exploratory case study. The methodology is the strategic plan the researcher used to gather, analyze, and interpret data throughout the study. The methodology is dynamic, and the researcher must review and adjust it during the study to make sure the study will answer the research questions appropriately. The methodology included design decisions the researcher makes regarding breadth and depth of the study, voice, and appropriate methods. The researcher must structure the methodology considering the nature of the problem under study and the research questions (Clough & Nutbrown, 2014).

Participant Selection Logic

The participant selection process involved a purposeful nonrandom sampling approach. A purposeful approach uses participants that best fit the study parameters to provide information that can answer the research questions (Tracy, 2012). The selection process may manifest bias introduced by the researcher's proximity to the site. Common biases are elite bias, the tendency to only recruit upper-management participants, and selection of participants best known by the researcher. To avoid these biases, the study included 25 participants from five different sections of the organization. The groups included CBIIT's program management, engineering, scientific computing branch, informatics program, and health sciences. This selection allowed for triangulation of data. Selection of participants included different levels in the organization, including top and mid-management and nonmanagement roles, because it is important also to include

participants with dissident perspectives and those considered deviants and marginal, who can contribute different worldviews (Miles et al., 2014).

Instrumentation

This study used two approaches to data collection, in-depth interviewing and observation/participation. In-depth interviewing was the primary method of data collection. The interview strategy followed a phenomenological approach (Manen, 2014). In phenomenological interviewing, the researcher sets aside his or her knowledge, assumptions, and biases and allows the participants to express their real experiences. A phenomenological approach to interviewing does not use precanned questionnaires. The researcher enters the interview with the objective of allowing experiences and beliefs to flow from the participants (Maxwell, 2013).

The second instrument was a protocol to guide participant observation as a method of data collection. Participant observation is a method commonly used by ethnographers in the study of cultural phenomena. Researchers can use the method in other areas such as the understanding of organizational cultures and participants' behaviors within the organization. Participant observation is the systematic gathering, organizing, and analyzing of data through observation and participation in the day-to-day activities of individuals in a particular setting (DeWalt & DeWalt, 2011). Here, in the role of participant-observer, I participated in activities related to new project selection at CBIIT. I took part in the Project Coordination Office activities, engaged in dialogues, and participated in the selection process. The observation protocol included narrative, descriptive observation logs, and field notes to capture observation and participation data.

Computer Assisted Qualitative Data Analysis was used to manage the interview and observation data. I used NVivo (QSR, 2014), a proprietary qualitative analysis software that integrates data storage, coding structure, field notes, voice, and video. The main reasons for using NVivo were availability and my familiarity with the application.

Procedures for Recruitment, Participation, and Data Collection

To recruit participants for the study, it was necessary to obtain written permission from the director of CBIIT. I procured written permission for recruitment after obtaining approval from Walden University's Institutional Review Board (IRB), IRB approval number 02-17-16-0070100. Participation in the study was voluntary, and all participants were required to sign an informed consent form. The informed consent form provided information about the nature of the study and the rights of participants, ethical considerations, and the participants' option to withdraw from the study at any time. The study required 25 individuals from different parts of the organization who were involved directly or indirectly in the project selection process. I used a purposeful, nonrandom sampling approach to select participants, including a mix of top and mid-management and nonmanagerial participants from the program office, engineering, scientific computing branch, informatics program, and health sciences.

Data Collection

The data collection process followed a phenomenological approach to interviewing (Vagle, 2014). The phenomenon of study or project selection process as experienced by the participants and the research questions are the most important considerations and are thus the drivers of the methodology used in the study. Data were

collected mainly through unstructured interviews. I did not use precanned interview questions. Instead, to guide the unstructured interview, I used a protocol to steer the participants toward the phenomenon when necessary (Vagle, 2014).

A protocol serves as a roadmap to ensure that all participants will focus on the topic of discussion (Seidman, 2013). Phenomenological interviewing uses open-ended, unstructured approaches and friendly conversations in different settings where participants are most comfortable. Seidman (2013) described four themes within phenomenological interviewing:

- The temporal and transitory nature of human experience. The interview focuses on the experience of the participant and the meaning the participant gives to that experience.
- Whose understanding is it? This theme focuses on the participant's subjective understanding, unlike the observation, where the understanding is that of the researcher or observer.
- Lived experience as the foundation of the phenomena.
- Emphasis on meaning and meaning in context.

Phenomenological interviewing aims to make sense of a participant's experience. According to Seidman (2013), these four themes provide structure for the analysis of interview data. The data collection process included digitally recording the interviews. I collected thick data and accessed the participants' perspectives in the context of what works, and what does not work. In this study, the term *interview* refers to a qualitative interview as defined by Yin (2011). Yin posited that the relationship between the

researcher and the participant in a qualitative interview must develop naturally, without a script. Also, a researcher should follow a mental protocol that guides the verbal questions (Yin, 2011).

To complement the first method of data collection, phenomenological interviewing, and to avoid total passivity in the data-gathering process, I used balanced participation and observation as the second method of data collection (Yin, 2011). Yin (2011) recommended that the participant-observer maintain a balance between observation and participation by listening carefully, keeping a good mental record, avoiding comparison of initial field experiences with the researcher's experiences, and making few initial assumptions. The third method of data collection is documentation. Data collected from historical records strengthen the credibility of a study because historical data are free of influences and biases introduced by the researcher (Yin, 2011).

The data included interviews, observation, and historical documents. All the data were digitally recorded and secured on a device accessible only to me. The data collection phase lasted from April 30, 2016 to May 31, 2016. I informed all participants about their right to withdraw from the study. Withdrawing from the study included purging the participant's data. An optional debriefing meeting was available to allow participants to express their reasons for withdrawing from the study.

Data Analysis Plan

The research problem and research questions drive the research design, including the data collection and analysis strategies. A protocol that steers the participants toward

providing information that is relevant to the research questions guided the data collection. All collected data should support the goals of qualitative research **(**Yin, 2011):

- Studying the meaning of participants' lives under real-world conditions;
- Representing the views and perspectives of the participants;
- Covering the contextual conditions of participants' lives;
- Contributing insights into existing or emerging concepts that may help explain human social behavior; and
- Striving to use multiple sources of evidence rather than relying on a single source.

The data analysis followed a two-cycle coding approach. Coding includes the process of assigning a word or phrase to a section of data for summative, salient, and meaning-capturing purposes. Saldaña (2013) describes a code as a construct symbolizing the interpreted meaning of the datum. These symbols identify patterns, categorization, and theory development. In the two-cycle approach I carried out, data coding followed the process below:

Precoding. Interview transcription, field notes, and data organization for coding.

First Cycle: Coding for themes, data examination, and development of the critical links between the data and the research questions. Following a heuristic approach, I did not use any sensing concepts or interpretative devices to allow themes to emerge naturally from the data. The first-cycle coding included the following methods (Saldaña, 2013): (a) attribute coding; (b) structural or holistic coding, which allowed me to conduct a "grand tour" or overview of all collected data; (c) descriptive coding, which

used field notes and historical documents, and; (d)*in vivo* coding, also known as value coding, in which the researcher codes interview transcripts for language, perspective, and participants' views.

Second Cycle: Pattern coding and conceptual ordering. Pattern characterization included similarities, differences, frequencies, sequence, correspondence, and causation (Saldaña, 2013). The organization of the data used conceptual ordering to organize the data into discrete categories by the data underline meaning. Conceptual ordering facilitated the identification of themes (Birks & Mills, 2015)

Further data analysis included the following iterative steps (Tracy, 2012): (a) data organization, including reading and rereading the data and recording analytical reflections; and (b) data immersion, which consists of submerging in the breadth of the data, thinking about the data, discussing the data with others, and further reflecting on the data. I systematically recorded all thoughts, emerging concepts, and perspectives and used analytical memos to record data characteristics. The memoing process included questions such as: What is interesting about emergent themes? How do the themes contribute to theory? How do they address the research questions? How to the relate to the research problem? (Miles et al., 2014; Tracy, 2012).

Recoding the data. The next phase of the data analysis was the recoding of the data. This time, the data were coded using sensitizing and heuristic codes derived from the theories framing the study. The TAM has precise codes that reflect phenomenological characteristics that participants may experience. Concepts such as perceived usefulness

and perceived ease-of-use can be used to codify the data from a theoretical perspective. To manage, store, and analyze the data, I used NVivo. The diagram below depicts the summary and presentation approach to the data analysis and reporting.

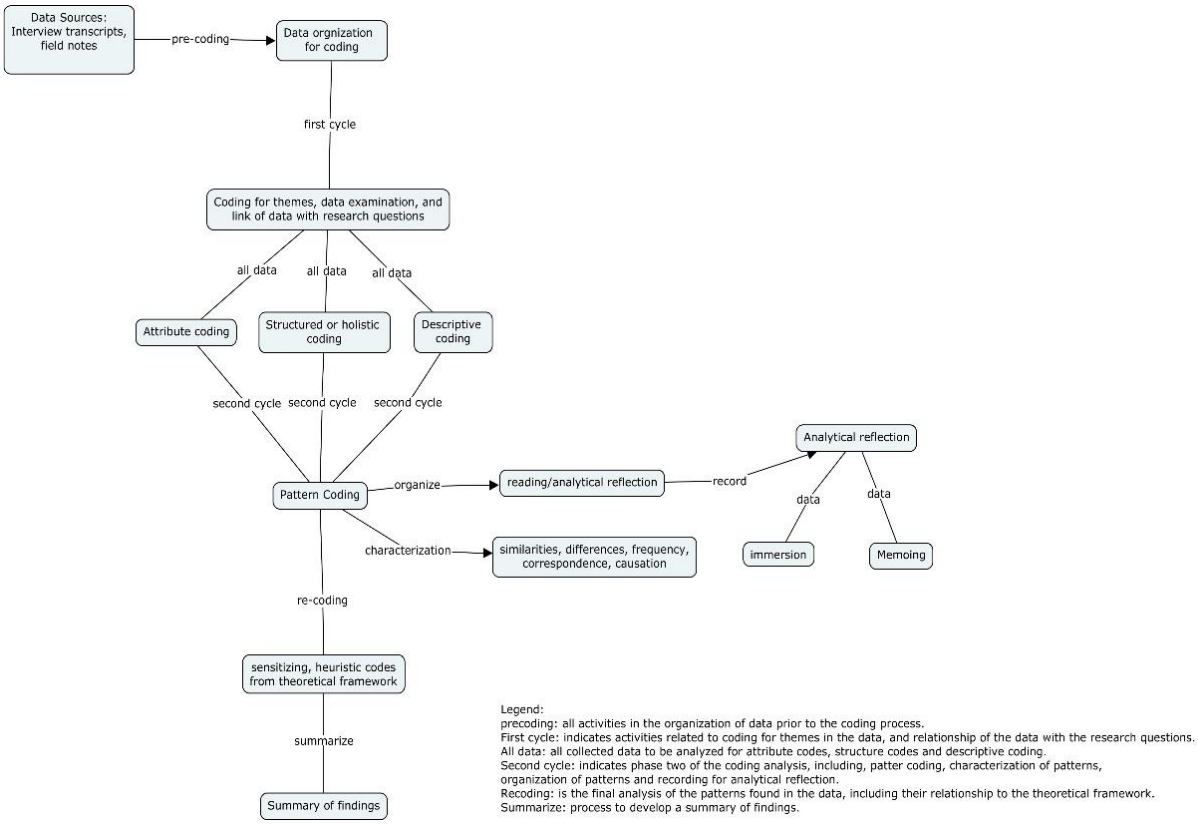

Figure 2. Information technology portfolio selection process study's data analysis approach.

The data analysis approach depicted in the diagram above described a multiphase approach (Tracy, 2012) that starts with the source of data and a precoding phase. During the precoding phase, the data were organized for coding following a first cycle to code for themes. The first cycle included attribute coding, structure or holistic coding and descriptive coding. The second cycle focused on identifying patterns and the analysis of the patterns through rational reflection. Finally, the data is recoded using heuristic codes

from the theoretical framework, linking the data to the literature review and the theoretical framework.

Issues of Trustworthiness

An essential factor in any research is trustworthiness. From a positivistic research point of view, issues of trustworthiness were addressed using construct validity, internal validity, external validity, and reliability (Beuving & de Vries, 2015; Lincoln & Guba, 1985). Similarly, the naturalistic researcher must address issues of trustworthiness by considering matters involving:

- Credibility, or the confidence that the findings is trustworthy and are credible;
- Transferability, which requires demonstrating that the conclusions are applicable in different contexts;
- Dependability or consistency of the findings; and
- Confirmability, or how the participants and researcher shaped the findings.

The researcher must also address how the study deals with issues of investigator bias or self-interest (Guba & Lincoln, 1989; Merriam and Tisdell, 2015). The section below briefly describes how this study addressed issues of trustworthiness. From a phenomenology perspective, validity requires that the researcher put aside his or her past knowledge of the phenomenon in question to present the findings as they are without filtering. This approach, named phenomenological reduction, allows for in-depth examination of why a phenomenon manifests the way it does. The phenomenological reduction also addresses how participants experience a phenomenon and not how the researcher conceptualizes it (Manen, 2014).

Credibility

Credibility in qualitative research is analogous to internal validity in the natural sciences. The concept of credibility concerns the question of how close to reality the findings of a qualitative study are (Lichtman, 2013). The credibility of qualitative research has many challenges, including the researchers' perspectives and biases, the methods used to gather data, the interpretation of the data, the accuracy of the data, and the influences of participants and the environment (Yin, 2011).

Addressing issues of credibility. Adopting a theoretical framework helps the researcher organize the study to include processes that will help others understand the study. The theoretical framework informs the steps the study follows and helps determine if they are sufficient to deem the study credible (Yin, 2011). To address issues of credibility, the theoretical framework for this study includes the triangulation of sources using different sources of data such as interviews, observation, participation, and historical documents (Lichtman, 2013). The framework also includes the triangulation of methods through the use of different data collection methods and theory/perspective. Another important method in the framework of this study is member check. Member check allows the researcher to verify his or her understanding of the setting and the phenomenon of interest, and how the researcher's knowledge corresponds to that of the participant. While the member check is in progress, the researcher will provide documentation to participants requesting verification of the accuracy of the data collected (Harper & Cole, 2012). Participants will also verify intended meaning, a reason for the patterns found in the data, and emergent theories (Gilgun, 2015).

Familiarization with the organization. The process of creating rapport with members of the organization and participants involves getting to know the organization's culture. Another important aspect of familiarization with the organization is how group members interact with one another and how their personal perspectives relate to the phenomenon of study (Yin, 2011). The researcher must be aware of his biases and possible influences on participants, especially when interviewing members of the organization with whom the researcher has working relationships, such as direct reports and customers (Seidman, 2013).

Generalization and Transferability

Generalization in empirical or quantitative studies refers to the applicability of the results of a study or conclusions drawn from a sample of the population as a whole. In contrast, qualitative research, specifically phenomenological and case studies, are considered unique to a particular event in a given context, and thus generalization is not the primary concern. Instead, qualitative researchers aim for an in-depth understanding of the phenomenon as it applies to its unique context (Yin, 2011).

In qualitative research, analytical and naturalistic generalizations are common. In analytical generalization, there is either a claim that the study informs another concept or a claim that the findings of the study can might apply to a similar situation (Yin, 2011). In particular, analytical generalization requires arguments that are resistant to challenge, including rival explanations and the understanding that generalizations are not conclusions. Generalizations are developing theories that need further refinement or abandonment (Flyvbjerg, 2011). Naturalistic generalization allows the reader of the study

to come to his or her conclusion about the applicability of the study to a similar situation experienced by the reader (Manen, 2014; Tracy, 2012). In all cases, the researcher must provide a thick narrative, well-documented data-collection procedures, and data analysis to give readers enough context for generalization. A possible generalization related to this qualitative exploratory study is that the same factors or concepts affecting the project selection process at CBIIT might exist in other government funded initiatives.

Dependability. Similar to internal validity in quantitative research, dependability relates to the ability of a researcher to repeat the study with the same participants and arrive at similar conclusions. In other words, the findings are consistent and repeatable (Lincoln & Guba, 1985), considering the limitations imposed by the changing nature of phenomena in qualitative research (Marshall & Rossman, 2011). This case study addressed issues of dependability by providing the following:

- A detailed description of the research design and its implementation;
- A detailed description of data-collection strategies and any issues or constraints found in the field during data gathering;
- A detailed description of data analysis and interpretation procedures, including ensuring credibility by describing how I arrived at the conclusion and strategy; and
- A member check and reflective evaluation of the project.

Confirmability. Confirmibility is concerned with presenting findings as objectively as possible and with recognizing and documenting potential biases introduced by the researcher. The results of the study must reflect the experiences of the participants,

filtered as much as possible to remove the researcher's perceptions and biases. This study addresses issues of confirmability through the use of triangulation of data collection methods and data sources. Addressing confirmability included documentation of the researcher's predispositions and biases. The approach to confirmability included the rationale for the use of selected methods and approaches, a detailed description of the methodology and reflective audits, and testing rival explanations (Bloomberg & Volpe, 2013).

Ethical procedures. It is the responsibility of the researcher to ensure that ethical procedures are implemented and followed throughout the study. An approved application is only the beginning; the researcher must be vigilant and maintain professionalism and awareness of any potential ethical issues during the study. Autonomy, the right of the participant to informed consent and the right to voluntarily opt to participate or not in the study, is a major principle of ethical conduct in research. Protecting participants from harm and maximizing the potential benefits of those involved in the study are also important principles. The principle of justice, including protecting vulnerable populations and the privacy of participants, must be kept in mind. Finally, protecting the confidentiality of each participant, providing a trustworthy environment, and avoiding intrusiveness are also important (Ravitch & Carl, 2015).

Participants expect that the research will be as unintrusive as possible and that the researcher will respect both their time and privacy. The researcher must avoid any behavior that is or gives the impression of being inappropriate. It is necessary to interpret the data carefully so as to avoid misstatements or misinterpretations (Miller, Birch,

Mauthner, & Jessop, 2012; Pollock, 2012). To safeguard ethical principles, this study incorporated the following processes:

1. As the researcher, I obtained approval from the IRB at Walden University, IRB approval number 02-27-2016-0070100, expires 02-16-2017. Upon IRB approval, the investigator asked for written permission from the site's director to gather data, see Appendix B. The request for the permission letter explained the purpose of the study, the participants' role, and how I would deal with ethical issues.
2. A recruitment letter and an informed consent form were published to invite participants to take part in the study, see Appendix C. The informed consent form described the purpose of the research, the role of participants, and how participants can benefit from the study. The informed consent form provided information about voluntary participation, how to withdraw from the research, ethics, privacy, and confidentiality issues.
3. The length of interviews averaged 45 minutes. I informed the participants of any need for follow-up.
4. Locations for interviews ensure the comfort of participants.
5. All information was safeguarded using encryption and password-protected devices.

The graphic below summarizes the research design including the data collection and data analysis process discussed in this Chapter 3.

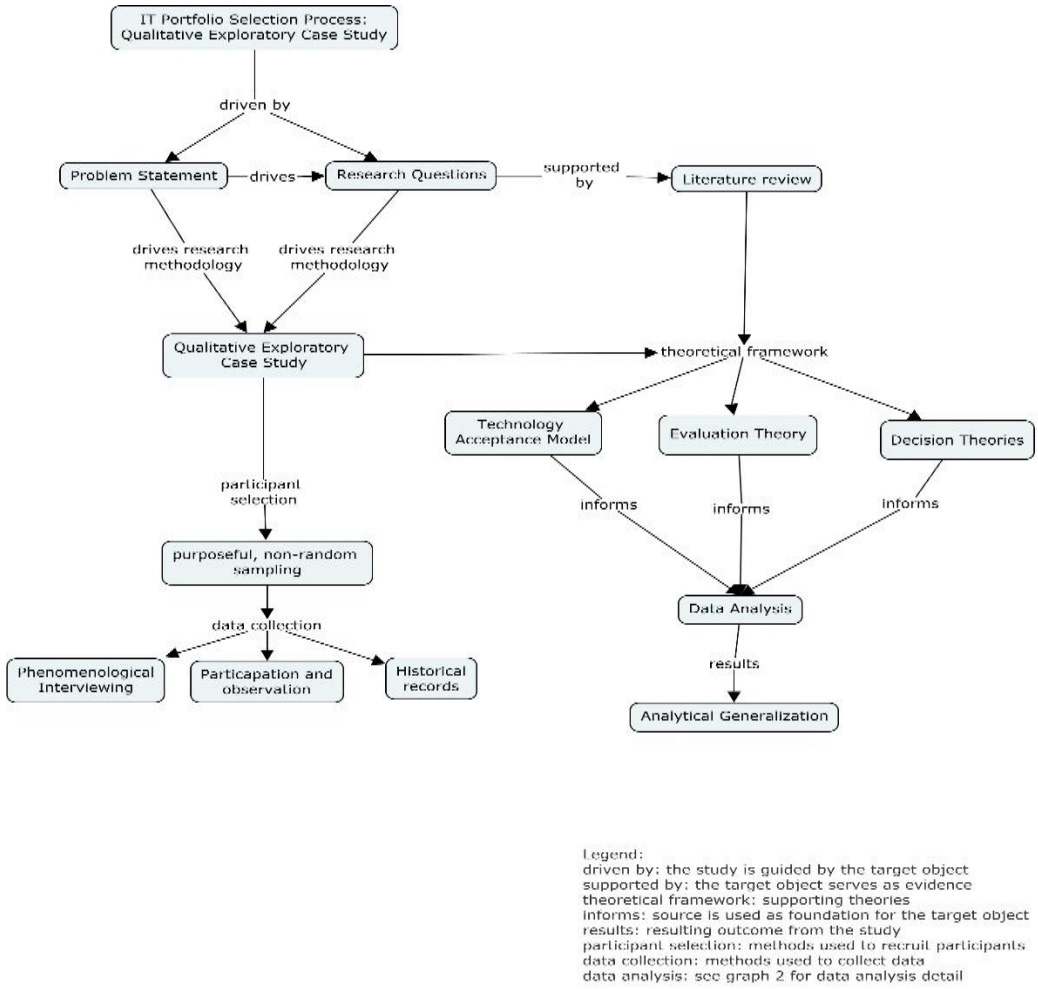

Figure 3. Information technology portfolio selection process research design.

Summary

Chapter 3 described the purpose of the study as understanding the project management selection process at CBIIT through the lens of a qualitative approach to inquiry. The objective of the study was to help the organization implement a more efficient process using the findings from the study and at the same time, fill a literature gap in project management for government-funded initiatives.

The research design followed a qualitative exploratory case study approach because of the research problem and the research questions. The research problem was the lack of a systematic and formal approach to project selection at CBIIT. The research questions were:

RQ1 How does CBIIT select projects for its project portfolio?

RQ2 What type of decision-making process guides the selection of projects in the CBIIT project portfolio?

RQ3 What environmental factors affect the decision-making process?

Given the research problem and research questions, I found that a qualitative approach and a case study design are a better fit for the study. A qualitative approach is appropriate if there is a need for in-depth understanding of the problem. A qualitative approach is also convenient if the research conditions for an experimental approach do not exist (Yin, 2011). A qualitative approach allows the researcher to study the phenomenon in real-world conditions, enabling participants to express their views. At the same time, the qualitative approach includes the contextual situation of the participants experiencing the phenomenon. The rationale for using a case study design is that case studies allow for the collection of thick data and detailed analysis of the phenomenon. A case study is also bound to a particular setting (Bloomberg & Volpe, 2013).

The chapter explained the role of the researcher. Unlike the researcher's passive role in quantitative research, the researcher has an active role in qualitative research. The researcher is the instrument for data collection; thus, the researcher's influence on the study and the site's influence on the researcher must be considered. As an observer-

participant, the researcher engages in daily activities related to the phenomenon of study and at the same time observes and collects data. As the researcher in this case, I had proposed a phenomenological interview strategy as the principal form of data collection, followed by a review of historical documents and data obtained from observation and participation. Other aspects of the study discussed in this chapter included participant selection logic, instrumentation, recruitment procedures, and a data collection and analysis plan. The chapter concludes with a discussion of issues of trustworthiness and ethical procedures.

Chapter 4: Results

Purpose of the Study

The purpose of this qualitative exploratory case study was to obtain an in-depth understanding of the project selection process at the NCI CBIIT. To acquire such an understanding, I approached this qualitative exploratory case study in a phenomenological way, investigating the phenomenon as experienced by the participants and using researcher's reflection. Reflecting on discovered themes helps balance the research context (Flick, 2014; van Manen, 2014). This study was driven by the need to better utilize public funds in programs that support the use of information technology in scientific research. There was also a need to fill a gap in the literature about the project selection process in government-funded IT initiatives (Nassif et al., 2013). The following research questions guided the study:

RQ1: How does CBIIT select projects for its project portfolio?

RQ2: What type of decision-making process guides the selection of projects in the CBIIT project portfolio?

RQ3: What environmental factors affect the decision-making process?

This chapter documents the application of the research method used in the study, including participant recruitment, data collection, data analysis, and the research findings. The organization of this chapter is as follows: a description of the research setting, demographics, data collection strategy, the data analysis, evidence of trustworthiness, the results of the study, and the chapter summary.

Research Setting

The focus of this qualitative exploratory case study was the project selection process at the NCI's CBIIT. Established in 2004, CBIIT (2016) was created to "lead the coordination, development, and deployment of enterprise-wide digital capabilities in support of the Institute's initiatives" (p. 1). Using a purposeful, nonrandom sampling approach, I recruited 25 participants following the criterion that they must be involved in or affected by the project selection process. The recruited participants belonged to different branches of the organization, including program management, scientific computing and bioinformatics, engineering, and life sciences. Individuals participated voluntarily in a phenomenological interview averaging 45 minutes. The interviews took place mostly in the participants' offices; four of the interviews took place over the phone due to participants' locations. It is important to notice that during the study, the organization experienced many changes, starting with the recommendations of the NCI BSA and the arrival of a new director. CBIIT changed its focus from historical extramural community support to the intramural research community. At the time of this study, the organization was shifting from a historically technology-focused mentality to a customer-first and service-focused mentality. This paradigm shift could have influenced the findings of the study, specifically in the way participants responded to the interview questions. Participants could have responded differently if interviewed before the changes the organization was experiencing at the time of the interviews.

Demographics

The participants in this study were selected using a purposeful, nonrandom approach; I recruited 25 participants involved in the project selection process at CBIIT. Practitioners and scholars commonly have debated the right number of participants in a qualitative study; a proposed approach or criterion for selecting the ideal number of participants is saturation (Seidman, 2013). The point of saturation is reached when the researcher does not get new information through the interviews, but instead, participants provide information that has been presented by previous interviewees. Saturation was more likely to be achievable with 25 participants (Seidman, 2013). I reached a point of saturation during the 20th interview.

Participants' time in the organization averaged 5 years; the gender distribution was 18 men and seven women. The distribution of participants across the management hierarchy consisted of four participants from senior management, nine participants from midmanagement, and 12 participants from lower management or program support. Senior managers are responsible for the operation of programs and have supervisory responsibilities over midmanagers. Midmanagers are responsible for projects and may supervise other individuals, and lower management is those people with project execution or project support responsibilities. See Appendix D for the hierarchy distribution table.

A number between P100 and P130 was assigned to each participant to protect his or her confidentiality. There was no expectation of compensation for participating in the study, but participants received a $10.00 Starbucks gift card as a token of appreciation. Table 1 describes the participants' titles and job responsibilities.

Table 1

Participants Ranking and Responsibilities

Participant Code	Ranking	Responsibilities
P100, P102, P103, P104	Senior Management	Programs, projects, finance, strategic planning, personnel management
P101, P105, P110, P115, P116, P117, P118, P119, P126	Midmanagement	Programs, projects management
P108, P111, P112, P113, P114, P121, P122, P123, P125, P127, P129, P130	Lower Management	Support for programs and projects in software development, engineering, project management.

Data Collection

Before starting the data collection process, IRB approval was requested by submitting the required IRB application. The Walden University IRB approved the petition and assigned record number IRB02-17-16-0070100 on February 17, 2016. I followed the data collection plan depicted in Chapter 3. The main method of data collection was a phenomenological interview. The length of the interviews was from 20 to 45 minutes. The interviews took place at each participant's office, except for four interviews that took place over the phone, due to participants' locations. Six of the participants opted for interviews at my office. The interviews took place from May 1 to May 29, 2016.

The interviews followed the approved interview protocol depicted in Chapter 3. See Appendix E for interview protocol. To capture how participants experienced the project selection process at CBIIT and to capture contextualization data, I decided that a phenomenological interview was the best approach. In phenomenology interviewing, the

researcher brackets his or her theories and knowledge, allowing the themes to emerge from the participant's description of his or her experience (Bevan, 2014). Adopting Bevan's (2014) method helped me guide the participants through the interviews, avoiding the use of leading questions. Bevan's provided written permission for the use of the interview protocol (Appendix A).

Bevan (2014) looked to accomplish four goals in his interview protocol. First, the protocol would provide an understanding of the meaning to the participant of the experienced phenomenon. Bevan accomplished this by having the participant contextualize their experience. According to Bevan, "contextualizing questioning enables a person to reconstruct and describe his or her experience as a form of narrative that will be full of significant information" (p. 4).

The second goal was to apprehend the experience of participants by directing focus on the phenomenon of study. This direction should be toward answering the research questions. The third phase or goal was to clarify the phenomenon. In clarifying the phenomenon, the participant uses different potential scenarios to elicit reflection and an opportunity to explicate the experience. During clarification, the participants had the opportunity to describe the phenomenon as they would like to see it, or the best-case scenario. This part of the interview was accomplished using predefined questions, contrary to contextualization and apprehension, in which the interviewer takes a descriptive approach.

Recruitment Strategy

Participants were recruited using an invitation letter (Appendix C). I scheduled a date and time for the interview. Consideration was given to the location of the interview to ensure the comfort of the participants. At the beginning of the interview, each participant was asked to read and sign an informed consent form. Remote participants received an electronic copy of the consent form that they printed, signed, and scanned back to me. The interviews lasted 20 to 45 minutes.

At first, I proposed 90-minute interviews, but many of the participants objected because of time constraints. Three of the participants agreed to 90-minute interviews, but the others gave 20- to 45-minute interviews. The length of the interviews did not impact the interviews negatively; each interview generated approximately 20 to 25 pages of dialogue after transcription. Participants received $10.00 Starbucks gift cards as tokens of appreciation for their cooperation. Three of the participants did not accept the gift card because they felt that it could constitute a conflict of interest given that they were government employees.

The possibility of a conflict of interest was not an issue; the National Institutes of Health's ethics policy about gifts to government employees stipulated that a gift of $20.00 or less is acceptable (Ethics, 2013). I informed the participants that the acceptance of the gift card was voluntary. As stated in Chapter 3, participants were selected using a purposeful, nonrandom approach.

Recruitment included participants from different areas and management ranking in the organization.

Interview protocol Phase 1: Contextualization. Example contextualization questions included the following:

- Please describe in detail your role within the organization.
- How does the project selection process at CBIIT affect your day-to-day performance of your duties?
- In your current role, are you involved in the decision-making process for the selection of projects?

See Appendix F for the list of questions asked during the phenomenological interview.

Interview protocol Phase 2: Apprehension. Apprehension questions included the following:

- How do you describe the selection process at CBIIT?
- How do you participate in the selection process?
- Is the current process working for you?
- What are the challenges related to the intake of projects?

Interview protocol Phase 3: Clarification. For this phase, questions such as the below were asked:

- How would you describe the ideal selection process at CBIIT?
- If you had the ability to change the project intake process, what would be your approach?
- Is there anything else you think should be done to improve the workflow?

Observation Strategy

The second approach to data collection was the use of observation. Observation is a systematic data collection approach in which the researcher uses his or her senses to examine the participants in their natural settings. The researcher looks to develop a full understanding of the setting in which the phenomenon of study occurs (De Clerck, Willems, Timmerman, & Carling, 2011). An observation protocol was developed and used during the observation sessions. See Appendix G for observation protocol. The Observation Protocol and Phenomenological Interview Protocol were both submitted to the IRB for approval. I received IRB approval on February 17, 2016, under the record number IRB02-17-16-0070100.

I participated in the following meetings: Enterprise Performance Life Cycle (EPLC) meeting on April 4, 2016; EPLC training on April 19, 2016; EPLC meeting on May 4, 2016; and Clinical Trials Reporting System Milestone 3, on April 14, 2016. Observation notes were taken and included in the data analysis described in this chapter.

Data Recording

All interviews were electronically recorded using a Samsung Note 4 cellular phone. For interviews over the phone, the speaker functionality of my office phone was used along with the recording function of the Samsung Note 4 cellular phone. To maintain anonymity, the interviews did not include the names of participants. The recordings were transferred to a secured hard drive and later transcribed. I will keep the data secure for 5 years as required by Walden University policy. At the conclusion of the 5-year retention requirement, the data will be destroyed.

Privacy Protection

I secured the data in a portable hard drive using biometric access control. After scanning and securing all informed consent forms, I destroyed their respective paper copies. All participants were assigned a code P100 through P130, guranteeing anonimity of the data.

Data Analysis

The data analysis followed a multicycle coding approach as per the analysis plan proposed in Chapter 3. I used a computer-assisted data analysis tool from QSR International called NVivo, version 11 Pro. NVivo allowed me to implement the proposed data analysis plan that started with precoding. This cycle included the transcription of all recorded interviews, the organization of meeting notes, and the importing of all material to NVivo for coding and analysis. The following sections describe each coding cycle.

First Coding Cycle

This cycle followed a heuristic approach to allow me to understand the data and allow for patterns to emerge naturally. Without using any sensing concepts or interpretative devices, I proceeded to code for attributes, specifically management hierarchy, and gender. A grand tour or holistic coding of the data followed the attribute coding. The holistic coding phase resulted in 86 unique codes. Next, an in vivo or value coding was conducted. The result of the in vivo coding was 114 codes.

The in vivo codes and the codes arising from the holistic analysis were further analyzed, collapsing all overlapping references. Field notes from observation and

participation data collection were coded using descriptive coding. Table 2 describes the most relevant categories resulting from the holistic coding in Phase 1.

Table 2

Most Relevant Categories and Subcategories from Phase 1

Category	Subcategory	Frequency
caBIG	Abandonment	4 (10%)
	caBIG Problem	28 (73%)
Change	Improvements	19 (39%)
	Opportunities	2 (4%)
Funding	Budget	3 (10%)
	Cost sharing	3 (10%)
	Funding projects	9 (31%)
Governance	Burden	3 (2%)
	Decision criteria	5 (4%)
	Decision making	12 (9%)
	EPLC	12 (9%)
	Process governance	15 (11%)
	Project portfolio	3 (2%)
	Scope of work	4 (3%)
	Selection process	21 (16%)

The percentages in the table above represent the frequency for each theme subcategory. caBIG has 38 references in total, of which abandonment has four references or 10%, while caBIG as a problem has 28 references or 75%. The Change category has 20 sub-categories, of which Improvements was referenced 19 times or 39% and Opportunities 2 times or 4%; the rest of the subcategories were referenced once each. The subject of Governance has 131 subcategories, of which the largest number of references pertained to burden, decision criteria, decision-making, EPLC, process governance, prioritization, the scope of the work, and the selection process.

Second Coding Cycle

During this cycle, I systematically recorded all thoughts, emerging concepts, and perspectives to identify the characteristics of the data. The codes resulting from the first cycle were conceptually ordered and analyzed to identify patterns and themes. Table 3 depicts the major themes, their description, and their frequencies.

Table 3

Major Themes, Description, and Frequency

Theme	Description	Frequency
caBIG	Related to the cancer Bioinformatics Grid program	21
Organizational Change	Current and needed changes in organization	57
Funding	Related to all project funding	62
Organizational Leadership	CBIIT leadership	12
Organizational Culture	The overall CBIIT culture	19
Vision and Mission	The vision and mission of the NCI and CBIIT	70

The data showed that some themes were more pronounced among senior management while other items were emphasized heavily among mid-management and management. Table 4 describes the distribution of themes and their weights among participant groups. As I described the themes, this distribution table indicates how strongly participants felt about the topics. The Research Results section provides detailed information about each case and the participant's views and experiences.

Table 4

Themes Distribution Among Participant Groups

Theme	Senior Management	Mid-Management	Management
caBig	3 (14%)	10 (47%)	8 (38%)
Organizational Change	9 (15%)	11 (19%)	37 (64)
Funding	23 (37%)	17 (27%)	22 (35%)
Governance	90 (28%)	75 (23%)	150 (47%)
Organizational Leadership	6 (50%)	3 (25%)	3 (25%)
Organizational Culture	21 (44%)	6 (12%)	20 (42%)
Vision and Mission	41 (58%)	5 (7%)	24 (34%)
Challenges	9 (39%)	1 (4%)	13 (56%)
Focus	46 (54%)	7 (8%)	32 (37%)

Finally, the data were analyzed and recorded using sensitizing codes from the theories framing the study, namely, the TAM, the decision theory, and the program evaluation theory. As interpretative devices, sensitizing codes help the researcher use a deductive approach for the alignment of the data with the theories framing the study (Gilgun, 2014). Table 5 describes the codes extracted from the supporting theories. Chapter 5 depicts the alignment of the data with the supporting theories and provides interpretation of the findings.

Table 5

Sensitizing Codes

Code	Description
Usefulness	The extend the user believes a system or application will benefit them
Ease of use	Believe the user has about the level of effort it will take to use a system
Intention to use	The willingness to use the system given its usefulness and ease of use
Options	Alternatives for consideration during the decision-making process
Information	The knowledge available to the decision-maker about the different alternatives in a decision process
Effectiveness	The degree to which a program accomplishes its goals
Accountability	The extent to which stakeholders hold accountable for the effectiveness of a program
Implementation	Putting in practice the strategic and tactical decisions
Support	Leadership and stakeholder consensus to back a particular decision.
Motivation	Reasons to support or to adhere to a particular decision
Goals	Desired endpoint
Utility	Benefit or value of an endeavor or system
Completeness	Well defined references to decide between alternatives

(table continues)

Code	Description
Transitivity	Consistency in the decision-making process
Independence	Ability to decide based on own references regardless of a third party input
Continuity	Ability to decide between alternatives based on the best outcome

Evidence of Trustworthiness

I ensured the trustworthiness of the study by following the study design depicted in Chapter 3. The research plan included addressing issues of credibility or the confidence that the findings are trustworthy and credible from the perspective of the participants. The plan also addressed issues of transferability, which requires demonstrating that the conclusions are applicable in different contexts. In the case of transferability, I used analytical generalization or the concept that the study may apply within organizations with similar settings.

Credibility

To address credibility, a theoretical framework was developed and followed using three main theories: (a) TAM, (b) program evaluation theory, and (c) decision theories. The theoretical framework informed the steps the study followed. The credibility of a qualitative research can be judged only by the participants experiencing the phenomena of study. To ensure the credibility of the study, the recorded interviews were revisited several times during transcription to verify the content and to ensure the sentiments related to voice and tone. I shared the findings with the participants for validation. Collecting information from different groups within the organization through interviews,

observation/participation, and historical documentation helped accomplish triangulation of the data, (Taylor & Bogdan, 2015).

Transferability

In qualitative research, transferability is the degree to which the reader can apply the result of a study to similar situations (Lincoln & Guba, 1985). The readers of this study may associate elements such as the relationship between the findings, theories, and the conceptual framework used to guide the study. To facilitate transferability, I development a conceptual framework to guide the study, the development of a protocol to guide the phenomenological interview, and the development of a protocol to guide the collection of data. The IRB approved all protocols. There was no change to the proposed protocols during the data collection and data analysis.

Dependability

Similar to internal validity in quantitative research, dependability relates to the ability of a researcher to repeat the study with the same participants and arrive at similar conclusions. In other words, the findings are consistent and repeatable (Lincoln & Guba, 1985), considering the limitations imposed by the changing nature of phenomena in qualitative research (Marshall & Rossman, 2011). This case study addressed issues of dependability by following the research design as described in Chapter 3, implementing the proposed data-collection strategy, and implementing the proposed data analysis design. I did not deviate from the proposed protocol, and there was no change in the strategy.

Confirmability

This study addressed issues of confirmability by using a phenomenological interview approach that allowed for the minimum injection of my biases during the interviews. Biases were minimized using an interview protocol based on open dialogue and avoiding the use of leading questions. However, I conducted the study at work and all participants were colleagues, this relationship with the participants may have influenced their behavior making participants withhold their true feelings. However, I do not have any evidence that participants were not as forthcoming as they might have been to someone else. The section below describes the results of the study, the findings of the data analysis, and any issues encountered or perceived during the data collection process that could have affected the results.

Study Results

This section describes the findings from the analysis of the data. Twenty-five recorded interviews were transcribed and exported into NVivo Pro; the data analysis followed the plan depicted in Chapter 3. NVivo presents codes in the form of nodes, where each node can represent a code or a group of codes organized in branching subcategories. From the first phase of data analysis, using a heuristic approach, I found 198 unique codes, 84 holistically coded and 114 coded using in-vivo coding approach. The second phase of coding resulted in seven major themes, namely; the caBIG program, organizational change, how funding works, the issue of governance, organizational leadership, organizational culture, and vision and mission. Within the major themes, Table 6 describes each corresponding subcategory:

Table 6

Major Themes Categories and Subcategories

Category	Subcategory
The caBIG program	Abandonment, caBIG problem
Organizational Change	Improvements, opportunities, resistance to change
How funding works	Budget cost sharing, funding projects
Organizational Leadership	Effectiveness of the organization
The CBIIT Mission	Acceptance, alignment, focus, meaning, challenges: Infrastructure, negativity, operation and maintenance, communication, execution, community Focus: Data sharing, direction, extramural focus, intramural focus, priorities, needs, values

Addressing the Research Questions

The following research questions guided the research design: How does CBIIT select projects for its project portfolio? What type of decision-making process guides the selection of projects in the CBIIT project portfolio? What environmental factors affect the decision-making process? Given the phenomenological nature of the interview, these questions were not asked directly to participants. Instead, the research questions were answered deductively through the data analysis. See Appendix F for a list of indirect questions from the interview. The section below presents the findings.

RQ 1: How does CBIIT select projects for its project portfolio?

There is not a specific selection process that dictates which project or initiative to support at CBIIT. Work comes into the portfolio in different ways, from word of mouth to reference from other NCI organizations to mandated initiatives from NCI leadership. About the selection process, P104 shared, "I think we still don't have a good process here. We are still very reactive, quite often people will go directly to the director of CBIIT and say, hey we need your help on this and that." P113 shared that "the problem with the selection process or one of the problems with the way we select projects is that any member of the leadership team could initiate a project without informing the rest of the organization." P111 commented, "I still believe a lot of work coming into CBIIT is fairly ad-hoc." P100 sees the process as mostly mandated, "in the government world, it's different, I say that because, you know there are some things that for us, and I would argue, the majority of our work is not negotiable." P100 also added: "there is work that comes in the form of essentially mandated work, and there is work that comes in and split between current work that we are supporting and work that is coming from other peers across the NCI."

P103 commented, "At this point, we don't have a good systematic process of taking new projects, for example, what we do, we just get requests from people around the NCI." P104 described the selection process in the following way:

> I would say most of the drivers are external to us. It's not as if we are coming up with new innovated projects that we are just thinking of ourselves. We are working in response, in a very much a service if you will, to respond to the needs

> of either the other divisions and centers within the NCI or more broadly at the NIH, and even more broadly at the HHS or government-wide as those big initiatives that are coming right now.

P110 stated, "it is kind of like, I don't know, projects just land in your lap [laughter], or sometimes it feels that way." Moreover, P111 asserted, "I think it still comes through conversations with customers, you know, when someone may have an idea and directly contacts someone from CBIIT." P100 shared: "Technically, the selection process is significantly overrated, there is very little work that CBIIT does that is really at the discretion of CBIIT, most of the work we do, we have to do."

RQ 2: What type of decision-making process guides the selection of projects in the CBIIT project portfolio?

The analysis of the data revealed the following perspectives about the decision-making process. As with the project selection process, the decision-making process is very dependent on particular situations instead of a set of rules. Participants described the project selection process as differing on a case-by-case basis. Participants agreed that the process is changing, CBIIT is trying to implement governance to aid the decision-making process, incorporating criteria such as customer value and alignment to the NCI and CBIIT mission.

P100 said, "That work is decided based upon the scope and availability, so it is something that CBIIT should be doing, is it within the mission of CBIIT? And do we have the resources in this instance?" P100 also added, "The focus is about performance management, it is about assuring that the decisions that are made, whether we make

them, or they are made for us." P103 shared, "Whether they make the go/not go decisions remain to be seen. However, one of the keys I think with this is the transparency that kind of decision making requires. Decisions cannot be made behind closed doors." P117 believes that the decision process should be with those who have domain expertise in the different areas of the organization and should not be dictated by higher management. P117 added, "But if I feel strongly about something, if I feel I should issue a request for information on something, if I know that there is a simple way to do something and complete it in a timely manner I should."

RQ 3: What environmental factors affect the decision-making process?

Participants identified the following environmental factors that influence the decision-making process. Leadership decisions made at the NCI, NIH, or HHS level and filtered down to CBIIT, budgetary constraints, limited resources, and the needs of other organizations within NCI. Participants also identified the needs of the extramural community, complexity of some problems, and the urgent nature of some requests for services among other factors affecting the decision-making process The following is a sample of some of the participants' perspectives on the topic.

P122 believes that all decisions should revolve around the need of the patients they serve: "Ultimately, we should take every decision we make and we should be able to track it back to how it helps a cancer patient." P100 stated, "The work is decided based upon the scope and availability, so is this something that CBIIT should be doing? Is it within the mission of CBIIT? And do we have the resources to support it?" P102 shared, "There are multiple drivers inside the NCI and at some level, some of them in specific

ways conflict with each other." P102 continues, "and we can't, we cannot get out of those requirements." This statement describes the influence of NCI's hierarchy in the decision process at CBIIT.

About the effect of the budget on the decision-making process, P104 commented, "A big piece of the change is much more efficient with the dollars that we do have, because budgets are tending to be very flat" Moreover, P112 stated that "one of the things we are required to do here, as you know when you have to look at 5% or 10% reduction in budget, you need to sit down and look at the priority of things."

Major Themes and Subcategories

In answering the research questions, the data also revealed themes that directly or indirectly influence the selection process. Participants expressed their opinions regarding the current status of processes, issues, and challenges and also provided rich data on their perceptions of how to solve the problems. The following section describes each of the seven major themes and subcategories.

Theme 1: The caBIG Program

The theme related to the caBIG developed throughout the interviews, as participants compared factors affecting the project selection process to the factors, processes, and procedures used during the caBIG program. Participants also described some of the challenges they faced during the caBIG program and the relationship of caBIG to the vision and mission of CBIIT. Participants P101, P104, P110, P112, P115, P117, P119, P122, and P127 commented on this topic. Two specific subcategories

resulted from the comments, caBIG problem and Abandonment. The section below provides examples of some of the participants' comments.

caBIG problem. Building in a vacuum or without a specific problem in mind were themes that resonated during the NCI Scientific Advisory Board review of the caBIG program. The caBIG Report submitted by the BSA stated:

> In particular, the interviews suggest that the strategic goals of the program were determined by technological advances rather than by key, predetermined scientific and clinical requirements. Thus, caBIG ended up developing powerful and far-reaching technology, such as caGRID, without clear applications to demonstrate what these technologies could and would do for cancer research.

P112 commented, "When you mention caBIG I think people fell in love with the technology, and they lost sight? of what they were trying to do when they started it." About the caBIG accomplishments, P127 noted, "And I am from the end user perspective. What problem did they solve? I know they wanted to solve a problem but did it? I don't know of any." Commenting on the reasons for the perceived failure of the caBIG program, P104 asserted, "Back in the old caBIG days; there was an internal vision that also included the community driving that vision, but CBIIT was executing on that vision without the input from the NCI extramural programs or the intramural programs." In this respect, P119 commented, "caBIG was one thing that CBIIT grew and grew, right? And basically lost support from the community." In relation to the focus of the caBIG program, P123 said that "they have not been inwardly focused is one of the main

reasons for its failure. There is a tendency to think that CBIIT knows the need of the customer better than other people know it."

Some of the participants viewed the caBIG program as a great vision, but not necessarily executed effectively. For example, P127 shared, "it seems that in the case of the caBIG program again, there was nothing that was said that didn't make sense, right, in principle. So, all good ideas and I think attention was not paid to the execution." For P110 there was a need that still existed: "I mean, absolutely, the need and the problem that caBIG was trying to address is still a problem." According to P115, the program did not address the right needs, "but it was just one program trying to address a particular global need, and that was I think a great vision that a lot of people had in common." P127 considered human nature and how it affected the program: "There is also a social aspect of things. And then just remember that people, are people. If you are a government agency, and you are a scientist, and you see all the money going into informatics, you are going to be jealous."

The caBIG program was shut down in 2012, but it still resonates with those who participated in or heard about it. In many instances, it is viewed as an example of a program with good intent and a good vision, but poor execution. A program driven by the technology of the day, instead of by a need to solve a clear problem.

Abandonment. Participants had a common view that during the caBIG program, CBIIT gave little attention to the needs of the NCI intramural community. P101 felt that during the caBIG program, CBIIT abandoned the intramural community and focused too much on extramural activities. P101 shared, "and admittedly I think that would not be an

unfounded feeling, right? I believe that we abandoned them, you know, for quite a long time." P101 asserted, "and you can look at our intramural community as a microcosm of what other researchers are trying to do."

Theme 2: Organizational Change

Cawsey, Deszca, and Igols (2015) define organizational change as a planned alteration of the components of an organization with the purpose of improving the effectiveness of the organization. According to Cawsey, et al., the components of an organization include its vision and mission, values, culture, people, strategies, processes and systems. Since the BSA review, CBIIT has seen many efforts to effect changes in the organization. Participants P102, P103, P104, P110, P111, P112, P115, P117, P119, P123, P127, P130 described in detail their perspectives on organizational change. I grouped participants' comments into two subcategories, improvements and resistance to change. Improvements referred to the need to implement changes, to understand where the organization was and where it needed to be moving forward. Opportunities referred to the implementation of changes that will allow the organization to better serve its constituents, provide new types of services, and be more aligned with the NCI's vision and mission.

Improvements. Since the review of the program by the BSA in 2012, the organization has committed to changing the way it operates. According to P104,

> I think there are several things, the first one was the BSA report that examined the caBIG program and recommended that we change the way we operate. We actually close down a number of those projects, and then it took a good bit of time to go through that process and at the same time we started to focus our energy a

> bit more internal within the NCI. That took a more dramatic turn when Warren came on board. His mandate was to focus very much on the NCI internally; it really increased our focus on the intramural programs that had been fairly ignored with some very minor exceptions by CBIIT.

P101 saw improvement as a continuous process: "This is a transition. Warren came in to replace Ken; he came to restructure everything; he came in to continue the dismantling of caBIG and build a new type of CBIIT." However, the effort to change the organization has not been without challenges, especially when trying to change direction and focus the mission on a more limited approach to technology implementation. P102 described it this way: "I think for some of our teams, it has been easier to make that transition than for others, and there are a lot of both team dynamics and psychology behind it."

P111 referred to the difficulties in implementing organizational change at CBIIT as a leadership issue: "it is a change management issue, right? I mean it needs a strong leader that is consistent in driving the change. It needs that unity of a shared vision, and everyone is saying the same thing."

Resistance to change. Organizational change is something that organizations cannot avoid if they want to survive, but change does not come without resistance by those affected (Prichett, 2016). Participants recognized the resistance CBIIT is facing in its effort to implement organizational changes. P103 described the challenge: "This old caBIG architecture is in their DNA, the other thing is that other people are really adaptable and just willing to do whatever it is that we are going to do."

P104 stated, “I think we are still not experts in implementing change. I believe there is going to be room for much improvement, and we will get better at that over time.”

In many cases, external factors force the organization to circumvent the processes they are trying to implement, in order to satisfy competing demands. P104 shared: “Unfortunately, I think we sometimes run into a problem when we get a request from maybe a director or a division head saying, we need this, and we need it in four months [laugh].” These are factors that tend to slow down the progress toward organizational change and promote old habits.

Theme 3: How Funding Works

Funding in government is a continuous challenge. Appropriation laws such as the anti-deficiency Acts of 1921 and 1950 impose a one-year funding cycle (Government Accountability Office, 2013). The expiration of funds at the end of the fiscal year creates stress among leaders. Leaders must execute projects within the allocated time and ensure funds are exhausted as efficiently as possible, minimizing waste and accomplishing the organizational goals. When discussing funding as a factor influencing the project selection process at CBIIT, the discussion centered on the way CBIIT funds its operation, and the services the organization provides to the cancer research community. Historically, CBIIT funded activities out of its operation budget; recently, the leadership team at CBIIT discussed the adoption of a new cost-shared model for those services provided to the intramural and extramural cancer research communities. The findings were grouped into three subcategories: budget, cost sharing, and funding projects.

Participants P101, P103, P104, P111, P112, P113, P114, P118, P119, P121, and P122 described the process as follows:

Budget. P104 identified the need to formalize the budgeting process. P104 added, "We are getting more rigor in our budgeting process, which is always very last minute." P104 also shared that "this is a very big piece of the change; we need to be more efficient with the dollars that we do have because budgets are tending to be very flat." About the changes to processes related to budget allocation and prioritization, P111 added, I think we did some good work this year around, you know, building a strategic plan, and talking about strategic objectives." P112 added, "One of the things we are required to do here, as you know when you have to look at 5% or 10% reduction in budget, you need to sit down and look at the priority."

Cost-sharing. As part of the change and to reduce the cost of operations, CBIIT is looking to modify the way it funds initiatives, especially those initiatives coming in as requests for development of systems by intramural or extramural organizations. CBIIT is looking at implementing a cost-sharing model in which organizations requesting services will share the cost. The rationale behind the cost-sharing approach is twofold. First, cost-sharing reduces the cost of operations, and second, cost-sharing creates a sense of commitment. If an organization is interested in using a system or service, it will be willing to pay for some of the costs associated with the service or system.

P112 believed that holding on to initiatives after they are in a production state adds to the cost of operations and should not be part of the CBIIT strategy. P112 stated, "What I really love to see is, that once the project gets to that production level, either

through the cloud pilot or whatever, to be able to move it out, that it becomes a community resource." On the topic of cost of operations, P104 shared, "and getting rid of, Warren really likes to use this term, "technical depth," which is really cost over the years." A cost-sharing model may be an attractive approach, but according to some participants, it would not be easy to implement. P118 asserted, "Some organizations have dependencies, and they are using our enterprise system through maybe services, or through service account. For those activities, a cost-sharing model can apply, but for other organizations, we are supporting it may not apply."

P119 stated that "What is the right cost model? We have been maturing that, there is an initiative to come up with a cost-sharing model." P122 added, "I think you will find this when you talk to other interviewees, you will find this a lot, it is becoming more of a cost center model, where if you want the work you need to put up your share of it." P101 described the cost-sharing process as a dual-funded mechanism or funding initiatives from two sources. P101 shared, "CBIIT will manage the payment of, you know, handle it from a fiduciary or will do it in combination, lately, the rule. I would not say the rule of thumb, but lately, the drive has been to be dual-funded."

Funding projects. Requests for services and software development projects come to CBIIT in different forms and from various sources. The annual budget and many projects competing for resources imposes a constraint on projects, as P104 stated, "You know, we may not always be able to fund everything we want to do." When asked if the reason for changing to this model was due to a shortage of funds within CBIIT, P104 stated, "If we need additional funds to move the NCI's mission forward, funds will be

made available, it would be clearly on us why those activities could not be done. So, I don't believe that is the real reason the real reason." P103 agrees with the previous statement: "yes, because people's conception of what is valuable is different when they have to pay for it." P103 added, "We will shift to a model where CBIIT does not have just to pay for everything, rather we ask the project requestor to put in the money for it."

Theme 4: The Issue of Governance

The most discussed topic was governance. Governance encompasses the processes and procedures used at CBIIT to run the operation, including the project selection process, project management, EPLC, and the HSS Capital Planning and Investment Control (CPIC). Participants agreed that CBIIT does not have a formal project selection process. Many projects initiate through interaction with other divisions, offices, and centers, by word of mouth, or by the references of other people who had previously used CBIIT services. There was also consensus among participants that CBIIT has been working to adopt formal processes and procedures that will allow for better prioritization and management of projects.

The governance theme includes five subcategories, namely: burden, decision making, EPLC, process governance, and the selection process. Regarding prior attempts to implement governance processes at CBIIT, P101 commented, "In my opinion, I think governance failed here at CBIIT, because we actually never implemented governance as it is intended. We implemented governance in order to adhere to an enterprise mentality that we have constructed." P101 also stated that "we had governance, which sole purpose

was to make sure that you didn't deviate from what was the acceptable approach on executing a project."

Burden. This subcategory started with the acknowledgment that any effort to implement governance will not be free of burden. P100 stated, "The fact of the matter is that it is not going to be burden free." P102 adds, "but if we do it right, we hopefully can minimize the burden on the people. For example, understanding what projects need to submit data to the genomic data commons is valuable." P102 shared, "When it comes to the process we should always be focused on what is the lightest method possible to allow us to get our job done." P104 believed the implementation of governance was very complex. "We did have CPIC and EPLC processes in place before, I think it was very heavy weight." P100 added, "Oh, by the way, the processes were extremely complex and cumbersome."

It seems that even when the processes are considered a burden, participants agree that the governance process is necessary and helps leadership make better-informed decisions. P103 shared, "I think if I want to do something that is really cool and if it doesn't pass through the governance process that means that maybe it was not the right thing to do in the first place." When compared to research and development activities, if there is not a firm expectation of deliverables or results, governance may be less relevant. P112 stated,

> I get it that it's a scientific way, and you have funding grants that say, you can go and explore anything you want to, but when you are a contractor you got to deliver something and show at the end of the period that you've got something.

> For the money that people are paying, then you have to look at it a little differently.

Decision-making. Many factors affect the decision-making process at CBIIT. The process is not a formal, step-by-step process. Instead, factors such as requests from different organizations and mandates from NCI hierarchy drive the decision-making process. Participants commented on the topic in the following ways: P100 commented that "Work is decided based upon the scope and availability of resources. So is it something that CBIIT should be doing? Is it within the mission of CBIIT and do we have the resources to support it?" P100 continued, "every project, regardless of whether is in the selection phase or is approved within the scope of the business or who approved it, has to continue to be assessed and evaluated based upon its value."

Participants agreed that the decision-making process must include criteria such as the value of an initiative in terms of how it helps the different stakeholders. P102 described it this way:

> I think that anything we are asked to do, we should consider, where I would like us to think about our role is, does it generalize to value for groups other than the one that is asking us to do it? And if it does not generalize, is something of strategic importance for the NCI? Or is it required by Federal guidelines? So, for instance, a project that I think we will take on but is not at some level, we need to do it, but it is not something I would pick to do is manage the workflow around the genomic data sharing policy.

Subject matter experts who can gauge the path of research science and the path technological developments are following must inform the decision-making process, P103 stated,

> We have to have people that have the subject matter expertise that can look five or ten years down the road and say, technology is moving in this direction, cancer research needs this particular type of application or a particular type of technology. We've got to kind of point in that direction and say, this is where we think we are going, then we have to look at the ground work and say, whom do we need to work with at the NCI right now? So when we find something that looks pretty solid, that we are going in that direction in the future, and we found people within the NCI that are willing to work with us and are excited about it and seemed really invested then, that sounds like a really good project.

EPLC. The EPLC is an IT-governance framework mandated by the HHS; the department describes it as "a framework to enhance Information Technology (IT) governance through rigorous application of sound investment and project management principles and industry's best practices" (HHS, 2016, p. 1). CBIIT started adopting EPLC several years ago, with minimal results, currently the organization is going through another attempt to make EPLC the de facto governance model for IT. Participants agreed with the need for EPLC, but also were very cautious about how to implement EPLC. P102 stated "But it is not just for process sake, and it has to be focused on how do we deliver real value, either internally or externally, and everything we do has to be focused on that customer value."

P115 added, “It is hard for me to make an assessment, I don’t want to sound judgmental, some of the processes are over-engineered, so it is just a huge amount of effort, to either understand or do they need for.” P118 shared, “I think a crucial part of it is going to be the classification of programs and projects. I mean, because EPLC can be applied to the project, but it is extremely hard to apply to a program.”

P130 agreed in tailoring that the process to the need of the organization and the type and size of projects. P130 commented that “what we need is a customization of EPLC for the size of the projects. What I’ve seen so far is that CBIIT, while they have taken on the effort to reviewing EPLC, the specific identification of projects in a category is not clear.” P103 added, “I think EPLC provides us a good general structure for managing projects. I think that it provides the logic and the sense of a good business practice for project management.” P104 believes that CBIIT is adopting a structured approach to governance. P104 stated, “We are finally getting back into the much more formal process, and a lot of this is being driven from the top-down.”

P111 asserted, “In the past, we were too prescriptive, and in our effort to be too prescriptive in providing a lot of things around how to tackle potentially any possible scenario. We have given the perception that EPLC is very complicated.” P111 added, “Another thing that we are doing differently this time around is that we are really trying to help the organization understand that, you know, how to use EPLC in a way that is not cumbersome.”

Selection process. The focus of this study was to understand the project selection process at CBIIT and the factors that affect that process. Participants agreed that at the

moment, there is not a formal selection process, but with the implementation of governance such as EPLC, CBIIT will be able to align the project portfolio better. P113 stated, “Project initiation was done without informing the rest of the organization and without having any standardization about how they initiated that.” A factor influencing the implementation of the formal selection process is the cost associated with the process. P130 commented that “cost is definitely a factor, because these are processes of managing a project, and it is different from the product itself. And so, developing the product has its value, has its cost, but the managing of the project has its own cost too.”

Theme 5: Organizational Leadership

Leadership and the responsibility of leaders to own the implementation and enforcement of governance and to own the alignment of the project portfolio with the overall mission of the NCI and CBIIT was also a theme of discussion during the interviews. When discussing the effectiveness of the organization, P102 shared, “Been more effective as an organization doesn’t necessarily mean spending a lot of money, it means thinking about what is it, what is it people actually need.” P115 saw a lack of effectiveness due to organizational structure. P115 commented, “I think the organization is structured in such way that we don’t have many people downwards. It's just a bunch of 14s and 15s, so basically that’s why we end up having to do with everything all the way to details.” P117 stated, “I don’t think the role has changed, some titles have changed, just with what management was comfortable with and of course, we didn’t have an organizational chart, and so that’s been resolved, we still don’t technically have functional positions.”

Theme 6: Organizational Culture

Organizations have their experiences, philosophies, values, policies, and norms. Also, they adopt different methodologies, technologies, and ways of dealing with their customers. The combination of all these characteristics defines the organization's culture (Bevoc, 2015). When thinking about changes in the organization, the first thing that should come to mind is the culture. Many times, specifically in IT organizations, leaders do not consider the impact of organizational culture. Instead, leaders rely heavily on information technologies as solutions to the problems of a cultural nature, such as communication and team collaboration (Edmonds, 2014). Participants commented on issues such as; lack of cooperation, lack of commitment, a culture of managing by crisis, lack of transparency and understanding of mission, and lack of a shared vision. P111 stated, "I think again, it stems from the things we talked about; I think because of sort of that culture, because of the lack of a common vision, I mean, I think that there are challenges for all the processes." P102 commented,

> [A]nd that is hard, that is fundamentally hard because when we have these multiple drivers inside NCI and at some level, some of them, in specific ways conflict with each other. So the only way to get through that conflict is by staying focused on value to the customer. That is a cultural thing and again, historically, the number one cultural issue that I see inside CBIIT is a feeling that we know what the customer need. The only person who knows what the customer need is the customer. We can believe that we have a reasonable understanding of the customer, but in fact, it's really always the customer that knows what they need.

> Actually, I would say that even sometimes the customer doesn't know what they need. We have to go in and watch, so I think, again, those are really important changes, and they are cultural changes. I think for some of our teams it has been easier to make the transition than for others, and there are a lot of both team dynamics and psychology behind it.

In reference to a change in culture P103 shared, "I think definitely the culture is moving away from that, there have been some challenges of course." P113 added,

> I believe that's why that happens, at least at CBIIT, is partially related to our cultural issues. We have, in my opinion, a culture in which, when a leadership team makes a decision, and the staff complained about that decision, the leadership attempts to show solidarity and support for their workforce by revisiting or changing the decision. I do not believe we do a good job of pushing back on the staff and saying, yes the decision that we made is painful to you and causes you more work or stress, but we still want you to do it.

P118 talked about how CBIIT has adopted a culture of managing by crisis; there is always something to be reactive to, but there is not time dedicated to strategic thinking. P118 shared, "There is a lot of history, I mean, one of the things it was never focused here, CBIIT as I said before, is always reacting to something." P111 stated that "there is also a lack of discipline, you know, and commitment to the organization."

When discussing the lack of collaboration as a cultural issue, P119 commented, "then you kind of treat CBIIT as your own, in a sense, not like you know, we want to control everything [laugh]. That kind of mindset." P112 wanted to see that, "across the

whole organization, we get each team talking to each other and really collaborating, sort of like you and I have been talking about recently." Several participants also mentioned a perceived lack of transparency. P100 commented, "I mean, again, one of the problems I think it all goes back to the whole concept of transparency. One of the struggles we have for example, with the MATCH project, was that negativity to expose the code."

Theme 7: The CBIIT Mission

The mission and vision of an organization are core components of its culture. The mission describes the current purpose of the organization and where the organization wants to be for the next two or three years. The mission helps everyone focus and understand what they are doing, for whom they are doing it, and most importantly, why (Babnik, Breznik, Dermol & Sirca, 2014). As a component of the culture at CBIIT, the mission of the organization was discussed with the participants. Participants described four particular categories: what the mission means to them, the need for alignment with the overall NCI mission, the challenges they face in executing the mission, and the necessity of a focus on the mission. CBIIT's mission reads,

> The Center for Biomedical Informatics and Information Technology (CBIIT) provides for the appropriate use of data science, informatics, and IT, exemplifying a commitment to customer services, teamwork, pride, professionalism and resulting in optimal support for the NCI's mission to accelerate the prevention and treatment of cancer. (CBIIT, 2016, p. 1)

What is the meaning of the mission and vision? When referring to the understanding or meaning of the mission, P100 shared that, "everyone interprets things

differently, the real thing, in my opinion, the only way to balance is to ask for that interpretation." P102 stated, "Do they really understand what it really means? Have they made that personal for them, to figure out how that really changes their day to day life?" P111 added, "But I think they struggle if you don't have a common vision of what you are doing, where you are taking the organization, what are your strategic priorities." According to the data, it seems that having a clear mission, and having a clear understanding of what it means, was important to participants. P111 added, "This whole concept of having a strategic planning approach is really critical, so there is a vision and mission part, for us to achieve that mission and vision, I believe we need to have sort of a long-term strategy for CBIIT." P111 also shared, "I think that the unity of a common vision and everyone saying the same thing, everyone driving the same purpose and objective is not there." This statement reflects the same sentiment of P102: "There is a need to have a common understanding and need to make the mission your own."

P117 described the mission of CBIIT as follows: "The mission of CBIIT has changed over time, which you're aware. It used to be around advising the NCI director of informatics, on developing clinical and informational capacities. Now it is more about providing support services for scientific initiatives." To P121, having a malleable understanding of the mission works to benefit some people. Given that a malleable mission allows for projects that otherwise are not necessarily in alignment with a well-defined mission, P121 shared, "CBIIT at some point was involved in rewriting its mission, but that was outsourced to a committee when you outsource to a committee, it becomes all things to all people. It ends up becoming so malleable, that it can mean

anything to anyone." To P122, "Ultimately, it's pretty clear, the mission that NCI has is a clear mission statement that says, we are here to help reduce the impact of cancer on people's live." P100 reiterated that "Warren's vision is that CBIIT serves as a facilitator, it is our responsibility to understand the customer's needs and make those needs a reality."

Aligned with the mission. Regarding aligning with the CBIIT mission, the discussion focused on how to align initiatives with the mission. P111 added, "The way that I see it in terms of the criteria, I mean, I think the way I would measure alignment, we will have to really map projects and all the work that we are doing to these priorities." P100 did not think everything that CBIIT does is in alignment with its mission: "I cannot say that all efforts are aligned. I think that depending on whom you ask; people could say that their efforts are aligned, and I believe that at face value any of them are aligned, potentially."

Challenges to the mission. Among the issues was the perception that the mission is not well understood, and that it does not look like members of the organization, specifically, leadership shares a common vision. P111 described the issue as follows: "I think there is a lot of great conversation, but I don't think they have a common mission or common vision and common approach, and common task that they are moving along, and they don't operate as a team." P102 see the challenge as a communication problem. P102 added, "So, I think that the biggest challenge is frankly communicating and making sure that everyone is aware of each other activities and can take advantage of those."

Other participants see a problem in the way CBIIT manages its IT infrastructure

and how the current IT infrastructure makes it more difficult to embrace new technologies to support the mission. P123 shared, “It is not rocket science if you can figure out how to put network infrastructure, storage, and computing infrastructure together. People have been doing it for many years; it is a common thing. It has been in place for the last 15 to 20 years.” P104 added, “I don’t see us doing sort of very large programs where everything is interconnected, we are much more like, way much nimbler, we tackle problems as they arrive.”

Focus on the mission. Finally, participants described their understanding and experiences with the mission at CBIIT as needing more focus. On data sharing and exchange of information focus, participants had the following perspectives: P101 asserted that “you can say that these datasets need to be made publicly available, the rationale isn’t because the public is paying for this. The rationale should be that if we are collecting these data sets, they should be available for reuse.” P112 added, “If we are really good we will even share negative information, here are the 30 things that we tried that didn’t work. You know, don’t fund those and try again.” P122 believed that “we need to drive on how it helps with the actual end customer, where the end customer is the cancer patient.”

When asked to describe what participants thought should be the focus of CBIIT, participants shared the following: P100 said, “Ultimately, this whole concept of governance will start exposing some of this stuff sooner rather than later. So that we don’t find ourselves in the same situation that we did back in the caBIG days, where nobody was monitoring the operation.” Participants also shared their perspectives on the

way CBIIT changed focus from extramural community support to a more intramural support approach. P101 said, “We were given the directive at that point, this is prior to Warren coming in. We were given the directive to really focus inward and support the NCI internally, to be the informatics center or hub for NCI proper.” P102 added, “Historically, I think that CBIIT missed a huge opportunity to understand the needs of the community through the needs of the intramural program.” P119 expressed that, “There is a lack of communication of what we do, what kind of service we provide beyond help desk, beyond core infrastructure. All of this software development and activities we provide are unknown to them as a service.” Moreover, P130 shared, “The communication says that we are more focused on supporting the intramural community, but at this time, based on the new projects that we see, I am not sure if they are progressing in that direction.”

Summary

The primary purpose of this qualitative exploratory case study was to answer the following research questions: How does CBIIT select projects for its project portfolio? What type of decision-making process guides the selection of projects in the CBIIT project portfolio? What environmental factors affect the decision-making process?

In Chapter 4, I discussed the findings from the analysis of the data obtained through a phenomenological interview of 25 participants and data collected from my observations. The data also included historical documents and reports. In summary, the findings supporting the research questions include:

About RQ1: How does CBIIT select projects for its project portfolio? CBIIT does not necessarily use a predefined selection process and the organization does not have a single source of initiatives and projects. Instead, projects come in through mandated initiatives, word of mouth, and references from other divisions, offices, and centers. There are initiatives in progress to improve the selection process, through the implementation of governance and IT systems. However, the existence of multiple project-intake mechanisms, official and unofficial, is likely to continue.

About RQ2: What type of decision-making process guides the selection of projects in the CBIIT project portfolio? I found that leaders make decisions on a circumstantial basis. For some initiatives, the decision is made before the initiative comes to CBIIT. Some initiatives are either mandated by NCI, NIH, or HHS or dictated by the need to comply with government regulations. For other initiatives, the decision-making process is based on the availability of resources, funding, time constraints, and the needs of the community.

Regarding RQ3: What environmental factors affect the decision-making process? The findings revealed that many factors affect the decision-making process, either formally or informally. As mentioned before, mandates, budgetary factors, community needs, and dependencies on legacy systems are among the most prominent factors.

In analyzing the data, seven themes were found that affect the overall decision-making process and that the organization should consider in any plan for improvements: the CBIIT mission, organizational culture, organizational leadership, governance, funding, organizational change, and the caBIG program. In Chapter 5 these findings are

interpreted and the answers to the research questions are further described and linked to the literature. Chapter 5 includes the limitations of the study, recommendation for further research, and the implication of the study to the field of project management, to the theory, and to social change.

Chapter 5: Discussion, Conclusions, and Recommendations

The purpose of this qualitative exploratory case study was to address a real-world problem by understanding the project selection process at CBIIT and how that reality compares to the conceptual framework guiding the study. The project selection includes the processes, formal or informal, leading to a decision to embark or not on a particular initiative. The need for the study arose from the NCI BSA's review of the caBIG program and identifying the lack of a rationale for some of the initiatives. Since then, the caBIG program has been retired and substituted by the NCI NCIP. I consider this study to be a follow-up to the BSA findings, how CBIIT is progressing in addressing the issue, and what the organization should consider as it implements solutions. The study addressed the literature gap existing in the portfolio and project management literature for government-funded initiatives. The literature had not dealt with a decision-making process to evaluate project selection into a project portfolio or the factors that influence the process of project portfolio selection.

Key findings included an ongoing effort to formalize the portfolio management and decision-making process at CBIIT. I also found that the organization was experiencing many challenges implementing the needed changes, including culturally related challenges, challenges in the adoption of a formalized governance process, perceived issues with leadership style and structure, and challenges in defining, clarifying, and disseminating the CBIIT mission.

Interpretation of Findings

For this qualitative exploratory case study, I used a phenomenological interview as the main approach to data collection. The study included 25 participants. I used a multiphase approach to data codification for the identification and categorization of codes. Phase 1 of the data analysis did not include sensitizing theories, to allow categories and themes to emerge naturally from the data. The second phase used sensitizing codes from the theories framing the study. During data analysis, I identified seven major themesL namely, the CBIIT mission, organizational culture, organizational leadership, the issue of governance, how funding works, organizational change, and the caBIG program. These themes were fundamental in answering the research questions:

RQ1: How does CBIIT select projects for its project portfolio?

RQ2: What type of decision-making process guides the selection of projects in the CBIIT project portfolio?

RQ3: What environmental factors affect the decision-making process.

In answering RQ1, the participants' perception was that CBIIT had multiple ways to initiate projects. There was not a formal, serialized selection process. Instead, different circumstances influenced how CBIIT incorporated projects into its portfolio. Among the circumstances influencing the selection process were mandates from NCI leadership, NIH, or HHS; availability of funds; the need for compliance with government regulations; the needs of intramural and extramural communities; and the stakeholders. Participants recognized that the mission of CBIIT and the overarching mission of the NCI influenced the consideration of projects in the portfolio. Participants also expressed that

aligning initiatives with the organizational mission was critical, but it was also challenging, given that not all initiatives necessarily aligned with the mission. In many cases, the alignment of projects with the mission was left to the interpretation of the stakeholder. This finding corresponded with Proposition 1 in Chapter 2.

Proposition 1: There is a direct link between the project selection process and the achievement of organizational strategies and objectives (Kaiser et al., 2015; PMI, 2013). This proposition suggests that the organization must include its mission and goals in the decision-making process related to those initiatives or projects that will be part of its portfolio.

Before defining a portfolio of projects and services, an organization must consider its vision, mission, and strategic objectives to ensure the aligment of the portfolio (Ramany, 2016). As CBIIT aligns its portfolio, it is necessary to consider people's understanding of the mission and how CBIIT staff internalizes the mission. As Ramany (2016) asserted, "Successful change initiatives consist of the integrated eco-system of its portfolio, programs, and projects. These change initiatives become the delivery mechanism for implementing the strategy of an organization" (p. 1). Participants commented on the need to define the mission, objectives, and priorities of the organization, and use the mission, objectives, and priorities a benchmark to evaluate new projects. Participants also added that it was necessary to base the priorities on the value or benefits a project brings to the customer and the community at large. For example, a project that will benefit only one customer or organization in particular should have a lower priority than one that will benefit a broader community.

Participants also commented on the need to accept the mission and the fact that before people accept the mission, they need to understand and internalize it, making it part of their day-to-day operations. Participants stated that when people do not accept something, it is not necessarily because of a lack of agreement, but because they do not understand it. In other cases, people do not object to the mission, but object to the interpretation of how to execute the mission. Based on participants' responses, there was a perception that the organization needs to disseminate a common mission and vision and ensure that everyone works as a team with a common purpose.

Propositions 3, 4, and 5 in Chapter 2 supported the findings related to selecting the right projects for the portfolio. Proposition 3: The problem with selecting the right projects into a portfolio has lingered for many years, and it is still relevant to current organizations (Killen & Hunt, 2013; Martinsuo & Killen, 2014). Proposition 4: The problem of project selection in the public sector has many factors that do not necessarily exist in the private sector, mainly related to financial return on investment versus social return on investment (Millar & Hall, 2013). Proposition 5: Organizations struggle to balance resources among projects. Limited information and ambiguous criteria do not help in the decision-making process. (Bible & Bivins, 2011; Martinsuo, 2013; Pajares & Lopez, 2014).

The data led to findings that answered RQ2. Participants described the decision-making process as a byproduct of different circumstances, and not necessarily the result of following a formal process. In some instances, there was not a decision to be made due to the mandated nature of the project; in other cases, the leaders made decisions based on

the stakeholder's belief that the project aligned with the CBIIT mission or the overarching NCI mission. The participants described the way decisions are made today, but also provided data on how they envisioned the decision-making process was used to align the project portfolio with the mission. The concept of how people should make decisions and how people make decisions in reality is a central concept in decision theories. A normative approach describes how people should make decisions, and the descriptive approach shows how people make decisions in the real world (Hansson, 2005; Kochenderfer & Amato, 2015). Participants commented that the role of leadership must be about supporting the people executing the mission, empowering them to make decisions on their own, and relying less on a top-down, mandate-driven approach. The top-down approach is a reflection of a perceived lack of truth from leadership about those executing the work. My research contributes to change toward a more normative approach in the decision-making process by informing leadership about participants' perceptions and their suggestions for change.

Another prevalent topic was value to the customer as decision-making criteria. Participants found it important to understand the value that each activity brings to the customer and how to measure that value to determine whether a particular activity should continue or be terminated. This concept aligns with the theory of program evaluation, which suggests that programs must be evaluated continuously to make determinations on future funding (Chen, 2015).

The result of the study provided sufficient data to answer RQ3. The environmental factors identified included mandates from leadership outside of CBIIT;

compliance with regulatory mandates, as in the case of implementing EPLC and CPIC; and the needs of intramural and extramural communities. Participants' perception was that many of the activities did not align with the mission. For some participants, their projects were aligned with the mission, while other participants may have had a different opinion when asked about a project or initiative and their perception of alignment. Participants suggested the incorporation of criteria that include value to the customer, value to the community, and alignment with the mission and vision, to ease the decision-making process and guide the process toward a more formal approach. These suggestions are supported by PMI's (2013) description of project portfolio management as "the processes by which an organization evaluates, selects, prioritizes and allocates its limited internal resources to accomplish organizational strategies consistent with its vision, mission, and values" (p. 4). Suggesting that criterion for the selection of projects into the organization's portfolio must support the organization's strategic approach to accomplishing its mission and vision.

Mandated initiatives have a significant impact on what CBIIT incorporates in its portfolio. According to participants, many of the activities they execute are things they must do, and there is little-to-no decision making for CBIIT; as P100 expressed, "those are things we just have to do." Other activities are part of government regulations, such as compliance with the Federal Information Systems Management Act, mandated for all federal systems; the EPLC; and CPIC, mandated by HHS.

The needs of the NCI intramural and extramural communities also influence what projects to support. According to participants, community members expressed their needs

to CBIIT leadership and CBIIT staff mostly informally. Sometimes the opportunities to collaborate with other organizations came through word of mouth, participation in conferences, and presentations of research papers, among others. Apart from answering the research questions, the data revealed seven major themes that not only supported the research questions but also described the participants' experiences in the organization and how they thought the organization should resolve its current challenges. The participants' expectation was that through the implementation of a framework such as EPLC, the decision-making process would be more structured and more people would have the opportunity to participate in the process. The results and interpretation of findings were shared with CBIIT leadership for possible consideration in the implementation of the organization's ongoing change initiative.

Limitations of the Study

Limitations of this qualitative exploratory case study included its focus on a single site or case, the NCI CBIIT. A wider spectrum, including participants outside of management and leadership, may provide a comprehensive understanding of the overall organization. In future similar studies, a longitudinal study to track the progress the organization makes as it goes through its transformation may provide researchers with useful data to understand the influence of the factors mentioned in the study.

Recommendations

The data revealed that participants understood the NCI's mission at a high level, at least the mission to conduct research in the search for a cure for cancer. However, how CBIIT contributes to that mission through its mission statement was not clear to

everyone, was not well understood, or had not been internalized. Alternatively, as P102 expressed, referring to the CBIIT staff, “Have they made that personal for them?” People tend to support missions when they understand the benefits the mission brings to them, or how the mission supports their values and beliefs. Understanding the positive impact of the mission before supporting it is supported by theories such as TAM (Davis, 1998). TAM uses constructs such as the perceived usefulness, which can apply to the perception people have about the mission as an indicator of how they support that mission. Perceived ease of use is another TAM construct that applies to the perception of the individuals about how attainable the mission is. The more difficult the execution of the mission seems, the fewer people will be willing to support it. This issue worsens when the mission is not understood, or if the individuals do not have a sense of direction toward that mission or cannot internalize the mission (Karatepe & Aga, 2016). Another theory supporting these concepts is the expectancy value theory, which explains why individuals accept or reject something based on their expectations of success and the value of those expectations (Ajzen, 2015; Bradley, 2012). Kotter (2014) has recommended shaping the mission of the organization, that is, making it clear, attainable, and focused. Leaders must communicate the mission constantly until it becomes second nature in the organization. According to Kotter, it is not enough to write a mission and vision statement; it is necessary to ensure that the mission is in people’s minds at all time. Leaders must use every opportunity to excite people to change the organization and support its mission.

The study also revealed that some of the challenges in internalizing and executing the mission are cultural in nature. Culture is hard to change, but not impossible. Edmonds (2015) recommended that leaders first understand their organizations' cultures and connect with team members. The author proposed a four-step process: (a) de-insulate oneself, do not depend on just a few people in the organization to know what is happening, and learn from different players to get the big picture; (b) genuinely connect with the team; (c) seek out the truth-tellers. Avoid those who reinforce the leader's perception, and request the input of those who will be willing to express opposing opinions, and (d) share one's assumptions with team members.

Another major theme was the issue of governance. Participants commented that governance is necessary, but its implementation must be done right. In other words, governance for the sake of governance becomes a burden; governance must have the least overhead. Participants also expressed that it is hard for governance processes to be adopted unless there is a reinforcing body, catalyst, or champion owning the implementation of the governance process. The same applies to an organizational change in general; if there is not a person or team acting as a change agent, persisting with the changes, people will reverse to old habits (Cawsey et al., 2015).

In summary, there is a mission and a vision that must be understood and internalized by everyone. For the mission to be successful, a culture change must occur. The leaders of the organization must champion the change and the members of the organization must internalize the mission. Once the mission is understood and people are ready to embrace change, governance must be implemented to ease the decision-making

process, to better align initiatives with the mission and to formalize the processes. For governance to be successful, leaders must consider the impact of governance processes in the organization regarding overhead and complexity. Finally, initiatives such as adopting a shared-cost model will continue to have a positive influence on the management of funds.

Recommendations for Further Research

Further studies in this area, such as a longitudinal case study, will help understand how different factors play a role in decision-making processes in similar organizations. A longitudinal study would also provide a view into the progress the organization makes and the effect of cultural changes. A force field analysis would also provide leaders with insight on how to implement the desired changes, by exposing the dynamic forces, both in favor and against the proposed changes. A qualitative study, including a wider range of participants, possibly participants from other divisions, offices, and centers of the NCI, can help leaders understand whether the issues found at CBIIT are localized or whether they are the result of the NCI culture at large.

Implications

The U.S. government spends billions of dollars every year to improve the quality of life of its citizens. Determining the effectiveness of programs in government has been a challenge for a long time and will continue to be a challenge (Muhlhausen, 2013). Any effort to better understand programs' performance and how to improve the performance of government-funded programs will have a positive social impact on the well-being of the citizens. More precisely, the NCI and the CBIIT are organizations dedicated to

improving the quality of life of those suffering from one of the most challenging illnesses experienced by the human race: cancer.

From a methodological and theoretical perspective, further studies on how the constructs of TAM and the program evaluation theory influence organizational change and decision-making can expand these theories. Finally, practitioners in the program and project management field can benefit from the study by incorporating elements of qualitative research and phenomenological interviewing to get a better understanding of the organizations they serve. The study also revealed a need for practitioners in the project-management field to be involved early in the project selection process.

Conclusions

The purpose of this qualitative exploratory case study was to understand the project selection process at CBIIT. I described the project selection as the processes and procedures leading to the selection of projects for the CBIIT's portfolio. The study answered the research questions guiding the study. The data revealed that CBIIT is a complex organization at which many factors influence decisions. Among the factors are culture, regulations, funding, and competing needs of the organization. The data also revealed that participants are passionate about their work, but are not clear on where the organization should focus. The participants' expectation is that the focus and direction must come from the leadership. The leaders interviewed agreed that leadership must work together in supporting and disseminating a clear vision and mission. The participants' perception was that if the leaders do not perform in unison, it is impossible for others to follow.

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Appendix A: Permissions

Mark Bevan Jan 22 (4 days ago)

To me

Hello Braulio
Thank you for your request. I am more than happy to provide permission to use my model and if you have any questions, please do not hesitate to contact me. I hope your study goes well and best wishes
Mark

Braulio Cabral <braulio.cabral@waldenu.edu> Jan 21 (5 days ago)

To mark. Bevan

Dear Dr. Mark T. Bevan

My name is Braulio J. Cabral; I am a doctoral student at Walden University in the USA. I am currently working on my dissertation titled "The Information Technology Project Selection Process: A Qualitative, Exploratory Case Study of Government-Funded Bioinformatic Projects". I would like to use your model to guide my phenomenological interviewing process. I am hereby requesting written permission to use your model as described in your paper titled "A Method of Phenomenological Interviewing".

Your assistance is greatly appreciated.

Respectfully,

Braulio J. Cabral
Ph.D. Student at Walden University
www.waldenu.edu

Appendix B: Site Letter of Cooperation

January 19, 2016

Dear Mr. Braulio J. Cabral,

Based on my review of your research proposal, I give permission for you to conduct the study entitled The Information Technology Portfolio Selection Process: A Qualitative Exploratory Case Study of Government-Funded Bioinformatics Projects within the NCI Center for Biomedical Informatics and Information Technology. As part of this study, I authorize you to recruit participants for interviewing and collect data relevant to your study as well as to disseminate the results of the study among participants. Individuals' participation will be voluntary and at their own discretion.

We understand that our organization's responsibilities are limited to granting permission for you to recruit, interview, and collect data relevant to the study at CBIIT. There are not explicit or implicit responsibilities to provide financial support or any other resources to support the study. The personnel at CBIIT will not be involved in supervising any research activities. We reserve the right to withdraw from the study at any time if our circumstances change.

I confirm that I am authorized to approve research in this setting and that this plan complies with the organization's policies.

I understand that the data collected will remain entirely confidential and may not be provided to anyone outside of the student's supervising faculty/staff without permission from the Walden University IRB.

Sincerely,

Warren Kibbe, Ph.D.
Director, Center for Biomedical Informatics and Information Technology
National Cancer Institute
9609 Medical Center Drive
Rockville, MD 20850
Warren.kibbe@nih.gov

Walden University policy on electronic signatures: An electronic signature is just as valid asa written signature as long as both parties have agreed to conduct the

transactionelectronically. Electronic signatures are regulated by the Uniform Electronic Transactions
Act. Electronic signatures are only valid when the signer is either (a) the sender of theemail, or (b) copied on the email containing the signed document. Legally an "electronicsignature" can be the person's typed name, their email address, or any other identifyingmarker. Walden University staff verify any electronic signatures that do not originate from apassword-protected source (i.e., an email address officially on file with Walden).

Appendix C: Recruitment Invitation Letter

Study Title: The Information Technology Portfolio Selection Process: A Qualitative Exploratory Case Study of Government-Funded Bioinformatics Projects

Dear <<Insert Participant's Name here>>,

My name is Braulio J. Cabral. I am a doctoral candidate in the Department of Management and Information Technology at Walden University. You may also know me in my role as Director for CBIIT Technical Operations Support at the Frederick National Laboratory for Cancer Research operated by Leidos Biomedical Research Inc. I am conducting a research study as part of the requirements of my Ph.D. in Management degree, and I would like to invite you to participate.

My study focuses on the project selection process at the NCI Center for Biomedical Informatics and Information Technologies (CBIIT). The purpose of the study is to understand the selection process in biomedical informatics projects in the government, and the factors that influence this process. The resulting knowledge can be used to derive solutions to project selection challenges and to generalize the findings to other similar cases. If you decide to participate in the study, you will be asked to meet with me for an interview.

In particular, we will discuss your experience with selecting and working on biomedical informatics projects at CBIIT and your overall perspective on the processes leading to the selection project for CBIIT's portfolio. The meeting will take place at a mutually agreed upon time and place, and should last about 90 minutes. The interview will be audio recorded so that I can accurately reflect on what is discussed. The information will be confidential and all data will be accessible only by the researcher. The participants do not have to answer any questions they do not feel comfortable with. A copy of the interview transcript will be provided to each participant. The data will be kept in a secured device for five (5) years as required by the university and will be destroyed at the end of the required period. The result of the study will be published in a dissertation format by the university.

Participation in this research is purely voluntary and participants have the choice to withdraw from the study at any time without negative consequences. Upon withdrawing from the study, all data related to the participant will be immediately destroyed. At the beginning of the interview, participants will be presented with an Informed Consent form to sign. The Informed Consent form serves as the inclusion criteria for the study. If the participant is not able or willing to sign the Informed Consent form, he or she will not be able to participate.

Thank you for your consideration, if you would like to participate, please reply to this email with your acceptance and I will contact you to schedule our meeting. At the end of

the interview and as a token of appreciation, you will receive a $10.00 Starbucks gift card.

With kind regards,

Braulio J. Cabral, Ph.D. Candidate
Phone: 304-995-5268
Email: Braulio.cabral@waldenu.edu

Appendix D: Participants Demographics

Participant	Senior MGM	Mid-MGM	General MGM
P0000100	X		
P0000102	X		
P0000103	X		
P0000104	X		
P0000101		X	
P0000118		X	
P0000105		X	
P0000117		X	
P0000108		X	
P0000110		X	
P0000116		X	
P0000119		X	
Participant	Senior MGM	Mid MGM	General MGM
P0000115		X	
P0000123			X
P0000130			X
P0000125			X
P0000127			X
P0000112			X

P0000114			X
P0000122			X
P0000111			X
P0000129			X
P0000126			X
P0000121			X
P0000113			X

Appendix E: Phenomenological Interview Protocol

The Information Technology Portfolio Selection Process: A Qualitative Exploratory Case Study of Government-Funded Bioinformatics Projects

Phenomenology Interviewing Protocol

By

Braulio J. Cabral

Phenomenology Interviewing Protocol

Phenomenology interviewing is based on the principles of phenomenology theory. Within phenomenology theory, the research looks to understand how participants experience the phenomenon of study, and aims to ask questions based on experience contextualization. In phenomenology interviewing, the researcher brackets his or her knowledge and theories and allows the themes to emerge from the participant's description of his experience (Englander, 2012).

The purpose of this guide is to help the researcher guide the interview instead of leading the participants. In guiding the interview, the researcher will ask questions that prompt the participant to verbalize, and reflect on his experience of the phenomenon of study (Rawat, 2011). This guide is based on Bevan's (2014) method of phenomenology interviewing. In this method, the author applies phenomenology structure to the interview process by guiding the interview to accomplish four particular goals to frame the research questions. First, through contextualization, the author seeks meaning of the experience to the participant. What does the experience mean to the participant and in what context do they apply the meaning? According to Bevan, "contextualizing questioning enables a person to reconstruct and describe his or her experience as a form of narrative that will be full of significant information." (Bevan, 2014, pp. 4).

The second goal is to apprehend the phenomenon. Or directing focus on the experience or phenomenon the researcher is studying. This direction should be toward answering the research questions. The third phase or goal is to clarify the phenomenon. Clarification of the phenomenon uses imaginative variations to elicit reflection and an

opportunity to explicating the experience. This part of the interview is accomplish using predefined questions, contrary to the contextualization and apprehension where the interviewing takes a descriptive approach.

Interview process:

Contact participants using invitation letter. Upon acceptance, schedule date and time for the interview.

Consider location for the interview and make sure it is conducted in a place agreed by the participants.

Interviews will be no longer than 90 minutes.

The first 10 minutes will be used for introduction and to explain and get signature for the inform consent form.

Keep in mind the phenomenon of study: The project selection process at CBIIT

Keep in mind the research questions

RQ1: How does CBIIT select projects for its project portfolio?

RQ2: What type of decision-making process guides the selection of projects in the CBIIT project portfolio?

RQ3: What environmental factors affect the decision-making process?

Phase 1: Contextualization

Example contextualization question:

Please describe in detail your role in the organization and how the project selection process at CBIIT comes into place in your day-to-day performance of your duties.

Other questions will be derived from the response to these question, and may include:

What does the process mean to you? How does it affect your day-to-day work? You must allow these and other questions to surface as a result of the description, do not lead the participants. During contextualization, the participants may provide information about their organization in their own personal context, their experience with other team members, and past experiences in similar environments. Remember, the purpose is to put the project selection process at CBIIT in context to the life of the participant.

Phase 2: Apprehension

Example apprehension question: How do you describe the selection process at CBIIT and your participation in it?

Follow up with questions geared toward obtaining information about decision-making process involved, and environmental factors affecting the decision making process.

Phase 3: Clarification

The clarification phase of the interview is geared toward seeking to understand the participant's perspective about the phenomenon. For this phase, ask questions such as:

How would you describe the ideal selection process at CBIIT?

Closing the interview:

As part of ending the interview, ask if the participant has anything else he or she would like to add, let them know that they can contact you if anything else comes to mind, and how to contact you. Let them know they will receive a copy of the

transcript. Thanks them for their time, and provide them with the participation gift of a $10.00 Starbucks card.

Things to avoid during the interview

Do not lead the participants to questions you want them to answer, instead, guide them through the contextualization, apprehension and clarification process.

Do not use theory-laden questions, theoretical analysis will be done as the last phase of the data analysis, and should be the result of naturally emerging themes.

References:

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Appendix F: Questions from Interview

How do you describe your role in the organization?

In your current role are you involved in the decision-making process for work coming to CBIIT?

How do you describe the intake process?

Comparing the process with the way it was in 2009, do you see a difference? What do you see that is different?

What role will the new committee on governance will have?

Will they control what comes into the pipeline?

What is different now in the attend to establish a governance body and governance processes?

Is there a balance between work that is focused on the mission and work that is considered R&D?

Is R&D of IT present in the current strategy at CBIIT?
Do you see value in terms of R&D?

Are you considering R&D in your strategic vision?

Have you discussed how to balance R&D and the mission related portfolio?

Do you agree that at large all the activities that you guys are working on are aligned with the direction or mission or the vision of the current leadership at the NCI?

Has the strategy to socialize or educate resources on the vision and mission been discussed?

Do you agree with the perception that some members of the organization have that people do not necessarily understand the current mission and vision?

Why will people not align with the leadership vision, since it is a good vision?

Do you think it has to do with the fact that many of the players are actually scientists and they automatically go to what they know and avoid any changes or new perspectives?
Is it because of funding issues with CBIIT not having enough funding?

What do you think was the criteria for project selection during the caBIG program?

Was it because CBIIT had money and needed to spend the funds? I am trying to understand why change from the caBIG model to a new model?

How is the process now compared to before?

Do you still have some initiatives focused on intramural community versus extramural?

Do you have any concerns that as you start looking inward again, and then incidentally the process will go back to the center and shift more and more into the extramural ending with another caBIG?

What is your take in the EPLC and CPIC process?

What do you think is going to happen or what should happen to avoid going into this cycle of adoption and abandonment of governance processes?

Do you see room at CBIIT for a little bit of R&D in terms of technologies?

Do you feel that before you had more autonomy but that has been taken away?

How does CBIIT get its work?

How does the process translate into the extramural community?

What challenges have you experienced with the current approach?

One of the things that I learned during the interviews is that people feel we have a better interaction with the intramural community, what do you think? Is that your understanding as well?

There amount of work and requests for work coming into CBIIT is increasing, do you think it is due to a better alignment with what the intramural and extramural communities are doing?

People believe that the adoption of EPLC is only another attempt to adopt governance, and may say that we have tried that before, what is your take on that?

Do you have a set of criteria by which you determine which work to take on or not to take?
Do you think there is still room at CBIIT for coming up with new ideas and trying R&D in the bioinformatics?

To what extend do you think CBIIT should undertake R& of information technologies?

People mentioned organizational culture as a challenge to the implementation of improvement processes, have you seen that changing from what it used to be?

How do we work toward internalizing the mission at a personal level with the staff?

How do you see the environment as it is now, in general, in terms of work coming in for both of your areas which looks like is more operational management versus R&D?

How do you determine what initiatives to work on?

Has the approach described by many that "if you build it, they will come" change?
What are the characteristics in a project that will be of interest to CBIIT?

Do you have any projects using the concept of shared cost you described?

What percentage of your activities are dedicated to R&D versus operational?

Do you have a plan to scale down the number of legacy systems?

You mentioned the word "valuable", what do you consider or what criteria do you use to define the value of any of those projects?

How are you measuring the value of those things before you engage?

How do you see the interaction or engagement with the extramural community? Is that something CBIIT would consider maybe at a more balanced level?

Do you see the new board or committee making decisions in terms of what projects come into CBIIT?

How do the existing processes you described affect your day to day operations?
Does the existing process impose some kind of constraint to you? You wanting to do these cool things but you have to go through that process?

In your role right now, are you in that position? That is, can you still develop tools and things like that?

Do you have any concerns that the layer you defined (DevOps) has a lot of the components of EPLC?
Have you seen a trend to move away from the old practices? A change in the culture?
How do you describe CBIIT as an organization? Is it a research entity or a software development entity focused on bioinformatics?

Appendix G: Observation Protocol

Observation Protocol

Observation is defined as a systematic, data collection approach in which the researcher uses his senses to examine the participants in their natural setting. The researcher looks to develop a full understanding of the setting in which the phenomenon of study occurs (De Clerck et al., 2011).

This protocol covers the role of the researcher as an observer/participant in the study, as such; the researcher will participate in CBIIT Project Coordination Office meetings. Observer/participant defines the role of the researcher while gathering data through observation on-site, near the participants, contrary to distance observation. This approach allows the research to learn participant's perspective, learn their behavior in the context of the research questions. Observation will allow the researcher compare participant's perspectives during interviews, versus behavior and perspectives during the decision-making process (Guest, Niamey, & Mitchell, 2013).

The following steps will be taken in this process:

1. Request meeting invitations

   Disclose purpose for attending the meetings, alert relevant personnel only to avoid disruption.

   Maintain a behavior that will disrupt the least possible the natural flow of exchange during meetings.

2. Data will be collected in electronic field notes format. The site does not allow for any form of recording during meetings.
3. Avoid gathering any identifying information such as names, addresses or personal characteristics. The researcher must take all precautions not to collect data that can be used to associate participants to the data.
4. Observation will include:

Environment:

a. Setting description
b. Any changes in the settings as observation progresses
c. Meeting start description
d. Chronological event description

Participants

a. Verbal behavior and interactions (who is interesting? How they interact?)
b. Physical behavior and gestures
c. Personal space
d. People who stand out (who are the decision-makers? How were decisions made?)
e. Communication (how were decisions communicated?)

Data Organization:

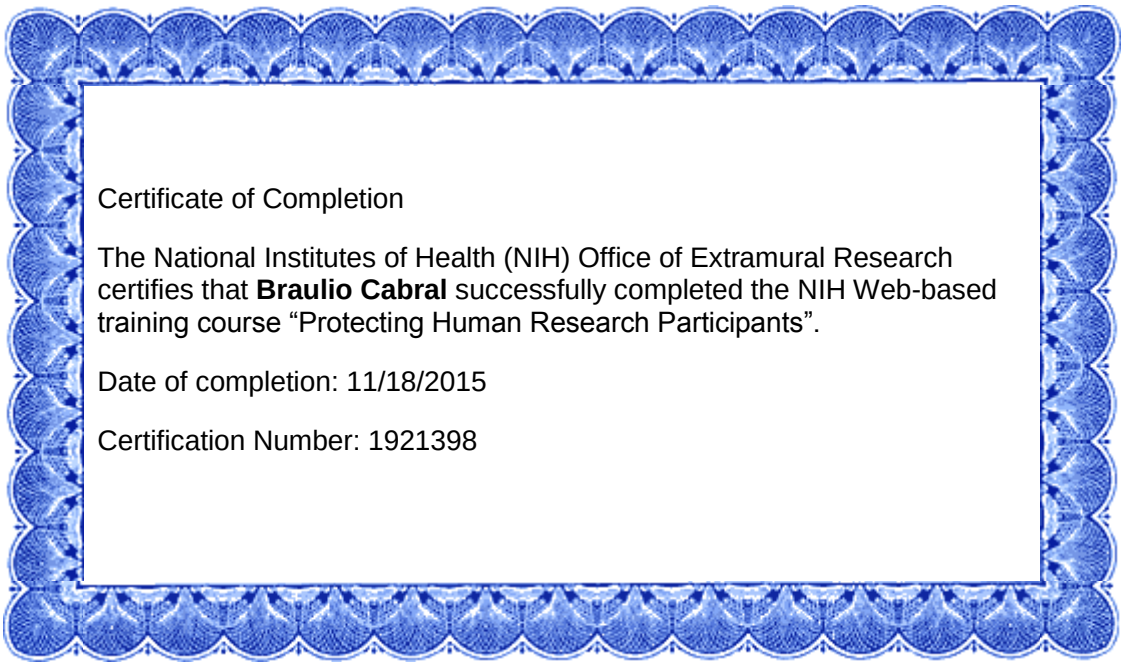
Observation notes will be further developed by expanding any shorthand into full sentences, and composing descriptions and narratives from the notes.

References

De Clerck, H. M., Willems, R., Timmerman, C., & Carling, J. (2011). Instruments and guidelines for qualitative field work. EUMAGINE. Extracted from URL: http://www.eumagine.org/outputs/PP6B%20Instruments%20and%20guidelines%20for%20qualitative%20fieldwork.pdf

Guest, G., Namey, E. E., and Mitchell, M. L. (2013). Collecting Qualitative Data: A Field Manual for Applied Research. One Thousand Oaks, CA: Sage Publishing.

Appendix H: Protecting Participants Certificate of Completion



Certificate of Completion

The National Institutes of Health (NIH) Office of Extramural Research certifies that **Braulio Cabral** successfully completed the NIH Web-based training course “Protecting Human Research Participants”.

Date of completion: 11/18/2015

Certification Number: 1921398

Appendix I: Theories Sensitized Codes

The table below describes the distribution of references to sensitizing codes derived from the theories framing the study.

Theory	**Code**	**Reference**	**Frequency**
TAM	Usefulness	P100, P101, P102, P103, P104, P108, P110, P111, P112, 1113, P114, P115, P116	227
	Ease of use	P102, P103, P111, P113, P118, P119, P121, P122, P123	15
	Intention to use	P100, P101, P102, P103, P104, P108, P110, P111, P112, P113,	100
Program Evaluation	Decision criteria	P101, P102, P103, P108, P111, P112, P113, P114, P115, P117, P121, P122, P125, P126, P127, P130	57
	Decision alternative	P103, P122, P125	3
	Useful information	P100, P110, P112, P113, P114, P116, P119, P121, P125, P127	19
	Effectiveness	P100, P102, P104, P111, P113, P114, P115, P117, P119, P122, P125, P126, P127,	46

(table continues)

	caBIGFinalReport	
Accountability	P113, P114, P117, P118, P121, P125	25
Control	P100, P103, P104, P111, P113, P114, P117, P119, P121, P125,P127, P130	24
Program implementation	P100, P101, P102, P103, P104, P105, P111, P112, P113, P114, P115, P117, P118, P119, P121, P123, P125, P126, P130, Memos, caBIGFinalReport, Observation Notes	92
Program continuation	P100, P101, P103, P104, P110, P111, P112, P114, P116, P117, P118, P119, P121, P122, P125, P127, p130, Observation EPLC 4-19-2016, caBIGfinalreport	58
Program modification	caBIGfinalReport	3

(table continues)

	Evidence for opposition		0
	Evidence for support	P100, P101, P102, P103, P104, P108, P110, P111, P112, P113, P114	109
	Understanding of psychological and social processes	P102	1
Decision Theory	Motivation	P110, P121, P122, P125, caBIGfinalReport	7
	Goals	P100, P101, P103, P104, P108, P112, P118, P119, P127, caBIGfinalReport	43
	Available options	P122, caBIGfinalReport	3
	Normative; how decisions should be made	P100, P101, P102, P103, P104, P108, P110, P111, P112	114

(table continues)

	Descriptive; how decisions are made in reality	P100, P101, P114, P125, P127	8
Expected Utility	Maximizing utility	P125	2
	Completness	P100, P112, P113, P114, P121, caBIGfinalReport	11
	Transitivity	P100, P101, P102, P103, P114, P115, P121, caBIGfinalReport	15
	Independence	P117, P112, caBIGfinalReport	16
	Continuity	P100, P101, P103, P104, P110, P111, P112, P114, P116, P117, P118, P119, P121, P122, P125, P127, P130, Observation-notes-EPLC-4-19-2016, caBIGfinalReport	50