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CRITICAL SUCCESS FACTORS IN MANAGING GOVERNMENT FUNDED R&D PROJECTS IN ABU DHABI

Mariam Ibrahim Al Mahmoud

This dissertation is submitted in partial fulfilment of the requirements for the degree of Doctorate of Business Administration

Under the Supervision of Professor Riyad Eid

November 2019

Declaration of Original Work

I, Mariam Ibrahim Al Mahmoud, the undersigned, a graduate student at the United Arab Emirates University (UAEU), and the author of this dissertation entitled "*Critical Success Factors in Managing Government Funded R&D Projects in Abu Dhabi*", hereby, solemnly declare that this dissertation is my own original research work that has been done and prepared by me under the supervision of Professor Riyad Eid, in the College of Business and Economics at UAEU. This work has not previously been presented or published, or formed the basis for the award of any academic degree, diploma or a similar title at this or any other university. Any materials borrowed from other sources (whether published or unpublished) and relied upon or included in my dissertation have been properly cited and acknowledged in accordance with appropriate academic conventions. I further declare that there is no potential conflict of interest with respect to the research, data collection, authorship, presentation and/or publication of this dissertation.

Student's Signature: ______________________ Date: 12/12/19

Declaration of Original Work

I, Mariam Ibrahim Al Mahmoud, the undersigned, a graduate student at the United Arab Emirates University (UAEU), and the author of this dissertation entitled "*Critical Success Factors in Managing Government Funded R&D Projects in Abu Dhabi*", hereby, solemnly declare that this dissertation is my own original research work that has been done and prepared by me under the supervision of Professor Riyad Eid, in the College of Business and Economics at UAEU. This work has not previously been presented or published, or formed the basis for the award of any academic degree, diploma or a similar title at this or any other university. Any materials borrowed from other sources (whether published or unpublished) and relied upon or included in my dissertation have been properly cited and acknowledged in accordance with appropriate academic conventions. I further declare that there is no potential conflict of interest with respect to the research, data collection, authorship, presentation and/or publication of this dissertation.

Student's Signature: ___________________________ Date: _________________

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Abstract

The purpose of this dissertation is investigating the critical success factors affecting the research and development projects funded by Abu Dhabi, UAE. Abu Dhabi particularly began to adopt innovative and internationally accepted standards and practices in their public administration. Therefore, it is a challenge to develop public projects, which require time to implement, cost, and as well as smart objectives to achieve. It is necessary the great ability to manage such development, instead of traditional methods. research and development projects funded by the governments have been very challenging while trying to clarify various factors contributing to their success. Design/Methodology/Approach: The conceptual model that built for the study purpose was used and constructed based on a literature review. Hypotheses were identified to be tested quantitatively. Next, a questionnaire is built and used to measure the perception of the participants in public organizations about the critical success factors and the research and development project success criteria. Quantitative methodology is used in this study, as structural equation modeling is utilized to analyze the collected data. Findings: The factors that contribute to the success of research and development projects were mainly identified, which strategic and tactical factors in supporting cost and objectives achievement. However, operational factors had a minor effect in determining the research and development succession. The most influencing for organizational culture has come from strategic and tactical factors which enhanced the succession state of research and development projects (i.e. achieving cost and timeline of projects). Finally, the moderating effect of organizational culture in achieving the cost, timeline and objectives achievement of projects were mainly via strategic, and tactical factors. Limitations: This study was conducted in public organizations in Abu Dhabi among 300 participants only. For this reason, the results cannot be generalized to other contexts. Originally/Value: This study contributes to the literature by providing an insight into the factors that make research and development projects success. There is a gap in the literature with regard to evaluating such a model, and this study explored the factors that make the research and development projects success from the perspective of employees. These factors are, strategic factors, i.e. its goal and the relevance of its content and material to the success of research and development projects. The tactical factors, and the operational factors. This study looked at research and development projects success from three different factors (i.e. Cost achievement, timeline achievement, and objectives achievement). This study looked at the effect of the organizational culture as the mediator factor for the relationship between strategic factors, tactical factors, and operational factors with cost, timeline, and objectives achievement. As well as, this study looked at the effect of the critical success factors into research and development success projects.

Keywords: Critical success factors, research and development, strategic, tactical and operational factors, cost, timeline and objectives achieved.

Title and Abstract (in Arabic)

عوامل النجاح الحاسمة لمشاريع البحث والتطوير الممولة من الحكومة

الملخص

هدفت هذه الرسالة الى التحقق من عوامل النجاح المؤثرة على مشاريع البحث والتطوير والممولة من قبل حكومة أبو ظبي، الإمارات العربية المتحدة. بدأت أبوظبي على وجه الخصوص في تبني معايير وممارسات مبتكرة ومعترف بها دوليًا في إداراتها العامة. لذلك، فإنه من الصعب تطوير المشاريع العامة، والتي تتطلب الوقت والتكلفة لتنفيذها، وكذلك لتحقيق أهدافها. لذلك فإنه من الضروري القدرة على إدارة مثل هذا التطوير، بدلاً من الطرق التقليدية. حيث ان من التحديات التي تواجه مشاريع البحث والتطوير والممولة من قبل الحكومات هي صعوبة توضيح العوامل المختلفة التي تساهم في نجاحها. منهجية البحث: تم استخدام النموذج المفاهيمي الذي بني لغرض الدراسة وتم بناؤه على أساس مراجعة الأدبيات. تم تحديد الفرضيات لاختبارها كميا. بعد ذلك، تم إنشاء استبيان واستخدامه لقياس إدراك المشاركين في المؤسسات العامة حول عوامل النجاح الحاسمة ومعايير نجاح مشروع البحث والتطوير. حيث تم استخدام المنهج الكمي في هذه الدراسة، كما تم استخدام نموذج المعادلة الهيكلية لتحليل البيانات التي تم جمعها. النتائج: تم تحديد العوامل التي تسهم في نجاح مشاريع البحث والتطوير بشكل رئيسي، وهي العوامل الاستراتيجية والتكتيكية في دعم تحقيق التكلفة والأهداف. ومع ذلك، كانت العوامل التشغيلية لها تأثير طفيف في تحديد نجاح البحث والتطوير. وقد جاء التأثير الأكبر للثقافة التنظيمية من العوامل الاستراتيجية والتكتيكية التي عززت حالة نجاح مشاريع البحث والتطوير (أي تحقيق التكلفة والجدول الزمني للمشاريع). وأخيرًا، كان التأثير المعتدل للثقافة التنظيمية في تحقيق التكلفة، والتسلسل الزمني، وتحقيق أهداف المشروعات من خلال العوامل الاستراتيجية والتكتيكية. محددات الدراسة: أجريت هذه الدراسة في مؤسسات عامة في أبو ظبي من بين 300 مشارك فقط. لهذا السبب فإنه لا يمكن تعميم النتائج في سياقات أخرى. الأصالة البحثية/ القيمة: تساهم هذه الدراسة في الأدبيات من خلال توفير نظرة ثاقبة للعوامل التي تعمل على نجاح مشاريع البحث والتطوير. حيث هناك فجوة في الأدبيات فيما يتعلق بتقييم هذا النموذج، واستكشفت هذه الدراسة العوامل التي تؤدي الى نجاح مشاريع البحث والتطوير من وجهة نظر الموظفين. حيث كانت هذه العوامل ما يلي: أولاً، العوامل الاستراتيجية، أي هدفها ومدى صلتها بمحتواها وموادها لنجاح مشاريع البحث والتطوير. العامل الثاني هو

العوامل التكتيكية، والعامل الأخير هو العامل التشغيلي. كما نظرت هذه الدراسة في نجاح مشاريع البحث والتطوير من ثلاثة عوامل مختلفة (أي تحقيق التكلفة، وتحقيق الجدول الزمني، وتحقيق الأهداف). بحثت هذه الدراسة في تأثير الثقافة التنظيمية كعامل وسيط للعلاقة بين العوامل الاستراتيجية والعوامل التكتيكية، والعوامل التشغيلية مع التكلفة، والجدول الزمني، وتحقيق الأهداف. بالإضافة إلى ذلك، نظرت هذه الدراسة في تأثير عوامل النجاح الحاسمة على تحقيق النجاح لمشاريع البحث والتطوير.

مفاهيم البحث الرئيسية: عوامل النجاح الحاسمة، البحث والتطوير، العوامل الاستراتيجية والتكتيكية والتشغيلية، التكلفة، الجدول الزمني، والأهداف التي تم تحقيقها.

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Dedication

To my beloved children Afra, Shaikha & Ahmed who were born during my DBA journey and inspired me everyday to keep going till the end

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Chapter 1: Introduction

1.1 Study Background

Research and development (R&D) projects are common in many countries around the world. This dissertation responds to scholars with regard to the variability of outcomes arising from R&D projects funded by the Abu Dhabi government (Byat & Sultan, 2014). Abu Dhabi government intends to participate effectively in projects that aim to develop and promote national capacity and competency in science, technology, and human capital. Therefore, it crucial to determine the critical success factors (CSFs) that should be considered by project managers to ensure the successful completion of such projects (Byat & Sultan, 2014). It is well known that CSFs are the main issues to be considered for any business to succeed (Butler & Fitzgerald, 1999).

Various definitions of CSFs in the literature are similar in terms of their managerial approach to the subject (Harvey, 2015; Linton, 2012; Lucia & Lepsinger, 2009; Sashkin, 2003; Wiener, 2006). Wiener (2006) stated that CSFs initially referred to business analysis and data analysis, and Harvey (2015) explained that CSFs refer to the elements that a project needs to meet to achieve the goals that led to its creation. Lucia and Lepsinger (2009) defined CSFs from the perspective of project management as things that are required to go well to make sure that the organization or the project manager delivers high performance. In line with this, Sashkin (2003) elaborated that these issues require special and repeated attention, since deviation will result in missing goals and in the eventual failure of the project. Moraveck (2013) added to this approach by explaining the difference between success criteria and CSFs: success criteria are a statement of a project’s outcome, whereas CSFs are the issues that are essential to the present activities of an organization and are equally crucial to its future success.

Linton (2012) went beyond this, taking a more independent approach in explaining how the quantification of CSFs is set and exploring various examples that show that such quantification is possible. Shimomura and Kimita (2013) argued that quantification is too broad and that an easier way would be to measure key performance indicators when examining success criteria. Nevertheless, Linton (2012) and Shimomura and Kimita (2013) agreed that CSFs are characteristics that are built into an organization’s structure and revealed only through identification of an opportunity that calls for resources to exploit. A good example presented by Linton (2012) showed how a company identifies a chance to provide better customer services. The company develops a customer call center, which results in the acquisition of more customers and the retention of existing customers. Thus, the call center is identified as the CSF of the company in terms of customer service.

Powell and Ong (2014) explained that CSFs are vital for the formulation and implementation of strategies in a project. For a plan to work, the presence of one or more driving factors is required. Strategies need human, capital, financial, and time resources, and these are created by CSFs. In a more strategic approach, Sashkin (2003) explained that when designing a strategy, a strategist attempts to answer the question, “Why would my strategy work as expected?” The answer is a CSF.

CSF methodology is an approach that can be used by project managers to specify, identify, and prioritize the most crucial and relevant factors at play in the success and survival of a project. In the literature presented by Powell and Ong (2014), CSF methodology is described as a strategic process for managing information. The process consists of several phases. First, a thorough understanding is obtained of the factors that are classified as external to the project, such as industry, environment, and market. Then, the championship and support of the management at the top of the project are secured. The third step is the encouragement of proactive identification of generic CSFs by staff and management. Finally, activity-related CSFs are prioritized, aggregated, and translated into information requirements for the organization to be used in designing the information infrastructure.

Practically, most R&D research is handled either by academic R&D institutions or by R&D institutions, as it requires a high degree of intellectual input (Yamazaki, Matsushima, & Mizuno, 2012). Several risk factors are specific to government-funded projects, where success may not guaranteed and benefits may not be tangible. Accordingly, it is necessary to establish the key factors that determine whether government-funded R&D projects in Abu Dhabi will succeed.

1.2 Significance of the Study

Since 2000, major changes have taken place in UAE public sector organizations. Abu Dhabi and Dubai, in particular, have begun to adopt innovative and internationally accepted standards and practices in public administration. The recent vigorous expansion of infrastructure and core public utilities and related services has instigated the establishment of project-based public organizations in the UAE.

Developing public projects is considered a great challenge. They require a great deal of time for implementation, and their management (planning, procurement, monitoring, and control) requires a high level of skill. However, these elements are often less effective than the elements used in projects developed by private initiatives (Esquierro et al., 2014).

R&D projects funded by governments have proved very challenging in terms of clarifying the various factors that contribute to their success (Yamazaki et al., 2012). In the case of Abu Dhabi, the government has been heavily involved in key development projects, and its influence has been felt from the R&D stages through to the implementation of the projects. Therefore, it is important to make sure that all the relevant factors for evaluating such projects are determined carefully. Thus, the main focus of this dissertation is identifying the CSFs that play a vital role in achieving the objectives of R&D projects that are funded by government. The list of CSFs obtained from this study for managing government-funded R&D projects will be forwarded to interested stakeholders who are carrying out research into implementation, so that the research outcomes will help them to achieve their goal of successful management of government R&D projects in Abu Dhabi.

1.3 Research Objectives

The main research objective of the present study is to answer this question: Which CSFs are key for managing government-funded R&D projects in the Emirate of Abu Dhabi? Accordingly, the following sub-objectives have been articulated:

1. to explore the factors that affect R&D projects
2. to determine the effects of three types of factors (strategic, tactical, and operational) on project success
3. to distinguish between the effects of each factor on project success.

1.4 Research Questions

Research questions are fundamental, since they provide a blueprint for the research design and research objectives (Khoo, 2005). In the present study, the primary research question is this: Which factors affect the success of government-funded R&D projects in the Emirate of Abu Dhabi?

1.5 Structure of the Dissertation

This dissertation consists of six chapters, each of which is devoted to a specific area of the study and covers a particular aspect of the topic under study. The structure is designed as follows.

Chapter 1, as an introduction, has provided a general overview of the research subject, the nature of the UAE public sector, and the theoretical and practical significance of the study. It has also set out the research objectives and questions.

Chapter 2 reviews the scholarly literature related to the topic and themes of this study. The review begins with the nature of R&D, its definition, its features, its importance for economic and business development, and how it works in practice. The chapter moves on to consider CSFs, how they are defined, how they function in R&D projects, and the internal and external factors that affect R&D projects. Organizational culture as a moderating factor is also considered, as are the outcome factors for success in R&D projects. The final section in Chapter 2 formulates the conceptual framework of the study.

Chapter 3 provides an overview of the operationalization of the variables, research methodology, methods, instruments, and design of the study, highlighting the issues associated with the available methodologies. Chapters 4 and 5 present the results from the statistical analysis, without drawing general conclusions or comparing results to those of other researchers. Chapter 6 then interprets and discusses these findings in the context of the literature reviewed in Chapter 2, taking into account the limitations and implications of the present study and drawing final conclusions.

Chapter 2: Literature Review

2.1 Introduction

This chapter reviews and evaluates previous studies in the area under investigation. The key concern in this study is to access the CSFs that have contributed to the success of government-funded R&D projects in Abu Dhabi. A critical review of the literature can help to understand the current issues and problems in the context of the research. Accordingly, Figure 1 illustrated the structure of current research literature review.

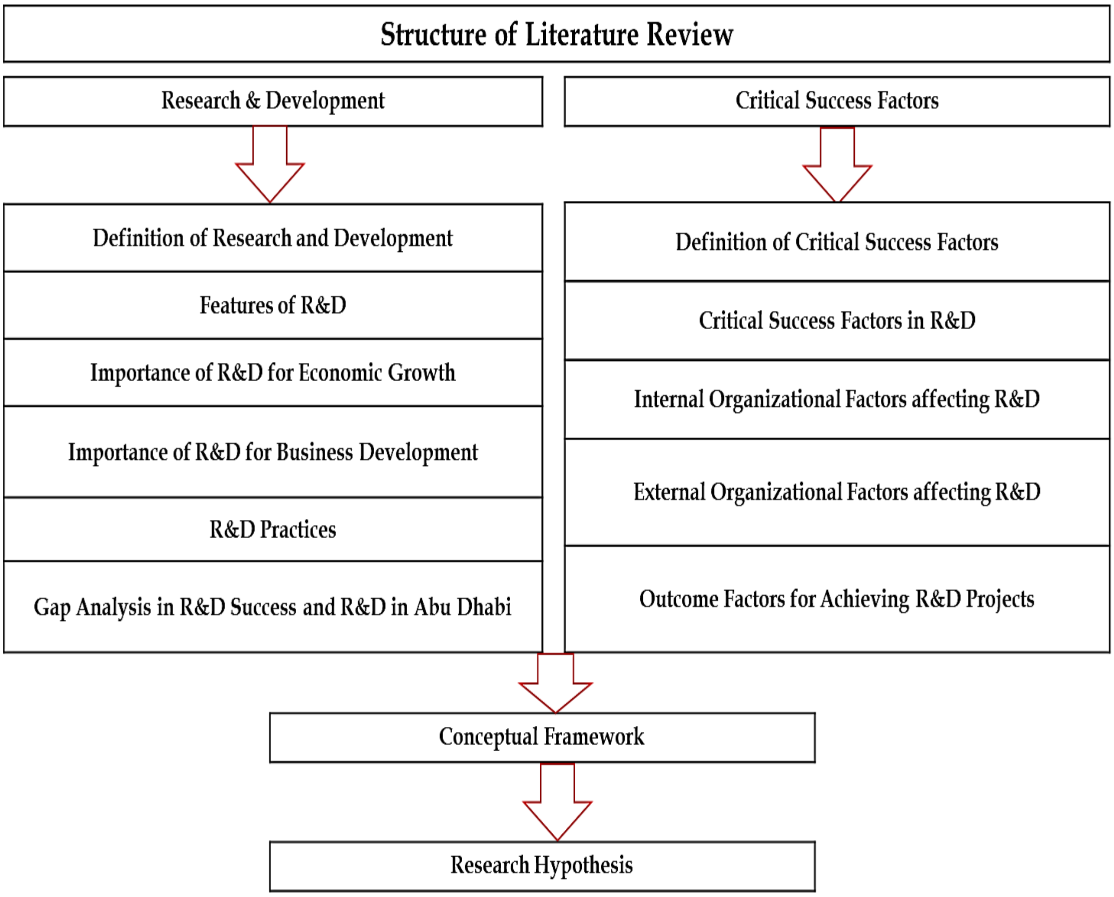

Figure 1: Structure of literature review

As Cheng and Phillips (2014) stated, secondary sources are useful in the data collection process for retrieving the information needed to complete the study. Cheng and Phillips (2014) notes that secondary data can be obtained from documented sources such as journals, government records, official websites, white papers, research articles, and company records, most of which are found on the internet.

Secondary data are used to provide evidence-based information that will act as evidence that a previously conducted process has been successful in an earlier project. Secondary sources are important, as they present a chance for an individual to compare other studies and compare their results to determine whether current processes and information are credible. Efficient employment of academic journals, reports, and scientific studies in data collection will help illustrate the critical factors in this study. Detailed descriptions of the variables under study have been extracted from the literature as follows.

2.2 Research and Development

2.2.1 Definition of Research and Development

R&D is any corporate or government activity or initiative that results in innovation that can improve the services and products offered by an organization (Phillips & Zhdanov, 2012). Doraszelski and Jaumandreu (2013) and Marchi (2012) explained that R&D can be divided into two general categories: the application of existing knowledge and technology that can be used to create new products or services; and research and study in different scientific fields to identify technology that has yet to be used in a given industry. In both cases, the role of R&D is to provide a solution to a determined business need, be it on how to gain competitive advantage over other companies or on how to improve current practices to increase revenue and market share (Takalo, Tanayama, & Toivanen, 2013).

A report by the Organization for Economic Co-operation and Development (OECD, 2015) defined R&D as creative and systematic work undertaken in order to increase the stock of knowledge (including knowledge of humankind, culture, and society) and to devise new applications of available knowledge. From the literature, R&D can be defined as any organizational practice that facilitates future product or service development. Therefore, the purpose of R&D is based on addressing strategic or long-term goals for the future; it can even be considered as a CSF for companies that rely on technological innovation to remain fluid and significant in their markets.

2.2.2 Internal Organizational Factors Affecting R&D Projects

2.2.2.1 Leadership Competency and Support

Leadership is the ability to bring people together and guide them toward the realization of a common goal by altering individual or group behavior (Fernandez & Jawadi 2015). Past research has shown that leaders tend to follow a similar path, characterized by common patterns in their leadership endeavors. As such, leadership within an organization is key to every decision made (Fernandez & Jawadi 2015). To put it in simple terms, a leader coordinates, controls, and monitors subordinates toward the desired goals (Fernandez & Jawadi 2015).

In R&D, the symbol of leadership on the ground is usually the project manager. As the Association of Energy Engineers (2011) and Cox (2009) explained, leadership is a science and art that is a prerequisite for supervision skills, productivity, trust, mentorship, decision-making, creativity, and communication. According to Cox (2009), a project manager should be able to supervise using a checklist for various processes. The list method of supervision enables a leader to remember all the activities on any given day in different parts of the entire project.

The Association of Energy Engineers (2011) explained that a checklist is one of the essential tools for managing an R&D project. In their opinion, a leader should have the capability to recognize activities that are important but that are outside the scope of the checklist. In such a case, the leader’s skills for reprioritizing come into play.

The creation of a transparent method of managing a project is vital in checking the powers of the project manager when necessary. Turner (2014) explained that the personal and professional characteristics of the project manager are equally critical for ensuring that the positive impacts of the manager’s position in a project are felt.

Cox (2009) explained that the leadership position must be productive, emphasizing that a leader must have a noticeable influence on a project through the implementation of manipulative practices in management. Both Cox (2009) and the Association of Energy Engineers (2011) observed that a leader cannot rely solely on inputs from outside. It is the duty of the manager as the leadership figure to create a vision for the entire project. Cox (2009) went on to explore the essential role of trust in leadership, asserting that a good leader is focused not just on management but also on the creation of relationships between various stakeholders. In doing this, the manager works at the highest level of transparency as a collaborator and a relationship creator.

According to Nagesh and Thomas (2015), top management support and leadership competence are important in the success of government-funded R&D projects. According to Dobbins and Donnelly (1998), a project life cycle runs through four major phases: conceptualization, planning, execution, and termination. The same researchers placed leadership in the key second phase, planning, in terms of top management support. The primary function of leadership support in R&D

projects is to ensure constant flow or allocation of resources to allow sufficient time to accomplish the relevant tasks and goals.

A study by Doraszelski and Jaumandreu (2013) found a correlation between improved R&D productivity and leadership support, indicating that more established companies will benefit more from R&D because their leadership generally have the foresight and patience to devote continuous resources to their R&D departments and can afford to do this, in terms of both time and resources. The leadership of other companies and start-ups with excellent R&D departments were identified as determined to take advantage of any successful discovery by increasing production of a newly discovered technology or product (Robertson & Wooster, 2013).

When the government is involved, leadership in R&D departments is different, since government value the fulfillment of goals within a shorter period of time. Steinhilber, Wells and Thankappan (2013) gave an example concerning government involvement in the production of electric cars, revealing that government leadership generally suffers from short-sightedness, focusing as it does on the production of results within a specified amount of time. These restrictions, while also present in private companies, are more prevalent when a government is involved, especially if there are leadership changes due to factors such as term of office, elections, or appointments. These results are supported by the studies of Mason and Brown (2011) and Westmore (2013), who showed that leadership in government collaborations are more invested in the final output and its application rather than the projected return on investment. Furthermore, Westmore (2013) determined that government R&D collaborations are more often affected than the private sector by other factors outside business development that may hinder productivity.

Purushotham, Sridhar and Sunder (2013) examined the leadership style approach, which focuses attention on the behavior of project managers and what techniques they use. A leadership style is the combination of traits, skills, and behaviors that a leader uses in interactions with those whom they lead. The style approach expands the study of leadership to a variety of contexts, specifically to the implementation of government-funded R&D projects.

According to Jain et al. (2010), senior management in an R&D project requires awareness and full support. Jain et al. (2010) presented a series of factors to consider when deciding whether the management are in support. First, the senior management must be aware of the role they play in the execution of a project. The roles of senior managers include the performance of tasks that more junior staff are not cleared to attempt, and the upper management are responsible for making crucial tactical decisions that the rest of the team may find controversial. Second, it is important to clarify whether the top management created the R&D project for business goals or needs. Jain et al. (2010) asserted that when a senior manager initiates a project, it has a higher chance of success than a project undertaken elsewhere. Gibson (2011) agreed with this, adding that a project is often advantaged if it has “top-down force.” Third, the owner of the R&D project charter will ideally be in the upper management, although Gibson (2011) indicated that it is acceptable to have the permit given to the project manager. However, both Jain et al. (2010) and Gibson (2011) explained that granting the charter to upper management indicates a deep level of commitment on the part of the organization. Where this is the case, Jain et al. (2010) observed that resources will be readily available. The fourth consideration proposed by Jain et al. (2010) is the amount of time that upper management takes to approve a project. Likewise, Gibson (2011) emphasized that the process of approval should not be taken lightly. Quick approval may be taken to indicate full support, while delayed approval could indicate that upper management have reservations about the viability of the whole idea. On the other hand, Jain et al. (2010) cautioned that speed in approval may also indicate a lack of attention to detail or a tendency to regard the project with less seriousness than it deserves. Gibson (2011) also noted that upper management should be ready to attend briefings in the course of the R&D project as a show of support and concern for its progress. Jain et al. (2010) recommended that upper management should be acutely aware of the risks involved in rough times during the process of execution; senior managers plays a significant role in the mitigation of risks and, thus, in making the project successful. The final consideration suggested by Jain et al. (2010) concerns the amount of support that the upper management has from its peers, the major question here being, “How wide is the organization’s external support?”

Baldwin and Hunter (2014), Morris and Sember (2008), and Wysocki (2006) reviewed the processes involved in gathering support from those at the top of the project. Morris and Sember (2008) explained that obtaining support requires the education of the people in power; although the person responsible for the solution of technical problems will have expertise in that field, the people in the authority may not have the relevant technical knowledge. The literature presented by Association of Energy Engineers (2011) indicated that the leader of the project is responsible for the teaching and mentorship of other members of staff. The ability of a manager to take an interest in the development of each team member at a personal level is regarded by the Association as an undeniable symbol of excellence in leadership.

In Cox’s (2009) view, the most salient attribute of a leader is communication ability. Excellence in communication is revealed in the manner in which a manager writes emails, conducts meetings, issues status reports, and makes enquiries. The Association of Energy Engineers (2011) explained that communicating briefly and clearly shows strength in leadership. On the other hand, Cox (2009) and the Association (2011) agreed that listening is equally important for a leader and that a manager's ability to listen and process information is an indicator of excellence in communication.

Wysocki (2006) recommended making the upper management feel as if they have a say in the decision-making processes of the project, as this makes a major contribution to their commitment. Wysocki (2006) explains that convincing begins with the provision of choices. Multiple options are suggested, each being a viable option. The options are presented to the upper management, and since the choices were the brainchild of the project's manager, either option will indicate a win for the project. Wysocki (2006) explained that this will make the top management feel part of the project and will draw them in closer. If they feel that they have control of the project's decisions, this will make them positively disposed toward the project.

When it is a question of goals, Lewis (2007) pointed out that being in contradiction with the aims of the management is not good for a project's approval and support. Therefore, Lewis (2007) suggested that during the knowledge and survey exercise, the upper management's goals should be brought out clearly. In addition, the goals of the project should be established with knowledge of the top management's goals so that conflicts of interest can be avoided. In terms of target analysis, Lewis (2007) recommended that the project's goals should be formulated to meet the bottom-line of the upper management's goals. For most projects, the goals go beyond the mere creation of the project. Therefore, their alignment with the primary goals of an organization such as the government will go a long way to securing support for all areas of the project. The Welfare Federation of Cleveland (2006) agreed with Lewis's (2007) argument and added that the key to an alignment of goals is practicality; the more practical a goal is, the more achievable it looks. The Welfare Federation also observed that knowledge of stakeholders' reservations is as important as knowing their goals. While goals will often provide the basis for progress, reservations will cause a project to grind to a halt, at worst, or to proceed very slowly, at best. Therefore, they strongly recommended the creation of goals that counter the reservations of upper management. The elimination of existing doubts creates an information superhighway between the top management and the project management team, and this makes it possible to achieve support for the project and to obtain the resources necessary for progress. In R&D projects, leaders motivate other personnel to maximize their potential in their own service delivery areas, with the overall aim of achieving the set goals and mission. Great leadership maintains a smooth process of service delivery and ensures positive outcomes by providing guidance and solutions for the challenging, issues and situations that arise during an R&D project (Fernandez & Jawadi 2015).

Leadership roles are potentially important for the innovative ideas found in R&D projects. Roberts and Fusfield (cited in Elkins & Keller, 2003) suggested that leadership helps with the generation of ideas, entrepreneurialism, project leading, gatekeeping, and coaching. Effective leaders are able to communicate, set the climate, plan, and effectively interface with the project group (Elkins & Keller, 2003). Moreover, leadership helps to span organizational boundaries and to champion an R&D project, offering a link between the internal and external factors that ensure effective progress.

According to Elkins and Keller (2003), leaders in R&D projects are involved in the development and testing of innovative ideas, as well as having the creativity to solve problems. In support of this view, Denti (2013) argued that leaders can create a conducive environment that encourages the revelation of multiple ideas, leading to innovation. Additionally, effective leaders can motivate project team members, organize the project, and coordinate members in conducting the project (Elkins & Keller, 2003). Studies cited in Denti (2013) have suggested that good leaders enhance intrinsic motivation and promote a quality work relationship among team members, which helps facilitate better R&D outcomes. Moreover, leaders can allow smooth communication and coordination between personnel and the collection of information necessary for the project (Elkins & Keller, 2003). It has been argued that leaders assist in allocating resources, setting goals, and overseeing reward systems (Denti, 2013); as such, they embody innovation, a trait required in successful R&D projects.

All these roles reveal the important of leadership as a success factor in R&D projects. Without leadership, there is no effective communication, coordination, or cooperation, which means that the execution of duties during an R&D project will not be smooth enough to allow successful completion. According to Pashah (2016), leadership affects organizational culture, which is the behavior, interaction, and cooperation among employees in a company. Organizational culture dictates employee performance and interaction.

Through effective leadership, a healthy culture is built, and this allows all R&D team members to view themselves as a group rather than as unfairly treated individuals (Pashah, 2016). Ineffective leadership in an R&D project is complicates the project plan, creating confusion between personnel, team leaders, and the organization. This, consequently, affects the success of R&D projects.

From the literature, it can be observed that the impact of leadership support on R&D departments concerns resource allocation, vision, and the objectives that the R&D departments should follow. In the private sector, R&D is mostly concerned with output technology and its role in increasing revenue and production, while R&D supported by the government is mostly concerned with technology output and its broader applications. The available evidence that confirms the involvement of a government in funding R&D projects informs the decision to evaluate the effectiveness of key stakeholders in ensuring successful implementation of the projects. From this perspective, it is evident that political leadership, and leadership style in particular, is a key critical factor in the success of government-funded R&D projects.

2.2.2.2 Human Capital Readiness and other Resources

Employee capacity is the existing and potential capability in an organization in terms of experience, power, and skills to perform duties. Sant (2008) and Shim (2012) explained the importance to the success of R&D of sufficient flow in human, capital, economic, and land resources. Sant focused on human resources, whereas Shim emphasized qualifications, skills, and sufficiency of staff. Sant (2008) noted that having sufficient resources at the disposal of R&D teams makes every plan viable at the start. Moreover, adequate resources provide backup for a project's contingency plans. Shim (2012) discussed improvements in the quality and supply of the factors of production, also known as resources, and found that the quality of human resources can be improved by training. In the same manner, the quality of capital and land resources can be increased through improvements in technology and infrastructure, respectively. The supply of all factors of production, except land, can be increased. In explaining the dynamics of resources, Shim (2012) claimed that correct allocation is as important as sufficiency. Misuse of resources leads to losses, disruptions, and eventual insufficiencies. To avoid this, both Shim (2012) and Sant (2008) recommended that the plan, budget, and duty allocation schedules should be formulated in the planning phase of any project. Additionally, they declared that supervision is of the essence. because the lack of close oversight of resource allocation can result in incorrect allocation, which reduces the ratio of the output from the R&D to the resources put into it.

Human capital readiness refers to access to the skilled and competent individuals required to complete R&D projects (Block, 2012). In most cases, qualified human capital is a finite or limited resource requiring careful management and outsourcing, particularly in R&D projects (Probert et al., 2013).

Stein (2010) asserted that, for a manager, people working for the organization are the most important asset and so must be managed appropriately to achieve objectives. He also mentioned that, as an important element in management skills, the personnel manager should identify the challenges that they are likely to face and design ways to deal with them as follows.

- Hiring and recruiting the right people. This starts with the manager's responsibility for recruiting qualified and suitable employees. As the organization grows and more success is realized, more employees are required to enhance the expansion of the organization.
- Achieving a stretch goal. Every organization has a responsibility or objective that it seeks to achieve and that the people of the organization are expected to

work toward. For the manager, the goals are achieved not in person but through the people to be managed. Achieving these stretch goals takes careful planning on how to apply the organization's workforce to realize the goals.

- Bringing out the best out in employees. This is quite challenging, given that every employee has a different motivating element for reaching their potential. Some of the factors that affect employee performance are out of the manager's control; what the manager can do is treat employees with respect, help them align personal goals with work goals, make the work environment conducive and appropriate, and encourage communication and cooperation.
- Dealing with underperforming employees. Some employees have issues that affect their work performance persistently. The challenge here is that the problem is not technically the manager's; however, since it affects the organization, the manager has to get involved and possibly help the employee to cope with personal issues.
- Dealing with outstanding employees. Employees whose performance for the company is outstanding must be treated differently from the others, mainly in terms of reward. Without appropriate rewards, they may lose morale and deliver poor work because of lack of motivation.
- Responding to crises. This is a challenge that mainly involves the ability of the manager to change plans when unexpected conditions present at. Such situations include an employee falling sick, resigning, or being harmed during work. The manager must be able to shift from the agreed plan to a way of working that is suitable for the new circumstances.

Camilleri (2011) explained that undertaking to encourage the identification of CSFs should begin with the creation of a team to work on them. He observed that, in any organization, the people who know the internal structures the best are the employees and management. Therefore, the creation of an investigative team should be like an observational quest. First, Camilleri (2011) recommended that a CSF investigation team be composed of members representing every department in the organization. Departmental representation will ensure that the interests and observations of various departments are incorporated into the report. Second, Camilleri (2011) recommended that an investigative team be composed of members from different levels, including upper management, project management, departmental management, employees, support staff, and interested stakeholders, as a team with a hieratical formation will succeed in obtaining data from different levels of the organization. Furthermore, appropriate representation can ensure discretion regarding various issues where necessary. The Centre for Volunteering (2008) also supported the idea of hierarchical team formation, noting that it will buy the management into the projects idea. Although a consultant specialist in matters of CSFs may come in handy, the Centre for Volunteering (2008) observed that internal discussion will also lead to a fruitful investigation.

Salminen (2010) explained that interactions outside the workplace can be a perfect place for obtaining insights about CSFs, as the environment creates an equalizing effect, making employees feel freer with the management. In such cases, inquiries can easily be made, not necessarily about work but about the industry more generally. As Salminen (2010) observed, the most brilliant employees may have a deeply hidden agenda for the organization. It could be a dream, a technological aspiration, or a viable research idea that remains hidden due to the method of management approach. Camilleri (2011) raised a similar observation, stating that employees and management may have hidden talents that can be huge assets for any organization, but the exploitation of such talent is only viable if it is allowed to emerge. Salminen (2010) supported the idea of off-work interactions, noting that hidden talents can be discovered in the right environment and that they may turn out to be CSFs.

The challenges of finding qualified human resources for R&D have been considered by Probert et al. (2013), who explained that the knowledge and expertise of qualified individuals may be highly valued but can have limited use outside of the projects they are involved with. Such individuals are often found in universities, and hiring them may be seen as a luxury for many organizations; this helps to explain why R&D investment levels vary. In this regard, the value of these individuals lies in their willingness to consult and oversee R&D projects rather than in becoming permanent employees of a company (Probert et al., 2013).

Probert et al. (2013) added that outsourcing these services remains a viable solution for government and private companies alike. Similar findings were reported in Guan and Yam's (2015) study on the effects of outsourced R&D staff in the Chinese economy during the 1990s and in Becker's (2014) illustration of the profitable relationship between outsourced R&D departments (such as universities) and private and government organizations. Becker (2014) noted that government companies can typically afford to make longer-term use of outsourced services for specific projects than private companies can, as they often have the capability to manage their own R&D departments, which may fulfill other purposes, such as data-gathering and analysis.

Another highly promising idea, presented in the literature by Carter et al. (2011), involves obtaining employee feedback. Although obtaining the honest opinions of employees may be hindered by their position and the nature of their employment, Carter et al. (2011) maintained that creating an open-door policy in an organization helps in gathering employee feedback. Additionally, they explained that the reaction of employers to feedback is a major determinant of the success of future CSFs audits. Thus, they recommended that companies maintain their approachability; the friendlier a person is, the more comfortable employees feel about contributing to feedback. In a similar study by Capelle (2013), an open-door policy is again encouraged. However, Capelle (2013) cautioned that an open-door policy will not be effective if the management maintains a defensive stance toward critics. In many instances, employees were in a position to identify factors with the potential to be critical to the success of an organization, but these factors remained unidentified because of a lack of openness on the part of management. In such cases, the management's maintenance of a defensive stance is an obstacle to the identification of other potential factors of success. Both Capelle (2013) and Carter et al. (2011) agreed that it is the duty of any organization to thank employees for their identification of CSFs, whether active or dormant. Both Carter et al. (2011) and Capelle (2013) maintained that unity is the key.

A basic strategy suggested by Premuzic (2013) makes use of the competitive environment and employees' desire to perform better than their colleagues or to defeat them. The strategy involves letting employees fail, allowing them to suffer the consequences and surrounding them with people who provide competition. Premuzic also mentioned that competition creates pressure and that employees should not be subjected to unnecessary levels of pressure.

In similar research by Northport VA Medical Center (2008), the need for repetition of inquiries was emphasized. The authors explained that interaction with employees as a method of auditing CSFs is not successful if done only once;

employees require constant engagement by the organization. They observed that the creation of a previous interaction instance makes employees feel as if they have won a chance to contribute on the management's terms. They added that employees must feel free to point out CSFs at any point, at any level of administration, and at any time. Such an atmosphere creates the impression in employees that contribution is a deserved right rather than a gift from management.

In their investigation of CSFs, Olson and Singer (2014) explained that gathering ideas from employees about generic characteristics requires intensive follow-up. Mere inquiry provides limited information and yields only limited insight into CSFs. However, Olson and Singer (2014) observed that, just like repetition, follow-ups enhance employee and management confidence in the firm.

Ventrice (2009) reviewed literature that shows a preference for the creation of employee and management faith in an organization, pointing out that being genuine in the activities of an organization makes employees and management have faith in the projects undertaken. When they have confidence in the overall course the organization is taking, employees feel free to point out discrepancies and high points. Ventrice (2009) explained that a firm whose activities are genuine always succeeds when it asks its employees about CSFs, observing that the faith caused by individual events makes employees believe that the leadership is considerate of them. Ventrice (2009) also noted that employees feel part of the organization when they see themselves as being in a relationship that involves not only the provision of labor for remuneration but also the sharing of valuable insight.

The literature shows that outsourcing qualified human capital and resources is considered by many organizations, both private and governmental, as an effective means of completing their projects. While many private companies can afford to develop and hire their own R&D departments, government involvement is mostly limited to outsourcing these services, which has proved to be an effective method for project completion and producing innovative technology. While both private and governmental organizations can benefit from outsourcing, it has been shown that outsourced R&D projects are more common when the government is involved (Becker, 2014). The study of Cunningham and Link (2016) regarding the R&D practices of EU countries showed that business collaboration, both private and governmental, with universities increases the efficiency and effectiveness of investments and projects in certain fields, such as power management and distribution. They explained that obtaining the permanent services of these outsourced individuals and companies may be beneficial for the government in terms of delegating specific services, such as mass transportation and infrastructure. The process may be slower than in private companies (Doraszelski & Jaumandreu, 2013), but the output and the technology developed are still beneficial and have positive effects on long-term projects and goals.

In terms of consultation and information regulation models, both Tracy (2013) and Elegbe (2010) have offered accounts of the essential elements. Elegbe (2010) explained that each organization’s model should be structured in a way that fits its specialty and internal team. The correct structure for consultation and regulation should be created through consensus with employees to suit the local circumstances. Likewise, Tracy (2013) recommended that the implementation of new rules for consultation should be carried out with attention to the impacts it will have on arrangements that are already in place. Both Tracy (2013) and Elegbe (2010) agreed that a dedicated workforce has the chance to transform an organization’s CSFs and their identification.

According to Elegbe (2010), structures for employee consultation fall into several categories. An organization can put in place committees for general discussion. Elegbe (2010) claimed that a committee will ensure cooperation between various levels of the organization. Besides the provision of consultancy, the committee will be responsible for endorsement of the different files that are presented before its meetings. Moreover, the committee will be responsible for the distribution of the strategies resulting from its decisions. Elegbe (2010) also recommended the formation of joint working groups, so that the end decision is influenced by the input of employees and management in equal proportions. The focus in a joint working group is directed toward a single issue at a time. Elegbe (2010) stressed that this focus enables the team to intensify its research, analysis, and decision-making processes. Elsewhere in the literature, Tracy (2013) proposed the use of direct consultation, which involves the expression of personal and professional views by employees on particular issues. He explained that the achievement of direct discussion relies heavily on face-to-face communication. Whether communication is upward, downward, or lateral communication, Tracy (2013) claimed that face-to-face communication has a high success rate when it is used in opinion surveys.

In the literature presented by Weizsäcker et al. (2009) and Darity (2008) the importance of skills, qualifications, adequacy, and suitability of employees is explained. Weizsäcker et al. (2009) demonstrated how the skills of employees shape the progress and outcome of a project. Having the combination of the right competencies in the labor force makes for efficient assignment of duties and increases the success of division of labor and specialization. Weizsäcker et al. (2009) cited further benefits of division of labor and specialization, including less fatigue, more nurturing of talents, greater room for creativity, and easier monitoring. In

Darity's (2008) opinion, the right number of employees creates the right combination of inputs required for the project. Excessive supply leads to overcrowding and chaos, which cause delays and underemployment. Both Weizsäcker et al. (2009) and Darity (2008) were of the opinion that employees should be hired and assigned tasks on the basis of the suitability of their specialization to the specific field, so that the organization will reduce underemployment, increase outputs, and improve accuracy rates.

The study of Marchi (2012) equated continuous financial support of R&D with the highest level of cooperation they can provide to help the R&D department accomplish their goals. The study determined that the confidence and performance of the R&D team improves significantly if members are confident that the funding and support will continue.

It is well known that R&D projects demand skills that are not currently utilized by employees. These skills bring innovative ideas and open up business opportunities. In R&D projects, one important aspect is disruptive innovation and creativity. Project team members need to have enhanced skills with ideas that stand out from the mainstream. Therefore, staff members are required to be flexible in creating new products (Kulatunga et al., 2005).

One of the main challenges of R&D projects is uncertainty (Quelin, 2000). Moreover, most R&D projects have lengthy cycles, which delays the technological response of the organization in bringing innovation to market (Quelin, 2000). According to Quelin (2000), the solution to these challenges is improvement of core competencies within the organization. In other words, the presence of employees with high levels of competency ensures that uncertainty is clarified and that R&D cycles are shortened.

Liu & Tsai (2008) found that effective management of R&D requires project personnel to possess competency skills such as professional R&D technological skills, and that this helps them to apply their existing knowledge to new technological ideas. Moreover, they need to possess skills in IT, communication and coordination, leadership, organizing and promotion, and integration (Liu & Tsai, 2008). This creates an impression that staff capacity is critical in R&D success.

In support of the above conclusion, Lee et al. (2016) performed a correlation study in China, revealing that the employment of employees with innovative cognitive abilities creates a successful organization in terms of creativity and innovation. Moreover, the study showed that self-efficacy among employees led to creative activities in R&D programs (Lee et al., 2016). In summary, Lee et al. (2016) showed that possession of self-efficacy skills, innovative cognition, and competency–position fit contribute greatly to innovative performance in R&D projects. In support of this, Andre (2013) argued that the occupational and educational skills of R&D staff are highly relied upon in developing an effective intellectual property strategy. It is, therefore, justifiable to conclude that the possibilities of project success are limited in the absence of a highly capable R&D staff.

2.2.2.3 Disruptive Technology

The provision of disruptive technologies is based on the combination of opportunity detection, creativity, and resource conversion (Hang & Garnsey, 2011). In disruptive technology, new technology, at the initial stage, competes with criteria that are not yet used to measure performance (Selhofer et al., 2012). As such, it can be classified as new to the firm, new to the market, and new to the world (Selhofer et al., 2012).

Disruptive innovation offers problem-solving abilities, as well as enhanced abilities to develop new idea and opportunities (Hang & Garnsey, 2011). According to Ofori (2013), problem-solving abilities are among the critical factors in project management. It can, therefore, be argued that in the conceptualization and planning phases of project development, disruptive technology plays a critical role. The demand for organizations to shift from mainstream research is reinforced by disruptive forces. Disruptive technologies lead to new commercial products, as well as to industries that potentially change the world (Chien, n. d).

Importantly, disruptive technologies contribute to thinking outside the norms of product development or invention. As Chien (n.d.) suggested, disruptive technologies are composed of features that are not in the mainstream. The problem associated with mainstream innovation is that it focuses more on improvement than on new ideas (Chien, n.d.). As such, there is a lack of true innovativeness (Chien, n.d.). As mentioned above, the successful integration of the outcome of an R&D project outcome is innovation. As such, disruptive technology is a CSF, in that it promotes innovative and new ideas.

Using disruptive technology, R&D projects are able to break through the normal product or technological outcomes and to provide a new paradigm (Propp & Rip, n.d.). A new paradigm creates new business opportunities for the organization and the market (Propp and Rip, n.d.). With an expanded market or business opportunity, R&D projects will succeed, given that both these attribute are CSFs. Noticeably, innovation from disruptive technology requires effective integration of knowledge and information about the R&D project by the R&D project team (Ebrahim et al., 2009).

Actualizing the benefits of a technology often requires that it be bundled with investments in complementary intangible assets, such as appropriate skills, and that new, better adapted business models channel income to innovators, in addition to the already mentioned new forms of organization (OECD, 2017).

2.2.2.4 Project Feasibility

Weizsäcker et al. (2009) and Roberts (2007) explained how complexity, size, duration, and the number of people involved in a project can influence its success. In Weizsäcker et al. (2009)'s view, a complex project requires more technical input than a simpler project. The absence of resources to acquire the right technology and labor for a complex project could render it a failure. Roberts (2007) argued that a large project lasting for an extended period is at higher risk of losing focus on the primary goals; however, adequate monitoring and sufficient resources will see the project achieve completion. In his view, a project involving a large number of people will most likely succeed given that there are sufficient ideas and resources. Weizsäcker et al. (2009) disagreed, stating that a project involving a large number of people will cause conflicts of interest and may fail even before it begins.

In Baldwin and Hunter's (2014) study, budget was shown to be the primary concern of most stakeholders, especially those providing financial assistance. Communication involving monetary resources should be official, indicative of caution, and characterized by impeccable attention to detail. Specifically, Baldwin and Hunter (2014) explained that a budget should show exactly how a project should be funded; when presented before the people in charge, it should include contingency plans to eliminate the chances of falling short of resources in case of unforeseen circumstances. In a similar vein, Hughes (2016) recommended the use of comparative costs in convincing the various stakeholders. To gather financial resources, it is important that for a budget to identify discrepancies in the current way of doing things. Hughes (2016) explained that the creation of a separate budget for the present state of affairs and a new budget for the project and the projected status after completion will provide an effective comparison; in other words, figures will translate into conviction on the part of stakeholders.

Jain et al. (2010) simplified the essence of R&D project planning into three aspects: transparency, organization, and focus. To achieve transparency from the formulation and updating of a plan, it is vital to ensure that every detail is spelled out as it will be executed. They also found that the formulation of a plan is important to government, since financers may not be familiar with the technical aspects of energy R&D projects. However, detailed plans will enable the government and other stakeholders to be fully aware of what is involved, thus enhancing transparency.

The power of a project has been explained in detail by Jacobsen, Kress and Belcher (2008) and by Turner (2014). According to Jacobsen et al. (2008), a sound project should have a reasonable degree of feasibility. From a professional view, a feasible project shows signs of viable outcomes (at best) and redundancy (in the worst-case scenario). They added that conducting a feasibility study is vital to the project's success, since it reveals various weaknesses. Turner (2014) claimed that in the energy sector, research will only be feasible if the working hypothesis has a scientific basis or is mathematically correct. Otherwise, Turner (2014) and Jacobsen et al. (2008) agreed that adopting a non-feasible project is not only a waste of time and resources but a drawback for future R&D projects. Future projects will result to functioning with minimal resources and will attract suspicion from stakeholders if current projects are undertaken without positive results in the feasibility tests.

Government-funded R&D projects must show added value to the economy of a country to ensure successful sponsorship. Moreover, a level of ease and convenience in conducting the R&D project is necessary. Two factors that determine the ease of conducting a project are project size and level of difficulty.

Some R&D projects seem doable in the initial stages, but unforeseen difficulties can arise. Ricky & Murray (2013) indicated that one important consideration in project success is detailed and comprehensive planning that allows for potential difficulties. In support of this, Nagesh and Thomas (2015) found that the degree of difficulty of a R&D project plays an important role in project completion. Feasibility, which assesses project difficulty, is helpful in that it reveals the cost of dealing with the difficulty, potential alternatives, revisions, and replacement methods that will ensure the completion of project.

Chan et al. (2004) identified project-related factors that influence project success, for example, type of project, nature of project, complexity of project, and size of project. As such, continuing with a project depends on its viability. Since governments need evidence of viability that will allow them to fund and continue to support the progress of the project, feasibility is critical.

2.2.2.5 Realistic Schedules and Objectives

When making a schedule, Vaughan and Arsneault (2014) and Campbell (2009) recommended that flexibility should be prioritized. Campbell (2009) explained that flexible schedules allow for any changes that may occur, enabling contingency plans to be implemented without any distortions in the progress; in addition, realistic schedules are the perfect match for budgeting plans. Vaughan and Arsneault (2014) stated that a combination of practical programs and projects makes the entire project impermeable to surprise changes, loss of interest from stakeholders, and loss of motivation in employees. They argued that interested parties, such as upper management and sponsors, rely on schedules for evaluation. If the plans defy the projected path, the project risks losing their favor.

Miller (2006) clarified that envisioning a R&D project's goals is not enough to guarantee its success. Putting the goals into a realistic shape indicates higher chances of achieving the project. In an energy R&D project, the relationship between the beginning and ending should be spelled out before the project begins; that way, the objectives become clearer to all parties affected. Miller (2006) also claimed that clear goals are usually inclusive of contingencies. Emergencies require some level of flexibility on the project manager's part. According to Kern (2006), a clear statement of objectives should contain a communication mechanism for all stakeholders. He also indicated that the establishment of a solid plan of action will add to the clarity of the objectives, as will role assignment for all stakeholders in the R&D project (Kern 2006).

Springer (2013) and Oakes (2008) explored the importance of risk management in terms of plans, preparation, evaluation, and results. Oakes (2008) explained that plans for risk management cover all the identification processes for external and internal risks. The program includes the possibility of occurrence, proposed actions, and potential impact. Springer (2013) demonstrated the importance of preparation to effective response. By identifying and minimizing potential risks before they occur, the staff are able to respond in the best way possible when the risks actually occur.

Springer (2013) explained that having the perfect control mechanisms will not only enable R&D projects to be transparent but also ensure their success. Oakes (2008) added that monitoring requires that a project's leadership be skilled and motivated, arguing that the existence of a control framework may still be ineffective if the people implementing it suffer from incompetence, lack of personal drive, or self-interest. In related literature presented by Oakes (2008), the monitoring of timescales is discussed. Oakes (2008) emphasized that timelines and deadlines should not be allowed to slip, regardless of the circumstances, as this indicates failure in various aspects of the project. Both Springer (2013) and Oakes (2008) explained the importance of monitoring the project's finances. Both researchers recommended a monthly expenditure report including bank statements. Examination of such reports will reveal erroneous activities and save the project's finances from unauthorized or unnecessary use.

R&D projects are no exception, in that they require a planned schedule that shows all stages from initiation to completion. Project success is attributed to realistic schedules. Hussein and Klakegg (2014) examined problems linked with project success. In their study, they correlated various problems, including incomplete development of success criteria, unrealistic criteria, and ambiguity (Hussein and Klakegg, 2014). Notably, there were positive relationships between these variables, in that incomplete development of success criteria led to unrealistic criteria that caused ambiguity (Hussein and Klakegg, 2014).

R&D project planners should realize that unrealistic plans lead to misinterpretation of information, underestimation of project procedures, and overestimation of outcomes. Unrealistic schedules lead to unrealistic targets, which cannot be achieved even under ideal conditions.

An important attribute of project success is the appropriate use of an existing plan and schedule. In a study to examine the criteria for project success or failure, Attarzadeh & Ow (2008) found that approximately 5% of respondents believed that unrealistic timeframes and unrealistic expectations are obstacles to process success. Realistic schedules go hand in hand with realistic requirements. Tuzcu & Esatoglu (2011) argued that successful software projects require realistic requirement. Moreover, Glass (cited in Tuzcu & Esatoglu, 2011) indicated that optimism and unrealistic forecasting of projects leads to their failure. Unrealistic schedules demotivate project team members, and unrealistic forecasting leads to work pressure associated with delays in the schedule of activities (Tuzcu & Esatoglu, 2011).

Accurate schedules provide a realistic schedule and, according to Korzaan, (2009) this helps to reduce the cost of a project. With a realistic schedule, project managers and team members can detect any deviations from the schedule and resolve them (Korzaan, 2009). Interestingly, Mikulskiene (2014) suggested that some R&D projects require unrealistic plans, in the sense that unrealistic plans have a higher chance of stimulating better results. However, Realistic schedules, unlike unrealistic ones, where ensure a balance between the unrealistic goals that the project team wants to achieve and the goals that are achievable given the available time and resources (Mikulskiene, 2014).

In conclusion, it can be argued that a realistic schedule reduces the pressure to meet deadlines, allowing the project team to undertake the project without shortcuts (McGevna, 2012). This ensures the quality of the product, which are less likely to have defects (McGevna, 2012). With a realistic schedule, there is no delay in available resources, which means that projects are performed on time without being out of date (McGevna, 2012). Moreover, a realistic schedule ensures customer satisfaction, because the end-products are of high quality (McGevna, 2012). As such, there is acceptance of the end outcome in the market, which promotes the success of the project (McGevna, 2012).

2.2.2.6 Effective Communication and Change Management

Miller (2006) explained the importance of effective communication in four different respects: expectations, consistency, productivity, and outcome. He claimed that having a communication plan enables the project manager to establish ways for stakeholders to receive information and mechanisms for participants' communication, such as emails, meetings, memos, and telephone calls. He also recommended weekly updates about the progress in meetings.

Another effect of a communication plan discussed at length by both Sapienza (2015) and Kern (2006) is consistency. Sapienza (2015) explained that the robust nature of a communication plan makes an R&D project more consistent regarding handling. Sapienza (2015) also observed that the possession of similar information by all parties involved and regular communication among them makes the overall progress consistent.

In the reviews of the literature presented by Devey (2014), Dinkmeyer and Eckstein (2006), Krausert (2009), and Kouzes and Posner (2011), employee involvement, consultation, education, and direction were discussed at length. Dinkmeyer and Eckstein (2006) explored the nature of information flow in an organization. There are many ways of informing employees, but Dinkmeyer and Eckstein (2006) observed that most companies prefer downward communication as their primary form of communication. Additionally, it is standard practice to exercise cascading briefings with several representatives from various groups and ranks. Other methods recommended by Dinkmeyer and Eckstein (2006) include informal networking, electronic information distribution, newsletters, noticeboard information, and memos. In the introduction of information structures, Devey (2014) explained that the administration might want to consider several issues. First, data timing is of the essence, whatever form of communication is chosen. Second, making employees aware of changes that are forthcoming makes them prepared for any eventuality. Third, as Dinkmeyer and Eckstein (2006) pointed out, the impact of information cannot be felt without proper timing. Devey (2014) added that proper timing should be instilled into employees through training, education, and direction. Both Devey (2014) and Dinkmeyer and Eckstein (2006) agreed that time is an essential element in planning; in both studies, timing is valued in planning because it allows adjustments and accurate projections.

Sapienza (2015) asserted that progress toward the desired outcome is possible through effective communication plans, justifying this claim by the fact that the incorporation of the stakeholders' interests into the results of the project is only possible if there is constant communication. In similar research presented by Kern (2006), it was shown that communication is imperative to the specifications of the outcome(s).

Roberts (2007) and Andersen, Grude and Haug (2009) focused on the vulnerability to change of R&D projects. In the case of energy research in the UAE, change may occur at any phase of the project. Variable aspects include economic changes, political changes, and technological changes. Roberts (2007) asserted that any drastic changes will affect the project but that the effect is proportional to the rate of reaction. He explained that the management of changes is most useful when the project’s management is aware of the current state of affairs at every milestone. Likewise, Andersen et al. (2009) noted that having the support and involvement of all stakeholders makes the reaction to changes faster and more efficient. Moreover, Roberts (2007) and Andersen et al. (2009) emphasized the importance of communication as a tool for managing change. Having up-to-date knowledge about the progress of all members involved enables efficient implementation of contingency plans and reactionary strategies.

Kouzes and Posner (2011) claimed that it is vital to distinguish between the kinds of communication where employees are consulted and those where they are merely informed. Kouzes and Posner (2011) stressed that the perception that a meeting is an informative conversation will mislead employees into limiting their contributions, and the organization will end up losing out on the essence of employee input regarding the identification of CSFs. On the other hand, Kouzes and Posner (2011) explained that confusing information with consultation could create chaos in the communication channels.

A lack of response might also cause employees to feel that their input has been dismissed, (Dinkmeyer & Eckstein, 2006). However, a careful distinction will allow for appropriate responses and progress. Gower (2011) emphasized the importance of lateral communication, asserting that lateral communication intensifies employee contribution because it depends on the establishment of mutual interests by employees who share the same rank in an organization. It is easier to offer compliments, make observations, and make criticisms among people of the same level than it is under a hierarchical arrangement. Gower (2011) explained the preference for lateral communication in terms of absence of judgment and fear of victimization, scrutiny, or dismissal.

Project team members need to trust each other to enable a high degree of execution of duty. Team trust is dependent on the quality of communication (Heinz et al., 2006). Effective communication boosts team morale and offers clarification of goals, tasks, and responsibilities (Heinz et al., 2006). It is well documented that collaboration is important in the success of R&D projects and that the latter is mediated significantly by effective communication (Nagesh & Thomas, 2015). For an R&D project to succeed, there is a need for project management success, product success, and market success (Nagesh & Thomas, 2015).

The links between the attributes in this section require effective communication (Nagesh & Thomas, 2015). For example, effective communication is required at all stages, from budgeting through the technical specification of product to market share (Nagesh & Thomas, 2015). Ofori (2013) concurred that communication is a CSF of R&D projects; he found that effective communication and lack of effective communication were facilitating and mitigating factors for R&D project success. Moenaert et al. (1994) hypothesized that the dissemination of external information from marketers to R&D personnel during product development promotes project formalization, an interfunctional climate, and role flexibility. They justified this hypothesis, showing that effective communication (1) promotes the following of project rules and procedures, (2) encourages a positive degree of interest, trust, awareness and support, and (3) enables project team members to perform extra functions beyond those of the project. As such, it can be concluded that transfer of information (communication) contributes positively to the commercial success of an R&D project (Moenaert et al., 1994).

According to Barragan-Ocana & Zubieta-Garcia (2013), effective communication between project members and clients promotes the interpretation of technological needs for the project. In R&D projects, there may be conflicts between members and various stakeholders, and resolving these conflicts requires communication. In this connection, Alias et al. (2014) argued that adequate communication channels are CSFs for R&D projects, in that they help to resolve conflicts between participants. According to Yang and Kassekert (2009), effective communication maintains the support and commitment of all R&D stakeholders. Effective communication allows a collective understanding among team members, and this enables them to work as a unit. Passage of up–down and down–up information is crucial for smooth project management and, consequently, for project success.

2.2.2.7 Client Involvement

In a case where the project involves research that affects citizens and the national economy, Brafield and Eckersley (2008) explained that the people and the government are clients by default. They argued that orchestrating the involvement of the customer constitutes some of the essential phases of any R&D project, and they emphasized that the project’s success should involve rewards, risks, teamwork, determination, discussions about money, and client inquiries. Mosey and Wiley Inter Science (2009) recommended scrum methodology for follow-through to clients, as it enables the project management to keep customers on board regarding progress through, for example, scrum sprint meetings. They added that informing clients of the rewards accrued on completion of the project will ensure they remain on board. Likewise, Brafield and Eckersley (2008) explained that it is important to make clients aware of risks that are involved in the project, as this enables the management to retain the support of customers in case the risky situation is actualized. Brafield and Eckersley (2008) and Mosey and Wiley Inter Science (2009) agreed that client support is vital in the formation of a team of stakeholders for a project; both explained that teamwork cannot be achieved without the clients being on board with the way the project proceeds. In particular, Brafield and Eckersley (2008) have shown that encouraging the client ask questions about the research will make them get involved and take a share of responsibility for the backlog of outcomes.

Research by Jonasson (2008) indicated that stakeholder support is crucial in the formulation of a communication plan. For any size of project, communication with interested parties enables the project's course to be adjusted when there is any deviation from the plan. Additionally, the alignment of project ideas with the organization's goals can be restored through effective communication and championed through the gathering of support. Jonasson (2008) summarized his argument by observing that the process of gathering support enables the project managers to gather the information they need, since the interaction is usually very informative.

The process of gathering support consists of four basic steps. These include surveying involved parties, presenting the budget, providing choice, and fitting in stakeholders' goals (Hughes 2016). Hughes (2016) recommended that before a project begins, information about the parties involved in it should be gathered. With the right information, building a case for the project becomes easier. Information will often point out the necessity of a project to the right parties in the right manner. Jonasson (2008) agreed with Hughes (2016), citing as an example the implementation of flexible scheduling in the workplace. Surveying employees and noting relevant logistics regarding their work/life balance will enable the flexible time project to be a success by gathering employee support.

In terms of the process of decision-making, the Association of Energy Engineers (2011) indicated that a leader must base conclusions on metric evidence, budgetary effects, deadlines, and political impacts. Cox (2009) agreed, arguing that it is not enough to demonstrate consideration of parameters, budget, politics, and deadlines; a leader must be able to gauge the effects of decisions on stakeholders and on various aspects of the project. Perhaps more important is the aspect of creativity. In the Association of Energy Engineers (2011)'s literature, the perfect leader is depicted as one who does not hurry to make decisions just because they look comfortable. Cox (2009) explained that a leader desires to achieve a win–win scenario at all times; moreover, a great leader is always ready for collaborative efforts in the course of the project.

In R&D projects, especially those involved in new product development, clients are an important source of information. They provide input that ensures the product will be integrated successfully into the market. There are different types of clients with different needs. Therefore, it is futile not to consider their input in a R&D project that is expected to develop a new product for the client's (customer's) use. However, according to Majava et al. (2015) involvement of customers in projects depends on the project itself. In new product development, for instance, customer involvement is limited, since there is no link between the existing product and the new product in terms of need (Majava et al., 2015). However, in R&D projects that change the attributes of an existing product, customers are involved in providing insight into what is lacking and what needs to be changed (Majava et al., 2015).

Customer involvement leads to the satisfaction of the project goals. By being part of the project, customers feel useful and appreciated in terms of their opinion, and this results in acceptance of the overall outcome. Considering that the existence of clients for the end-product of R&D projects dictates the availability of a strong market, it is imperative to include their involvement during all phases of the R&D project. In support of the above comments, Hooge and Dalmasso (2015) conducted a longitudinal study to examine the involvement of stakeholders in engineering R&D organizations. The study clearly showed the importance of stakeholder involvement in R&D projects, suggesting, however, that this is highly dependent on the legitimate perception of organization owners (Hooge and Dalmasso, 2015).

In R&D projects, the outcome might be different from that expected by clients (Tuzcu & Esatoglu, 2011). Therefore, it is essential to allow user participation so that the critical requirements of the project are supported by users, leading to its success. From a personal perspective, client involvement creates confidence in R&D project members, in that they have a detailed requirement portfolio of the anticipated product. Moreover, there is confidence that the probability of the final outcomes of the R&D project not being accepted in the market is low. With the expectation of a strong market, the success rate of the R&D project is high.

2.2.3 Features of R&D

Common features characterize R&D activities, even if these are carried out by different performers. R&D activities may be aimed at achieving specific or general objectives. R&D always seeks new findings based on original concepts (and their interpretation) or hypotheses. It is largely uncertain about its final outcome (or at least about the quantity of time and resources needed to achieve it), it is planned for and budgeted (even when carried out by individuals), and it is intended to produce results that can be freely transferred or traded in a marketplace (OECD, 2015). For an activity to be an R&D activity, it must satisfy five core criteria, namely being (1) novel, (2) creative, (3) uncertain, (4) systematic, and (5) transferable and/or reproducible. All five criteria are to be met, at least in principle, every time an R&D activity is undertaken, whether on a continuous or occasional basis (UNESCO-UIS, 2014).

The term R&D also covers three types of activity: basic research, applied research, and experimental development. Basic research is experimental or theoretical work undertaken primarily to acquire new knowledge of the underlying foundations of phenomena and observable facts, without any particular application or use in view. Applied research is original investigation undertaken in order to acquire new knowledge. It is, however, directed primarily toward a specific practical aim or objective. Experimental development is systematic work that draws on knowledge gained from research and practical experience and that produces additional knowledge, which is directed to producing new products or processes or to improving existing products or processes (OECD, 2015).

2.2.4 Importance of R&D for Economic Growth

Khan's (2015) review of theoretical and empirical studies relevant to the role of R&D in economic growth of countries around the world found agreement on the significant role of different forms of R&D in productivity and economic growth. Khan concluded that developing countries should concentrate on R&D to achieve sustained economic growth.

Accordingly, researchers went through scholarly investigations that observed several contributions made by R&D to the economic situation. Blackburn et al. (2000) observed that R&D leads to inventions and innovation, which improve the quality of manufacturing and updating of existing technologies. It is well known that accumulation of skills and knowledge for people in an economy is essential for economic growth. Frantzen (2000) supported the view that R&D plays a significant role in total factor productivity; he found that both domestic and foreign R&D had a significant impact on total factor productivity, but the impact of domestic R&D played a more significant role in growth in richer countries than in smaller economies. Zeng (2001) developed a multi-sector dynamic general equilibrium growth model to view the role of innovation and imitation in economic growth, showing that subsidy to innovation will drive economic growth and that subsidy to imitation will move it in the opposite direction. Chou (2002) examined the contribution of R&D to the Australian economy using country-level data for the period 1960–2000. His model showed that long-term steady-state growth is the result of local as well as global R&D of new ideas. He concluded that the growth of Australian per capita income was not entirely due to factor accumulation but also due to enhancing the efficiency of transformation of inputs into outputs; the Australian economy is expected to continue its growth, and R&D will continue its role in that growth. Jones (2002) introduced the world of ideas into his growth model. This model states that the economic growth of an economy in the long run depends on globally developed ideas. The hoard of ideas is directly proportional to worldwide research and to the population of the economy concerned.

Lee (2005) assessed the Korean economy using methods of growth accounting and level accounting, showing that the output-per-worker gap between Korea and the United States had fallen over the previous three decades. The study suggested that the Korean economy should increase R&D expenditure for innovation in technology and improve the quality of education in order to achieve the desired level of growth.

Improvements in political, cultural, and social institutions have been recommended to achieve sustained rates of economic growth. Ornaghi (2006) analyzed the role of knowledge spillovers in the productivity and demand of firms. Grossman (2007) developed a model to find the contribution to economic growth of R&D subsidies and publicly provided science education. The study concluded that R&D subsidies may not contribute to economic growth and public welfare and that intertemporal knowledge spillovers are the externalities of firms' expenditure on R&D. Subsidies to R&D increase income inequality. The model confirmed that publicly provided education intended to increase skills in science and technology will contribute positively to the economic growth of a country. Therefore, as public education contributes to economic growth more efficiently than R&D subsidies, it was suggested that R&D be developed through the promotion of public education of scientists and other skilled workers.

Falk (2007) developed a dynamic empirical model to identify the significance of R&D investment in the long-term economic growth of OECD countries using a panel data set. The study provided new evidence for the relationship between R&D and economic growth, and its results were derived through a generalized method of moments. The study investigated whether higher R&D investment pushed economic growth while keeping constant the ratio between investment, industrial R&D intensity, and human capital. Five-yearly and ten-yearly averages were used. Higher R&D investment was found to be positively related to GDP growth in working-age populations. The results were robust in both the five-year and ten-year cases.

Goel et al. (2008) considered the trends in various components of R&D and its contribution to economic growth in the USA by using half a century's worth of disaggregated data. Surprisingly, the USA experienced a decline in outlay on defense R&D and in federal R&D expenditure, although non-federal R&D funding grew sharply during the period. The estimation showed a strong association between economic growth and federal R&D expenditure rather than non-federal R&D outlay. Economic growth showed a strong relationship with defense R&D instead of with non-federal R&D. The study proposed a substantial increase in defense R&D and non-federal R&D for sustainable economic growth in the USA.

Kuo and Yang (2008) examined the effects of knowledge capital and technology spillover on regional economic growth in China. The results showed that R&D, capital, and technology imports contributed significantly to economic growth in China. The elasticity of R&D to economic growth was as great as that of technology, showing the same contribution to the country's economic growth. The study suggested the existence of R&D spillover as well as international knowledge spillover. Tax incentives, financial assistance, and R&D grants may therefore be helpful tools for encouraging research activities and innovation in the economy.

Sterlacchini (2008) conducted a study to determine the association between regional disparities in R&D and higher education with regional economic growth. The data were taken from 197 regions of 12 European countries for the period 1995–2002. The empirical evidence indicated a positive and significant impact of knowledge, educational attainment, and intensity of R&D expenditure on economic growth in these European regions. The results showed that equal growth opportunities in regions of the European Union (EU) may not be achieved only by providing investment in public and private education. R&D expenditures were found to be significant only in the most developed regions of the EU. Therefore, to obtain the benefits of innovation and knowledge, public support for higher education and R&D can be an effective tool. The study concluded that the weakness of the relationship between public universities and business firms may be one of the most important reasons preventing EU regions from reaping the rewards of R&D and higher education.

Jin (2009) used the Granger causality framework to analyze the causal relationship between rising research productivity and economic growth in five Asian countries. The relationship was found to be bidirectional in Hong Kong, a small open economy offering numerous kinds of services and tertiary education, which may have a direct and immediate effect on services in management and other sectors. In Japan, the relationship was unidirectional from economic growth to research and productivity. In Korea and Taiwan, research productivity caused economic growth during the study period. Singapore, with its relatively small number of higher education institutions, had a limited number of publications; for this reason, the relationship between research and economic growth was not significant there.

Mohnen (2018) showed how R&D can contribute to productivity growth and (indirectly) to economic growth. R&D efforts, especially when they are carried out on a continuous and systematic basis, can lead to new processes, new products, new ideas, or higher absorption capacity. New processes can save on the use of certain inputs, thereby increasing productivity. Moreover, average cost reductions can be transmitted into lower prices, which can increase demand for existing goods and (indirectly) productivity by an expansion of demand that unleashes unused capacity, produces economies of scale, and increases learning by doing. New products or services can increase the utility of consumers, creating demand that in turn can give rise to economies of scale or can give downstream producers a larger number of intermediate inputs to choose from, thereby increasing their production efficiency. New ideas can be sold on the market for knowledge (like an additional good), or they can increase the stock of knowledge, allowing firms to be more receptive to the new ideas that are available or that have been developed by others.

2.2.5 Importance of R&D in Business Development

As theoretical and empirical studies have reported the role of R&D in the economic growth of countries, its effect on business development has also been illustrated.

R&D studies have shown that business development relies on R&D to develop future strategies and new products and services in order to maintain their relevance in their markets (Block, 2012). A study of Belederos et al. (2014) claimed that innovation remains a fundamental function of R&D for ensuring that a business continues to obtain revenue from the products and services it is known for. Belederos et al. (2014) also explained that while the discovery of groundbreaking technology may occur in a specific field, the overall objective of increasing revenue and maintaining services should be the core objectives of R&D. This finding is consistent with the findings of Frishammar et al. (2012), who found that the commercialization of technology was the most efficient use of R&D management, and with the study of Tassey (2012), who determined that R&D investment is a necessity for smaller, already established organizations to ensure their processes remain relevant and appropriate.

Zúñiga-Vicente, Alonso-Borrego, Forcadell, and Galán (2012) highlighted the importance of R&D to collaborations between government and business and in government-managed companies in ensuring that an organization successfully provides a service or product based on a fixed budget and financial goals. They demonstrated that government funding for R&D is focused on discovering new technology to make existing products and services remain cost-effective, implying that innovative R&D findings ensure that a product or service remains available as long as it is needed. This finding was corroborated by a study by Fu, Chang, Ku, Chang and Huang (2014), who explained that government involvement changes the focus from company revenues to ensuring that a proposed project or venture will continue to meet its intended purpose using innovative technology to maintain and update existing business.

According to these studies, the importance of R&D in business development stems from the belief that innovation ensures the fluidity and adaptability of companies for the future. Government and private organizations achieve this fluidity in different ways, with the former focusing on ensuring that a funded project remains relevant and fulfills its purpose for the future, while other organizations are more focused on maximizing revenue by improving the efficiency of their practices and developing new products to sell.

Organizational innovation, which can lead to improved market share and increased revenue, is directly related to proper R&D funding allocation, and proper R&D support can lead to sustained growth for a company (Block, 2012). According to Takalo et al. (2013), companies that invested in R&D experienced sustained growth in terms of increasing their revenue and supply chain over a period of years after the R&D findings were implemented by the company. Zúñiga-Vicente et al. (2012) had similar findings in terms of R&D initiatives funded by governments in state-run organizations. Likewise, Belderbos et al. (2014) explained the significance of R&D in the success of a company, highlighting its major contribution in their review of collaborative practices between different departments within successful companies.

2.2.6 R&D Practices

The Crown Prince of Abu Dhabi and Deputy Supreme Commander of the UAE Armed Forces has approved a development plan called “Ghadan 21”. It worth AED 50 billion for the Emirate of Abu Dhabi in a three-year development accelerator program in which AED 20 billion is to be allocated to the 2019 development package (Khaleej Times, 2018). The first phase of the program includes over 50 initiatives that reflect the priorities of citizens, residents and investors, and the aim is to enhance the competitiveness of Abu Dhabi on the basis of four main tenets: business and investment, society, knowledge and innovation, and lifestyle. The objective of the first tenet is to stimulate business and investment and to promote economic development in Abu Dhabi by creating an attractive and conducive environment for enterprise growth, encouraging competitive work environments, developing the private sector and small medium enterprise growth, and stimulating industry projects (including the renewable energy sector). Society, the second tenet of Ghadan 21, aims to develop the UAE community by ensuring the employment of its citizens, launching housing projects, offering quality education at a reasonable cost, and establishing social welfare and other development initiatives to ensure that UAE citizens are well provided for. The third tenet focuses on developing the knowledge and innovation systems in the Emirate by encouraging emerging companies in the field of technology, attracting talent to Abu Dhabi, supporting R&D centers, and training and developing talent and expertise. Building a knowledge-based society and economy will contribute to Abu Dhabi's progress in indicators of global innovation and knowledge-based economies; these, in turn, will ensure the sustainability of the Emirate's growth. In terms of the lifestyle tenet, the objective is to enhance the quality of life in Abu Dhabi by ensuring the participation of individuals in recreational, cultural, and sporting initiatives, as well as by developing infrastructure, including transportation, communication, and urban development (Trade Arabia, 2018).

The Ghadan 21 program grew out of the continued participation of the Abu Dhabi government in R&D projects where there was a need to determine CSFs that project managers ought to embrace to ensure successful project completion (Byat & Sultan, 2014).

Abu Dhabi has made significant efforts to shift its energy needs and its image in the international community by investing heavily in knowledge-based industries and projects through R&D. Henni (2015) publicized the vision of Abu Dhabi, explaining that the Emirate seeks to make the transition from being a hydro-carbon-based economy to being the home of knowledge-based industries through collaboration with academics and private industry. His report emphasized the effectiveness of outsourcing R&D, a process in which knowledgeable human resources are hired by the government as consultants to achieve a common objective. Other studies, by Ferroukhi, Ghazal-Aswad, Androulaki, Hawila and Mezher (2013) and by Ansari, Haroun, Rahman and Chilingar (2015), have indicated that Abu Dhabi has invested heavily in R&D projects in different industries to help shift away from carbon-based fossilized energy sources and toward green energy.

According to Probert, Connell and Mina (2013), the large scale-use of academic human resource is mostly seen as a positive practice when the government is involved in R&D projects, provided that the government has the resources to hire external consultants. Therefore, the innovation program spearheaded by the government in the UAE, under the three main pillars of financial capital, technological capital, and human capital, has provided a means for government involvement in R&D (Byat & Sultan, 2014).

Using the pillar of financial capital, the government of Abu Dhabi has actively funded various state projects to foster an innovative ecosystem and to promote economic development. For instance, the Khalifa fund and the Expo 2020 Partnership Fund require successful management to ensure that they are utilized efficiently for the achievement of their intended purpose (Byat & Sultan, 2014). The available evidence confirming government involvement in funding the R&D projects influenced the decision to evaluate the effectiveness of key stakeholders in ensuring successful implementation of the projects.

All of these studies show that Abu Dhabi is an attractive place for the R&D market, with the government itself showing a willingness to fund R&D projects in its bid to shift its energy needs. The studies also show that Abu Dhabi has recognized the value of academia and of other individuals with similar talents and knowledge, and is making efforts to hire them to help improve the country. The review of the literature shows that, properly used, R&D is an effective tool for encouraging future innovating and may serve as an important CSF for future development.

In 2005, the UAE ratified the Kyoto Protocol to the UN Framework Convention on Climate Change (Alnaser & Alnaser, 2009), making it the first of the principal oil-producing countries to do so. Abu Dhabi has also come up with the most comprehensive initiatives in clean energy to date (Shin, Ouarda, & Lee, 2016).

Each of the emirates has control over its own oil resource development and production. The Abu Dhabi government tends to involve private sector investment in gas and oil exploration as well as in production (Al-Amir & Abu-Hijleh, 2013). It did not nationalize the holdings of investors from foreign countries during the period of nationalization that swept the global gas and oil industry in the mid-1970s (Radhi, 2010). Abu Dhabi continues to benefit from and to promote R&D by means of the high levels of private investment in the country. Currently, international companies from the most developed countries, including Britain, France, and Japan, hold combined equity stakes of more than 50 percent in Abu Dhabi oil concessions (Shin et al., 2016).

Having an R&D program gives the government leeway in supporting renewable energy technologies and, thus, in increasing the deployment of renewable energy commercially (Alnaser & Alnaser, 2009). There are significant R&D payoffs for the oil sector of Abu Dhabi, as it accounts for over 5.5% of the total proved reserves in the world. A recent survey carried out by Gulf Intelligence noted that by creating a national research council, the UAE has made significant progress toward the achievement of a recovery rate of 70% in the target oil reservoir (Karmakar, 2014). Given the natural gas and oil reserves and the great competitiveness of technologies of conventional energy supply based on gas and oil, energy in the GCC countries, including the UAE, has significant characteristics (Alnaser & Alnaser, 2009).

R&D is crucial in advancing the efficiency of energy through promotion, creation, and commercialization of new technologies and practices that are energy-efficient (Doukas, Patlitzianas, Kagiannas, & Psarras, 2006). Different institutions such as universities, governments, and utility funds implement R&D programs to ensure advancement in energy-efficiency (Karmakar, 2014). The research programs that help to secure efficient use of energy include improvements in energy-saving technologies and their deployment through partnerships.

Economic well-being and economic vitality depend on safe, reliable, and affordable energy. In today's world, the way energy is used and the type of energy that is used are changing continuously. For the UAE to benefit from the status quo and achieve its energy and climate goals at minimum cost, it needs innovation. Impartial, rigorous, and impartial R&D can diversify the energy portfolio of the UAE and move its energy to a different level (Doukas et al., 2006). Innovations brought about by investigation and development can generate the energy that people use in ways that are less costly, more reliable, and safer.

Most countries have invested money in the deployment of existing technologies rather than the development of new technologies. The private sector is best at handling the deployment of existing technologies (Alnaser & Alnaser, 2009). In situations where the technologies to be used are viable, the private sector will find it easy to deploy them. The private sector does not involve itself in uncompetitive technologies. It is, therefore, of great importance for the public sector to invest in the R&D of more efficient types of energy (Karmakar, 2014).

R&D efforts can address some of the market failures facing the use of new energy-efficient technologies (Krane, 2014). Private industry may be fragmented into given sectors to finance R&D for energy-efficient systems (Alnaser & Alnaser, 2009). In addition, deployment time frames may be long, or the risk of investment may be too high for any given business. The return that is projected for a particular application of energy may be less than for non-energy investment. Industries can, however, benefit from and share the risk of the R&D that the government provides.

Energy use in the UAE has increased by about 4 percent in the last six years. There are projections that consumption is likely to increase by a further 5 percent by 2020. In the past 10 years, electricity consumption has doubled at a rate that will be hard to sustain in the long term (Islam, Kubo, Ohadi, & Alili, 2009). One measure that the UAE has put in place is sustained energy consumption. This type of strategy could lead to reductions in the consumption of electricity and could be implemented quickly at very little expense (Krane, 2014). Reducing energy consumption has many advantages; it could safeguard the reserves of the UAE, reduce the energy bills of end-users, assist in the management of constraints on infrastructure, and reduce potential burdens regarding subsidies (Mezher, Dawelbait, & Abbas, 2012).

The UAE has taken several steps in R&D to ensure that it meets the energy needs of its people and has invested its resources in ensuring that it achieves its R&D goals (Doukas et al., 2006). Programs have been put in place to ensure that the technologies that are used are efficient and that new technologies are deployed. Examples of these programs include smart cities, building efficiency, water usage, and the four strategic priorities. The urban population in the UAE is expected to continue increasing. The UAE should, therefore, integrate its infrastructure planning as an important element in any urban master plan (Mezher et al., 2012).

One of the approaches that the country has put in place through R&D is the smart city that takes advantage of big data and digitalization. Although the smart city does not have any agreed definition, it involves integrating infrastructure planning and using digital technologies to provide better services and to reduce the consumption of energy in the UAE (Doukas et al., 2006). Research into the utilization of smart cities is underway, although it is still in the early stages, and the improvements in urban design and the total sustainability of the initiative are yet to be measured (Mezher et al., 2012). The transition to smart cities involves overcoming pressure from habits and technologies that have been in use for a long time (Karmakar, 2014). The change also needs the implementation and development of coherent governmental policies to deal with the changes that smart cities bring. Most researchers have agreed that smart cities are likely to improve energy efficiency.

Through the adoption of a comprehensive approach, smart cities will enable planners to improve effectiveness at the point where different sectors meet, such as water, transport, and electricity (Mezher et al., 2012). The number of smart cities is expected to increase all over the world. One of the advantages of electrical grids is that they can monitor usage and, therefore, encourage efficient consumption habits (Mezher et al., 2012). For instance, the demand for electricity in Abu Dhabi has been growing over time. To respond to the increased use of electricity, the government in Abu Dhabi has provided an advanced metering system that offers different functionalities. This has encouraged the customers to consume less or to shift their consumption to off-peak hours. Dubai has put several programs in place, including smart metering, to reduce its consumption of electricity. Other measures include the generation of energy onsite so that loss during transmission is reduced (Shin et al., 2016).

One of the crucial aspects of smart cities is transportation. This is an area where R&D has made dramatic advances. The UAE has 16 power-charging stations currently in use for electric vehicles, and it expects to have more than 100 in the next few years (Lu, 2002). The smart vehicle is part of the energy solution, but the UAE needs to address other challenges, such as fuel efficiency and the emissions that come from imported cars.

The UAE has also invested in building efficiency, commonly known as sustainable or green construction. This refers to structures that are built and designed with improved energy-efficiency as the major constraint, a concept that will reduce the environmental impact of the buildings and improve the lives of other residents (Mezher et al., 2012).

The UAE has put many building efficiency measures in place. The Estidama program regulates the design, operation, and construction of buildings through a system of approvals at various phases (Mezher et al., 2012). The program also has an assessment scale, which is called the pearl rating system and which measures the sustainability performance of the communities involved as well as the buildings.

District cooling is another measure with substantial potential to increase the energy efficiency of UAE urban areas. The cooling of buildings currently accounts for more than 50 percent of the peak electricity load. The system is network-based and uses centralized infrastructure to provide conditioning and air to several buildings simultaneously. This type of system has been found to be more efficient than previous methods of air conditioning because it improves the availability of the cooler air. In UAE, different authorities are carrying out research into ways to mandate and to regulate district cooling (Ma, 2006). This type of technology should be considered in any new urban planning.

Water use in the UAE consumes about 30 percent of the power generated in the country. This is because of problems with the way the country obtains its water. Most of the water used in the UAE is produced as a byproduct of thermal energy plants through the combined power and water infrastructure (Al-Amir & Abu-Hijleh, 2013). The demand cycles of these two resources are different, the demand for water being quite flat while the demand for electricity has large peaks. Because of these different cycles, the infrastructure cannot be optimized for either of the resources. When it comes to recycling and reclaiming water, the UAE is under major constraints (Mezher et al., 2012). Recycling reduces the country's reliance on desalinated water; however, the infrastructure for recycling is insufficient, and the leakages lead to substantial losses.

One of the changes that will focus on this problem is the introduction of nuclear energy, which will become the primary source of power in the UAE. Recycling could also reduce the country's reliance on desalinated water (Shin et al., 2016). The country, however, does not have sufficient infrastructure for recycling, and leakages lead to further losses. To reduce this problem, nuclear energy needs to be introduced (Mak, 1997) to break the relationship between water and the electrical infrastructure. This will create opportunities to use more efficient technologies, such as reverse osmosis (Mak, 1997).

To address these market challenges, policymakers must come up with an integrated strategy for managing electricity and the generation of water and its distribution (Mezher et al., 2012). Part of the strategy is the selection of treatment technologies that are in line with the requirements of production. From the discussion of this sector, it can be observed that the UAE has the capabilities and the opportunities for more development in which decision-makers will have to rely on R&D to compete effectively.

2.3 Critical Success Factors

2.3.1 Definition of Critical Success Factors

The definition of CSFs differs depending on how they are used and applied in businesses and analytics (Gomes, et. al, 2012), although the most common definition

(Fu et al., 2014) characterizes them as any identified variables that contribute to the success of a project or initiative in meeting its set goals or mission. This definition applies to all factors and variables that are considered to be key components of a strategy that increase its chances of success and to variables that make a strategy more viable than the alternatives (Robertson & Wooster, 2013).

CSFs are critical areas that an organization must accomplish to achieve its mission by examination and categorization of their impacts into dramatic gains in business performance (Alghamdi, Alfarhan, Samkari, & Hasan, 2013). Therefore, they represent the minimum key factors or sub-goals that an organization needs, and which together will achieve the mission.

Chen (2011) identified CSFs as the small number of things that must go well to ensure success for a manager and/or organization. They represent managerial areas that must be given special and continual attention to ensure high performance. There are several methods and techniques for determining CSFs, including environment scanning, industry structure analysis, opinions of experts in the industry, analysis of competitors, analysis of the industry’s dominant firm, and a specific assessment of the company.

CSFs are also used to measure the success of a strategy or project. Alvani, Bemanian, & Hoseinalipour (2014) explained that CSFs are often used in building maintenance to evaluate a completed project, either to validate its success or, where a strategy or project has failed to accomplish its goals, to identify areas for improvement. The same definition is used by Gomes et al. (2012) in the area of strategic mergers and acquisitions, stating that pre-acquisition and post-acquisition factors are evaluated to determine whether a merger has been a success.

2.3.2 CSFs in R&D Projects

Various research has been conducted into the importance of identifying CSFs before the start of a project. Camilleri (2011), Centre for Volunteering (2008), and Carter, Cook and Dorsey (2011) have presented literature regarding the auditing of CSFs by staff and management. Their research has indicated that an audit of CSFs will provide a mechanism for measuring variances of opinion within the organization. Moreover, it has been generally noted that checks carried out in the presence of relevant data enable an organization to benchmark its position relative to its competitors. The incorporation of a future element into the audit is also of value, since it will reflect on future scenarios for any undertaking. A final point of consensus is that reviews of CSFs are motivating for staff and management, thereby improving their performance capabilities.

R&D projects funded by governments have faced numerous challenges in trying to clarify various factors contributing to their success (Yamazaki et al., 2012). Regardless of these challenges, Yamazaki et al. (2012) found that the key objectives for these projects must be clear and that public funds should be utilized in an efficient manner to ensure project success.

Project managers need to identify all possible success factors to be observed. Numerous studies on the CSFs of managing government-funded have been conducted by different scholars on a variety of R&D projects at different times, and the findings have been consistent (Ofori, 2013). For any R&D project to be successful, there has to be proper process management. Various factors, such as adequate communication, effective transfer of technology, thorough assessment, and feasibility studies, have been identified as important in ensuring the success of government-funded projects in the UAE (Alhashemi, 2008).

Various researchers, including Gibson (2011), Jain et al. (2010), Miller (2006) have covered CSFs in the management of R&D. In all the research reviewed here, a number of factors are common: support from upper management; clear and realistic objectives; excellent communication; detailed and updated plans; client involvement; effective change management; skills, suitability, sufficiency, and qualifications of staff; the competence of the project manager; the soundness of the project's basis and the strength of its business case; adequacy and allocation of resources; real leadership; use of familiar/proven technology; realistic schedules; the involvement of a project champion/sponsor; assessment, addressing, and management of risks; effective control and monitoring; appropriate organizational culture, adaptation, and structure; adequate budget; good performance by contractors, suppliers, and consultants; provision of training; planned closedown/review/acceptance of possible failure; political stability; previous experience of project management tools and methodology; previous relevant experience in terms of project complexity, size, duration, and number of people involved; and the involvement of different viewpoints.

To understand the specific CSFs that affect R&D projects, the researcher classified them into internal and external factors, as discussed in the sections that follow.

2.3.3 External Organizational Factors Affecting R&D Projects

Several external factors that affect organizations have been identified by Ermisch (2016), Goldstein (2016), Hámor and Rosta (2016), and Mohr (2014), who emphasized the influence of customers, the economy, the government, competition, and public opinion on a project.

2.3.3.1 Economic Analysis

Goldstein (2016) explained the nature of the environment regarding economic changes and their influence on an organization. The research pointed out that the manipulation of the economy is challenging, but adjustments are a possible solution. Additionally, Goldstein (2016) recommended that the best way to cope with economic changes is through changing the internal structures of an organization to fit the changes.

More compelling research by Ermisch (2016) examined economic changes in a single country, in a business domain, and in the entire global economy. Ermisch (2016) explained that analysis of the economy as an external factor is imperative when there is a genuine concern about the potential economic impact of a proposed project. He focused his research on the economic impact on output. Output analysis involves examination of the total production in the context of the organization or project in question. A good example given by Goldstein (2016) is the sales revenue for business or research results by a R&D team. Conservative approaches by Doshi (2015) and by Hámor and Rosta (2016) have used the value-added impact to estimate changes in gross regional product (GRP). The research by Doshi (2015) adopted a more convincing approach, with its emphasis on the examination of the size of the local economy. In creating a clear view of the local economy, Hámor and Rosta (2016) argued that gross domestic product (GDP) enables the project management to understand the kind of environment in which to establish a project.

A similar study by Shucksmith and Brown (2016) focused on the relationship between GRP and GDP. The noted that the two approaches by Doshi (2015) and by Hámor and Rosta (2016) showed the size of the local economy and that they were equally accurate methodologies. However, Shucksmith and Brown (2016) observed that there is a risk of overstating the economic profits during transfers across various national economies when using the GDP approach. Therefore, they suggested a measure of labor income impact to gauge the extent of the economic consequences.

Doshi (2015)'s approach used the increase in wages paid to local employees as a key economic indicator. Increases in income may result from union campaigns, legislation, or the employment of previously unemployed people (Doshi, 2015). Henderson (2016) explained employment impact in a similar study, asserting that employment impact measures the rise in the number of employees in an economy. However, Doshi (2015) differed from Henderson (2016) regarding measuring economic forces as impacts of money rather than as employment opportunities in an economy.

Mohr (2014) diverged from the methods used by Goldstein (2016), Ermisch (2016), and Hámor and Rosta (2016) by using the property value impact. Property value impact measures the total increases in the value of assets in an economy. Mohr (2014) explained that the addition of value is a clear reflection of the related increases experienced in wealth and income for both businesses and individuals.

Mohr (2014) warned that identification of economic impacts may not be sufficient for formulating adjustments in a project. However, identifying the sources offers a more compelling approach to economic analysis. In Mohr's explanation, the impacts were classified as direct, indirect, or induced effects. Direct effects come from the money spent on operational expenses, raw materials, supplies, and salaries. However, as Hámor and Rosta (2016) explained, indirect, incidental costs result from transactions between businesses, and increases in indirect impacts are an indication of a rise in some business-to-business sales.

On the other hand, Mohr (2014) noted that induced effects come from the increment of personal income caused by a combination of direct and indirect impacts. Ermisch (2016) simulated a scenario where the businesses in an economy experience an increase in their revenues, which results in an increase in payroll hours and salaries. This effect is predicted to influence the expenditure of households on businesses in the local area. In similar research, Hámor and Rosta (2016) suggested that changes in geographical characteristics of businesses and population cause dynamic effects.

Economic analysis is important for several reasons. First, it helps to identify the attributes that warrant government support (Tassey, 2012). Second, it gives a clear view of the technical output and economic outcome of the R&D project (Tassey, 2012). Third, it helps to collect enough data to enable accurate development of policy-guided metrics that contribute to resource allocation (Tassey, 2012). Finally, it offers a platform for the evaluation of the general impacts of the R&D project (Tassey, 2012).

Strategically, the initial phase of an R&D program involves an economic impact assessment. According to Tassey (2012), most government-funded R&D programs do not anticipate the magnitude or scope of intervening in a R&D program. As such, there is no proper planning or measurement of the impacts. Thus, there is an increased possibility of negative outcomes or of no changes at all. With economic analysis, R&D agencies can formulate clear plans that lay out a focused mission and a recognized outcome.

The overall outcome of a R&D project should have a strong market. It is universally agreed that a strong market is needed for the success of an R&D project. Any R&D project in any discipline is intended to introduce a new product onto the market. An economic market analysis offers an idea of whether the product of an R&D program will enter an existing market or whether it is an innovative product with a new potential market. Moreover, the analysis clarifies the competition, thereby helping to evaluate its likely success or failure (Rundquist, 2012).

Chan et al. (cited in Alias et al., 2014) suggested that adequate financial budget is a CSF. The capital cost of a project determines its completion and overall success. These costs arise from resources, which are human and non-human (Nagesh & Thomas, 2015). There is a need to evaluate the economic costs of completing a study, including resources used on personnel in terms of training or hiring (Nagesh & Thomas, 2015). Moreover, the project size, which dictates its degree of difficulty, has a significant effect on its completion (Nagesh & Thomas, 2015).

All these aspects of economic analysis (i.e., market, finances, resource allocation, and project size) are important for effective completion and success of R&D projects, especially those that are publicly funded. These attributes determine the initial, intermediate, and final stages of R&D projects if properly sustained, maintained, and managed (Milosevic et al., cited in Alias et al., 2014).

2.3.3.2 Governmental/Political Analysis

Various researchers, including Al-Khouri (2013), Frisch and Kelly (2008), Mitlin and Satterthwaite (2014), and Roberts (2010), have been keen to point out the role of the government in the success of any R&D project. The literature presented by Mitlin and Satterthwaite (2014) noted that public policy plays a vital role in both the formulation and implementation stage of a project. Mitlin and Satterthwaite (2014) observed that, in the UAE, most governments are responsible for the allocation of the society’s risk and capital. Therefore, accurate estimation of the cost of programs that are supported by the government requires public oversight, transparency, and efficient allocation of resources. However, as Robert (2010) observed, most UAE governments use the cost of capital as their borrowing rate. Robert (2010) recommended a more efficient method, namely using the weighted-average cost, which is inclusive of various risks, such as the risk which the taxpayer and the general public bear as equity holders. Additionally, Robert (2010) raised concerns regarding the budgetary and accounting practices used by the governments. In Al-Khouri (2013)'s review of the literature, these methods were shown to cause a significantly downward and biased trend in terms of cost approximations for credit provision. Al-Khouri (2013) recommended the use of the fair-value metric, which aims to recognize the total cost of a risk taken.

In related literature presented by Frisch and Kelly (2008), tariffs and taxes laws have been discussed at length. Frisch and Kelly (2008) examined the effects that taxes and duties have on trading activities with foreign nations. Higher taxes make imports more expensive and less competitive than local products. However, Frisch and Kelly (2008) observed that in a scenario where a project requires imports, the adverse effects of tariffs and taxes will affect the economic resource allocation. In their discussion, they explained how consumers' purchasing power is reduced by the imposition of taxes and tariffs on imports. After purchasing expensive imports, consumers have little left to spend on local products. The overall adverse effect is an economic challenge that results in a reduction in national income. However, Irwin (2007) took a different approach, noting that support for local companies and jobs depends on the effectiveness of the taxation and tariff system. By encouraging the purchase of local products, the government creates the foundations for growth of local businesses and small industries. In addition, Irwin (2007) explained that the effectiveness of a taxation and tariffs system will determine the government's investment expenditure. It is this expenditure that the government delegates to projects, including R&D projects, in the central areas of a country's economy.

A more sensitive issue is the stability of the government, as discussed by Merino (2013), who focused on the relationship between economic growth and government stability. With political instability come uncertainties, and investors tend to avoid difficulties because of the risks they pose to their investment. Having an unstable government reduces the level of economic development and results in a country with poor economic performance. In such a country, according to Merino (2013), the government lacks sufficient resources for funding major R&D projects. Additional research presented by Tassel and Trust for Public Land (2009) revealed that poor performance in the economy may result in anarchy if there are insufficient funds to run a government. They pointed out that political stability and economic performance are interdependent. Both Merino (2013) and Tassel and Trust for Public Land (2009) agreed that the chances of success for government-funded projects are slim under conditions of political instability.

In government-funded R&D projects, the support of the government itself is crucial. One area of interest is in R&D policies that guide the allocation of resources to R&D projects (Cunningham & Link, 2016). Presumably, these policies are drawn up by government officials, which means that their support of any project is important for its completion. Cunningham and Link (2016) argued that government support enhances the performance of R&D activities within companies. Government support means the possibility of interventions in R&D projects that are not running smoothly, hence the potential for making a difference (Cunningham & Link, 2016).

Notably, in government-funded R&D projects, different stakeholders with conflicting interests are involved. As such, the success of a project depends on incorporating a system that keeps all stakeholders focused on the mission. Okamuro and Nishimura (2015) found that the success and performance of an R&D project is improved when there is monitoring and evaluation by the relevant government. Kang and Park (2012) found that government support directly and indirectly affects R&D success; government support promoted innovation directly through the stimulation of internal R&D and indirectly by making upstream and downstream collaborations smoother. Without government support, funding itself is likely to be terminated, hence affecting the successful completion of the project.

Importantly, government support can have a negative influence on the progress of R&D projects. In a conference paper, Aoshima et al. (2011) found that overdependence on government resources prevents project team members from interacting with other people within the company. As a result, project members cannot leverage all the possible resources that can help them overcome any project problems (Aoshima et al., 2011). In addition, overdependence on government support leads to limited internal on project activity, which increases the difficulty of justifying further investment in the project (Aoshima et al., 2011). Arguably, these results are an indication that successful R&D projects are dependent on more than government support.

Hsu and Hsueh (2009) found that the efficiency of government-funded R&D is strongly affected by organization size, the external industry, and budget. As such, R&D success requires a smooth interaction with other sections of the organization.

2.3.3.3 Public Opinion Analysis

Lippmann (2007) acknowledged that public opinion plays a crucial role in the success of a project. Evidence presented by Aalberg (2013), Blendon (2011), Haaften (2011), and Sniderman and Highton (2011) has emphasized the mechanisms that apply to the analysis of public opinion. Lippmann (2007) explained how the study of openness enables the managers of a project to understand various social dynamics. Social dynamics exist in different forms, ranging from formations to shifts. With the evolution of social media, Aalberg (2013) explained how researchers can exploit social media to obtain a clear picture of public opinion.

However, Lippmann (2007) presented literature that criticized the analysis of openness through social media. In his argument, research using social media was shown to be methodologically arbitrary, owing to the dilemma of choosing the parties that will take place in the research. Further criticism from Blendon (2011) focused on the fact that the use of social media to examine public opinion is only successful in most cases after the completion of the project in question. Blendon (2011) also argued that users of social media do not reflect the actual voting population in a nation. Therefore, the margin of error is higher than for other modern techniques.

More analytical literature presented by Haaften (2011) explained the development of custom questionnaires for conducting surveys. Haaften (2011) recommended the use of custom surveys in order to reflect the dynamics of the locale and project. The literature shows support for time allocation as a determining factor in a study’s success. For example, a project whose survey began 25 years ago will have collected and analyzed public opinion collected long before the project starts (Haaften, 2011).

Blendon (2011) favored timelines, because they allow the collection of ideas and the formulation of plans that include public opinion. In addition, the creation of custom questionnaires enables a project's management to include the factors that are unique to the public under examination. For example, a survey of public opinion on the construction of smart cities in the UAE can be customized to take account of Arab architecture, cultural heritage, and religion.

For successful data collection, Sniderman and Highton (2011) favor the use of live experts instead of robots. They explained how human interaction can change the nature of data collection from a discrete or analog form to a method that involves facial expressions, reactions, and other details that papers cannot cover. The interaction of an expert with the party under study creates an interpersonal bond between them, enabling easy information flow. Haaften (2011) expressed a similar opinion, suggesting that the success of human interaction as a method of gathering information when conducting public opinion survey is dependent upon the establishment of interpersonal bonds. He went on to explain that robotic methods miss out vital details, just as closed questionnaires do.

Concerning tabulation techniques, Burrowes (2014) suggested that the collection process is a major determinant of the ease of tabulation. However, the tabulation of results from data obtained from interpersonal interactions is complicated by the absence of a discrete determining factor. Burrowes (2014) explained that the tabulation method adopted should provide for a three-way, entirely separate classification of opinions. First, there should be an option for support, whether full or partial, with a comment section for later review. Second, an open view should be represented, showing the neutrality of the whole situation. Finally, any reservations regarding a project should be classified, and the reasons provided should be taken into account.

2.3.4 Organizational Cultural Aspects as a Moderating Effect in R&D Projects

Organizational culture is believed to be the most significant factor in the determination or various organizational variables. Every organization, in this case, has the unique culture that differentiates it from others (Bortolotti, Boscari, and Danese, P. (2015). Besides, this culture usually reflects on the behavior portrayed by employees in a company. The challenge experienced by most organizational managers is how to use the diverse cultures that exist within a company to manage various projects and developments (Driskill, 2018). Furthermore, the success of most research and development projects depends on a company's organizational culture. This review aims at demonstrating the existing relationship between organizational culture and the success of R&D projects in an organization. Previous research studies will be used in this chapter to illustrate the meaning of organizational culture, the concept of R&D, the impacts of organizational culture on the performance of R &D projects, and the role of organizational culture in the success of R&D projects.

According to literature cited in Belassi (2013), organizational culture is the shared belief and values within an organization that shapes the behavior and attitude of employees. Tan (2007) observed that an organization's culture may be viewed from the perspectives of process orientation, governance, training, and responsibilities. Tan (2007) explained that an organization that follows a scalable process of managing a project has a high success rate. Successful projects result in the adoption of a single culture and structure that an organization perfects over the years (Tan, 2007). However, Cox (2009) pointed out that the existence of processes and cultures is not enough to guarantee success and that governance is necessary. Management ensure that people follow the procedures that they are supposed to follow and make adjustments where necessary.

Tan (2007) explained that changes to culture may be brought about by training, project specifications, and technological developments. Tan (2007) and Cox (2009) examined people's knowledge of their roles in the processes adopted over the years. Sponsors, clients, and management are more informed about their roles if there is a consistent culture.

According to Belassi (cited in Tajudin et al., 2012), organizational culture determines three important performance measures in projects: (1) It dictates the commercial outcome of projects; (2) It determines the technical outcome of projects; (3) It determines the level of customer satisfaction in new product production (Belassi, 2013, cited in Tajudin et al., 2012).

A study by Chipulu et al. (2013) examined the effects of cultural values and certain demographic factors on the success or failure of projects. Using interviews to collect data from project staff in eight countries, the authors revealed that the effect of cultural values are reflected in two managerial styles of project management: the masculine (characterized by use of force rather than consensus to solve problems) and the relationship-oriented. Each style has its own cultural values that determine the progress of a project.

It is important to note that personnel in R&D projects experience stressful conditions in terms of performance pressure, time pressure, the competitiveness and demands of R&D projects, and social isolation. Therefore, they tend to develop learned helplessness behavior, which can affect their performance. Organizational culture has been found to counteract this behavior. Organizational culture has the capability of enhancing organizational performance, decision making, job satisfaction, innovation, and investments in projects (Ram and Ronggui, 2018). The effect of organizational culture on the employees can be summarized into various key ideas (Joslin and Müller, 2016). One, understanding of an organizational culture gives employees an appropriate knowledge about a company's performance and operations. Secondly, knowledge of a corporate culture contributes to making employees understand the philosophy and values of a company. Finally, organizational culture fuels the energy of working towards a common goal among the employees — all in all, organizational culture impacts on the performance of corporate projects both directly and indirectly. According to Kerzner (2017), the organization of critical steps towards the success of a given project requires commitment and cooperation from every individual in a company. Consequently, this level of dedication and collaboration can only be achieved if employees decide to work towards a common goal just as directed by organizational culture (Mousa and Alas, 2016).

Overall, a lot of studies on R&D project performance and success and the role of organizational culture is still necessary as the latter is vital for the overall performance of a company. Besides, there is inconsistency in the link between corporate culture and organizational performance. The literature review, in this case, reveals that companies that use their culture adequately greatly benefit and achieve productivity, advancement, and quality. All in all, employees should adapt organizational culture to assist in the achievement of success in projects and innovations. Furthermore, when the corporate culture is used correctly, people within an organization get tuned towards a common goal. Hence, success is evident (Joslin and Müller, 2016).

Therefore, they tend to develop learned helplessness behavior, which can affect their performance. Organizational culture has been found to counteract this behavior. Saxena and Shah (2008) found that organizational culture is negatively correlated with attributes of learned helplessness. Moreover, they found that organizational culture plays an important role in removing learned helplessness (Saxena & Shah, 2008). In addition, organizational culture is crucial for predicting the outcome of learned helplessness (Saxena & Shah, 2008).

2.3.4.1 Working Culture in Abu Dhabi and its Effect on the Success of R&D Projects

The intensively competitive economic environment has led to the appreciation of innovation as a critical tool for the nation's growth and development. Most importantly, for innovation to prevail, the reliance on successful R&D projects (Alshehhi, 2018). For Abu Dhabi, the evaluation and enhancement of R&D projects have been crucial towards ensuring that the firms in the nation accomplish high performance. Nonetheless, a significant difficulty or challenge has been the need to maintain information intelligence about work culture and its potential to reshape the success or failure of R&D projects (Jensen, 2018). The complementary relationship between R&D projects and workforce inputs is a critical aspect that defines the operational dynamics of various activities (Alshehhi, 2018). Therefore, from the evaluation of the nation, work culture affects the success of R&D projects in the following ways.

Work culture in Abu Dhabi is shaped by the formation of cognitive plans in a given period, which can potentially influence R&D projects. Accordingly, the thinking and behaviour of the employees in different projects can define its outcomes. Alshmakhy & Habib (2019) reveal that work culture disparities are a leading cause of the gradual process of adopting R&D projects. Critical facets of concern are the leadership support, behavioural scripts, and communication dynamics that are unique across cultures. Alshmakhy & Habib (2019) demonstrate that ineffective communication among the employees within a project can have detrimental outcomes on its success. For the success of a project to be assured, it is advisable to have comprehensive information about the link between culture and behavior and how it can impede on the project outcomes (Alshehhi, 2018). Being acquainted with the individual culture is a critical approach that can effectively handle any shortcomings that may impede on the R&D project.

Awal (2016) acknowledges that in Abu Dhabi, a high context of national culture seems to take a central stage in defining the operational dynamics of employees. Most importantly, the context of operations among the organizations ought to be in line with the individual national culture, which can be a hurdle in accomplishing the projects (Alshehhi, 2018). The need for a detailed approach to project evaluation, monitoring, and implementation translates into considerable barriers in ensuring successful outcomes. Therefore, the work culture in Abu Dhabi has a considerably crucial role in determining the trajectory of the R&D projects.

2.3.5 Outcome Factors for Achieving R&D Projects

2.3.5.1 Cost

Although most public-funded activities are non-commercial, cost management assumes an important function in ensuring better performance from project management. In government projects, proper cost management indicates the credibility, integrity, and competence of the participants. Therefore, informed financial decisions are encouraged, and any inappropriate expenditure of public finances poses a challenge to financial departments. In this regard, any project that misuses allocated funds is deemed unsuccessful by some professionals, although rational justifications for extra expenditure are usually considered. However, the cost management process should be reviewed closely, as it has a significant impact on the outcome of a project.

Projects consume enormous amounts of money before completion. Therefore, investors in both public and private organizations focus on the profitability or success of these projects; failure is a waste of finances and time. According to Adna, Hashim, Marhani and Asri (2013), project delay is among the key factors that increase the cost of these schemes; thus, minimal expenditure on projects can serve as a determinant of success. From a mathematical perspective, Kuen and Zailani (2012) argued that every activity has time limits attributable to cost. Interestingly, Ika (2009) stated that cost increases when the duration of an activity is reduced but decreases when the duration is prolonged. Most public-funded projects and other large projects are characterized by enormous costs and take a substantial amount of time to complete.

The need for accurate costing of a project is imperative, as the quality of the outcome is also dependent on the total expenditure of the project (Ashokkumar, 2014). The intervention of top management in ongoing projects has a vital influence on cost. They assist in providing necessary resources on time, thus minimizing delays that can affect the allocated financial budget. According to Kendra and Taplin (2004), cost management involves estimating, determining, and controlling the assigned budget for the completion of the entire project. During the estimation stage, project managers should collaborate with the financial department in order to allocate the amount of money needed to complete a particular plan (Assaf, Hassanaian, &

Mughal, 2014). This phase requires close concentration, as an inappropriate allocation of funds can lead to failure of the entire project because of inadequate resources and delays.

2.3.5.2 Time

Time in project management can be defined as the time taken or needed to accomplish a given activity. The duration of a project depends on several factors, such as the amount of work, quality requirements, and the availability of resources According to Jiang (2014), proper time management is realized through prudent setting of goals followed by consolidation of all future activities toward the attainment of those aims. Better time management facilitates the accomplishment of missions on time, while poor time management leads to inconveniences such as increases in project cost and botched quality due to unnecessary hurry. Time management refers to the venture of time whereby a satisfactory outcome is expected to be delivered within the planned time (Allen et al., 2014).

Therefore, time management in the execution of projects has a unique value in the determination of project success, as projects are expected to be completed within the stipulated time. According to Drouin and Judgev (2014), project managers focus on three aspects of managing time: increasing operational speed, shortening delivery time, and reducing schedule growth. On the other hand, Muller and Turner (2010) observed that some developmental changes might be enacted and alter the direction of the project, to the extent of invalidating some of what has been accomplished. They also stated that these changes tend to prolong the project time, raise costs, and demotivate the workers. Government projects adopt a different perspective, according to which the project may be considered unsuccessful to some extent because of poor time management and extra costs but may generate good results upon completion. In such cases, the blame is shifted onto the project managers rather than the project itself.

Projects with short durations tend to perform better than lengthier projects. Drouin and Judgev (2014) argued that the short projects are advantageous, as their management is easier and proper control can be maintained. However, Allen et al. (2014) suggested that strict monitoring of projects based on cost and time can have adverse effects on the results. They claimed that the product may be neglected and that the long-term orientation may be compromised in favor of short-term functionality (for example, technology). According to Killien et al. (2012), the time taken to spot discrepancies in the project has a substantial effect on the outcomes. The longer it takes to recognize discrepancies, the more the damage escalates in terms of cost and time taken to correct the errors.

According to Assaf et al. (2014), unpredictable changes tend to impact the schedule of public-funded projects. Muller and Turner (2010) observed that the time factor has regularly been taken as an indicator of the success or failure of a project. They argued that a project that falls behind schedule is likely to fail due to mismanagement or other unforeseen challenges. On the other hand, a project that comes in ahead of its deadline is considered successful. Since time has a significant value in the success of a project, project managers should make timely and prudent decisions before executing any project. Comprehensive forecasting analysis should also be conducted to curb any challenges that may arise in future (Mishra, Dangayach, & Mittal, 2011). Toor and Ogunlana (2010) emphasized that projects equate an investment of resources in a timebound scenario to earn profits. Muller et al. (2012) focused on the evaluation and coherence of “distinct dimensions,” which they likened to time frames. Their findings suggested that timely achievement of project objectives prevents additional problems from arising and can, therefore, be used as an indicator of success (Dosumu & Onukwube, 2013).

2.3.5.3 Meeting Objectives

Government projects focus on targeted goals, as a vast number of those such have a developmental purpose for the nation. Therefore, project managers are challenged to yield satisfactory results for the process to be considered successful. In this regard, high levels of field competency are required to manage all the resources provided and to produce the results efficiently in terms of time, cost, and quality. Ideally, the attainment of set objectives marks the completion of a project, as most of them are goal-oriented. Therefore, failure to meet the targeted aims translates to a failed project on the part of subordinates. The objectives should also live up to the stakeholders' expectations, because a decline in the standard may have adverse effects on the project's supervisors.

Researchers agree that success is tantamount to the accomplishment of stipulated goals. According to Borman & Jansenn (2013), success is related to the results, execution, and general environment of the project. Kuen and Zailani (2012) stated that lack of ambitions adversely affects R&D projects because of a lack of clear direction from project management. Yalegama, Chileshe and Ma (2016) observed that success is determined by the extent to which the scheme has accomplished its purposes. They also mentioned that if the technical specification has been achieved and the interested partners are satisfied with the outcome of the project, then the entire activity can be termed as successful. They accepted that measuring objectives is difficult but ultimately agreed that the views of the clients play a vital role in determining project success.

For a project to succeed, the goals should be well communicated to the participants. Kuen and Zailani (2012) argued that a definite objective transmitted to all the workers contributes to the realization of the ultimate target. They asserted that clear guidelines are readily adhered to, as the parties are not overwhelmed, and they serve as motivational elements that promote the achievement of the ultimate ambitions. A transparent approach leads to the accomplishment of targeted goals. In addition, developing effective channels between scholars and trade partners is a crucial factor that positively impacts the success of a given project (Barret & Gilkinson, 2004). The sharing of knowledge and skills between the two parties facilitates the achievement of the stipulated objectives. Patanakul and Shenhar (2012) asserted that explicit goals, communication, and leadership competence form an adequate basis for project success.

Lewis (2007) defined project excellence as the proper utilization of the project output and the sustainability of the achievement over a long period. To ensure acceptability of the end-product, frequent updates on the progress of the project should be provided to stakeholders. This assists in accountability and identification of probable risks (Project Management Institute, 2013). Morioka & Carvalho (2014) regarded the realization of goals and enjoyment of subsequent benefits as indicating the success of a project. Jiang (2014) stated that the degree of expectation and the formulation of the objectives serve as a primary determinant of the success of any project. According to Allen et al. (2014), the completion of a project is characterized by the delivery of targeted goals. Once the goals have been attained, then the entire activity can be deemed successful. Similarly, Patanakul and Shenhar (2012) affirmed that project managers are indispensable in the realization of targeted goals. They declared that the competency of these managers is measured against the achievement of allocated project goals. Therefore, meeting the project objectives translates to project success.

2.3.5.4 Quality

Quality is an essential factor in determining the excellence of a particular activity. Ashokkumar (2014) defined project quality as compliance with the legal, aesthetic, and operational requirements of a venture. All other factors—cost, time, and objectives—are oriented to improving the quality of the outcome. Consequently, proper management of these factors leads to a better quality result, which translates to project success, as the stakeholders tend to accept the outcome. According to Toor and Ogunlana (2010), the participants' satisfaction is facilitated by their perception of quality, hence the need to pay close attention to it. If a project manages to meet its objectives, its quality tends to be satisfactory, although it is not guaranteed (Ashokkumar, 2014).

Project management mostly emphasizes cost, time, and achievement of goals. However, the quality of the objectives and their effectiveness are paramount in determining the success of a project. Muller et al. (2012) asserted that a satisfactory outcome relies heavily on the project process, requiring continuous attention to its acceptability among stakeholders. For government R&D projects, activities require close attention, as knowledge and skills are vital, especially when focusing on innovative developments. The success of government plans is crucial, as they may benefit many people. These projects are also known to consume many resources, both tangible and intangible, in the effort to ensure quality results.

Quality is a paramount determinant of success, since clients expect outcomes that live up to their expectations. If the result fails to achieve this, then the entire project is considered a failure. Therefore, close attention is required to ensure that the quality of the outcome meets expectations. The quality of a project may be perceived through different aspects, such as durability, profitability, the efficiency of the outcome, and aesthetic appeal (Mishra et al., 2011). However, from the process perspective, quality is attributed to the capability to meet targeted outcomes, an aspect that can be measured using technical metrics such as functionality, permanency, and dimensional quality. Kendra and Taplin (2004) defined quality as value for money, whereas Jiang (2014) saw it as a measure of customer satisfaction. In any case, the needs of the client should be adhered to, and close monitoring should be conducted during the implementation stage (Morioka & Carvalho, 2014).

A study of IT projects conducted by Adnan et al. (2013) demonstrated that project managers focus on timelines and budgets and disregard the essentiality of the ultimate product. They contended that the quality of the final product is key to the success of the project, although they agreed that the cost and time factors should be taken into consideration. Agreeing that customer satisfaction is vital in ensuring project excellence, they nevertheless noted that what counts as satisfaction differs among individuals. Thus, a project may be considered successful by one person but declared unsuccessful by another (Dosumu & Onukwube, 2013). According to Adnan et al. (2013), the quality (“value capture”) and profitability of a project are critical determinants of its success. They argued that the success of government R&D projects can be identified by the level of satisfaction of the involved parties. Carvalho and Rabechini (2011) claimed that there is a challenge in determining the quality of a product, as it is contingent on the perspective of an individual, the type of project, and expectations. Muller et al. (2012) emphasized the evaluation and coherence of “distinct dimensions,” comparing them to timeframes. For projects concerned with welfare aspects, it has been observed that quality surpasses the criteria for time and cost. In such a scenario, time and cost take second place, as the focus shifts to “doing things right” (quality) (Dosumu & Onukwube, 2013).

2.3.5.5 The Gap between Successful R&D Projects in Abu Dhabi and Actual R&D Projects in Abu Dhabi

Research and development (R&D) has become crucial to achieve a knowledge economy and ensuring the creation of innovative products and services prevails. For major economies such as Abu Dhabi, looking at different nations such as the US, Germany, and Japan, through an analysis of their R&D investments is advisable. Accordingly, the countries have been on the front path to expanding their R&D operations to sustain a relatively competitive edge over other nations in their economies (Al Naqbi, Tsai & Mezher, 2019). Acknowledging that R&D intensification is the right approach to economic growth is a critical component for Abu Dhabi to expand its position in the global economy. Accordingly, nations that invest highly into R&D reveal the devotion towards monitoring resources and sustenance of a competitive marketplace. Therefore, the initiatives by Abu Dhabi to increase investment into R&D have not been uncalled for with potentially positive implications evident. The proportion of R&D investment at Abu Dhabi has been extensive with the need to enhance the knowledge economy and improve its position in the global economies (Jensen, 2018). Nonetheless, a gap prevails between the successful and actual R&D projects in the nation attributed to diverse reasons such as unique governance structure and bureaucracies across the different sectors of the economy.

Understanding the gaps between successful and actual R&D projects in Abu Dhabi depends on an in-depth evaluation of the political, economic, scientific, and educational dimensions that define the nation's operations. As an essential pillar in the government, the variety of the different structures of R&D projects is characterized by significant parameters of decision making (Al Naqbi, Tsai & Mezher, 2019). Gaining knowledge about the R&D performers in Abu Dhabi centres on a comprehensive evaluation of working conditions, researchers, the role of funding agencies, research output, and scientific cooperation. Alshmakhy & Habib (2019) further purports that it is challenging to examine R&D projects due to the internal and external hurdles that prevail in maintaining real-time information relay and open access to vital information from private and public sector businesses. Further, the uneven concentration of the successful R&D projects remains an elusive aspect that impacts on the information access process. Regional variations are a norm in Abu Dhabi that seems to redefine the information access process (Al Naqbi, Tsai & Mezher, 2019).

2.4 Conceptual Framework

A vast number of R&D projects are sponsored by various governments across the globe. These projects have an immense impact on the development of their respective nations, hence the need for profound consideration to ensure their success. Although there is no consensus on how to measure the success of these projects, the "iron triangle" framework has been in use since time immemorial, with most projects being compared to models that emphasize elements of cost, quality, and time. The targeted objectives have also been employed by some practitioners as a criterion to measure success. The realization of objectives indicates project success, while failure to meet specific goals indicates the failure of the project. The achievement of project goals has a direct or indirect impact on the quality of the product, because the degree of perception of quality is different among individuals.

Time is a valuable factor in determining the success of a project. Some practitioners believe that the accomplishment of an activity on time is the sign of a successful project. Time is also related to project expenses, because costs increase as duration extends. Although some short-term projects require massive amounts of money compared to longer ones, expenditure on a particular project tends to be taken as an indicate of its success or failure. Cost-conscious projects are considered worthy.

This literature review has helped to understand the essential aspects related to the overall process of determining the CSFs that contribute most to the completion of government-funded R&D projects. Moreover, it has provided the basis on which the researcher developed the research framework and hypotheses. As discussed above, the conceptual framework model is drawn from the current literature on CSFs for projects. However, the conceptual model has been modified to meet the demands and objectives of a study of government-funded R&D projects (Figure 2); a moderating factor has been determined, and project achievement indicators are determined as cost achievement and timeline achievement, which will lead to the achievement of objectives.

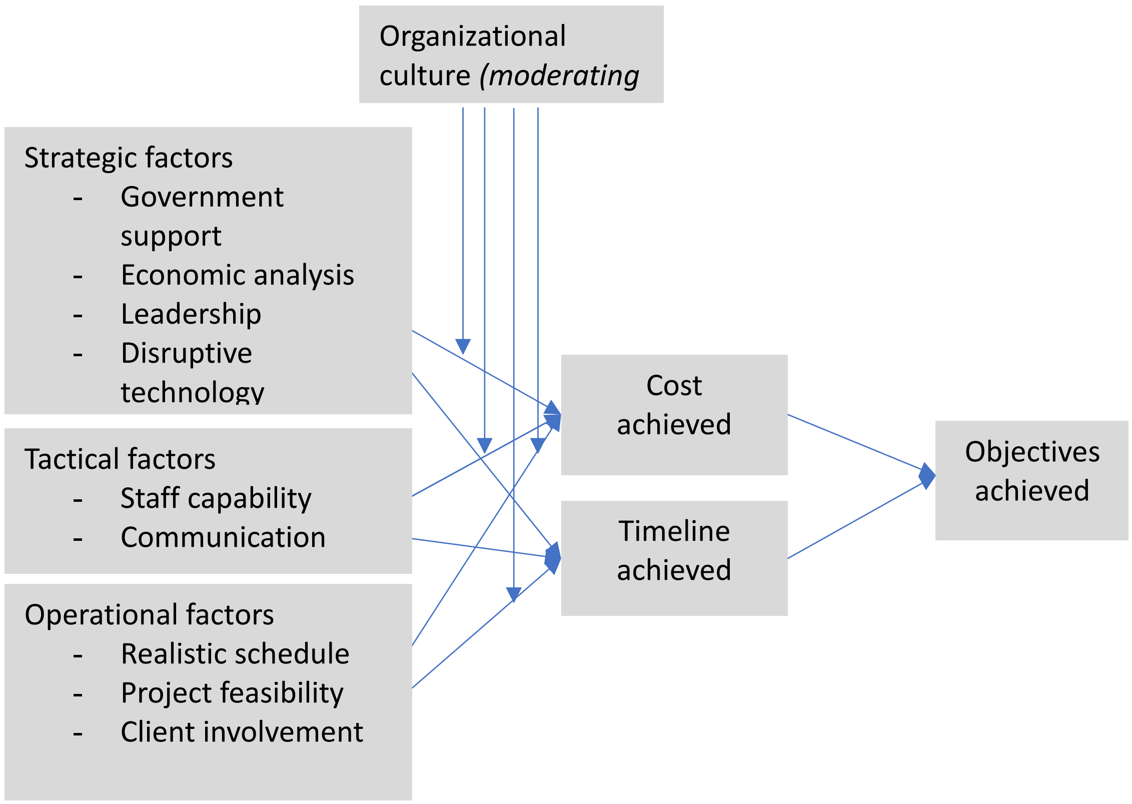

Figure 2: The research model: CSFs of managing government-funded R&D projects

In this study, the independent variables are the CSFs for R&D projects: strategic factors, tactical factors, and operational factors. The three dependent variables are cost achievement, timeline achievement, and achievement of the project objectives. The moderating factor is organizational culture. The next chapter provides an overview of the phases associated with research design and methodology.

2.5 Research Hypotheses

Hypotheses are frequently used in modeling to find rational relationships between the candidate components of functional and reliable models. The hypotheses formulated for the present study are based broadly on the work of a wide range of scholars. The formulation of the hypotheses originates from the research questions. The following section represents the hypotheses of the study.

$H1_a$: Strategic factors positively affect cost achievement in projects.

For $H1_a$, strategic factors include government support, economic analysis, leadership support, and disruptive technology. Government support can improve the profit of R&D projects. Einio (2009) argued that government support through subsidies encourages companies to carry out R&D projects that would not have been profitable without that support. Thus, it can be clearly conceptualized that the government not only ensures the success of an R&D but also its initiation. A good example is the Finnish R&D support program (Einio, 2009). With the departure from the principal of neutrality, where resource allocation is based on feasibility rather than discriminative criteria the government selects the R&D projects to support (Bizan, 2003). However, even after funding is provided, these R&D projects need to be continuously supported to ensure that no political obstacles or challenges prevent their successful completion. In R&D projects, one important consideration is economic analysis, including market, financial budget (capital cost), planning, project size, and resource allocation. In most government-funded research projects, the overall outcome is the economic impact of the R&D program (Tassey, 2012). Ferraro (2008) elaborated that the project manager is responsible for tasks such as planning scope, activities, and schedules; estimating costs and time; taking care of documentation; and developing a budget. Ferraro (2008) noted that the professional code of conduct must be maintained in performing these and other duties. Lastly, disruptive technology focuses on innovation, and is defined as an innovation that significantly affects the market and economic activities of organizations in that market (Selhofer et al., 2012).

$H2_a$: Tactical factors positively affect cost achievement in projects.

For $H2_a$, tactical factors staff capability and communication. Koopmans and Donselaar (2015) found find that an increase in 10% of R&D investment was associated with gains in labor productivity of between 1.1% and 1.4%. In the European case, assuming the amount of hours worked remains constant, an increase of 1.1% in labor productivity would represent an increase of 1.1% in GDP, or put differently, an increase in R&D investment of 0.2% of GDP would trigger an increase of 1.1% in GDP (European Commission, 2017). Kern (2006) asserted that regular communication between employees improves their output, explaining that having to stop for consultation reduces time spent working and makes human resources less productive. This decreased productivity affects the total productivity of the R&D project.

$H3_a$: Operational factors positively affect cost achievement in projects.

For $H3_a$, operational factors include realistic schedule, project feasibility, and client involvement. For economic purposes, either in terms of time or monetary value, project feasibility is critical. The examination of whether a project is profitable or viable for an organization is important in determining its success (Bause et al., 2014). Kujala (2003) characterized the benefits of effective user involvement in system design projects in terms of improvement of system quality, since there is accurate identification of client requirements. Moreover, it reduces the cost of unnecessary expenditure on items not required by clients, increases acceptance levels and user satisfaction due to a better understanding of the product, and promotes the client–organization relationship (Kujala, 2003).

$H4_a$: Strategic factors positively affect timeline achievement in projects.

$H5_a$: Tactical factors positively affect timeline achievement in projects.

$H6_a$: Operational factors positively affect timeline achievement in projects.

While the theory behind $H4_a$ to $H6_a$, Ward & Daniel (2013) stated that project success depends on the ability of managers to deliver the expected project quality within the specified time and cost. Various management factors believed to be important in ensuring that the projects succeed have been identified, including support from top management, project schedule, client consultation, recruitment and training of personnel, technical tasks, acceptance by the client, proper monitoring and feedback, communication, and timely troubleshooting of crises (Ofori, 2013). Other CSFs include managers having clear project objectives, realistic estimates of the time and cost of completing the project, adequate resources, clear project missions, and project ownership (Ofori, 2013).

$H7_a$: Strategic factors positively affect objectives achievement in projects.

$H8_a$: Tactical factors positively affect objectives achievement in projects.

$H9_a$: Operational factors positively affect objectives achievement in projects.

As well, the theory behind $H7_a$ to $H9_a$, CSFs can be characterized as variables that determine the success or failure of a project in meeting its objectives or mission. CSFs are important because their absence or misinterpretation can ultimately lead to the failure of a project or prevent an organization from completing its mission or objective (Robertson & Wooster, 2013). On this definition, identification of CSFs and careful management practices based on these variables greatly increase the chance of success for a project or organization.

$H10_a$: Strategic factors positively affect organizational culture in projects.

$H11_a$: Tactical factors positively affect organizational culture in projects.

$H12_a$: Operational factors positively affect organizational culture in projects.

On the basis of the literature review for $H10_a$ to $H12_a$, Tajudin et al. (2012) found that entrepreneurial culture has an impact on new product production, a major component of R&D projects. From this point of view, it can be concluded that successful development of products in R&D projects requires organizations to foster a culture that enhances commitment among employees and helps them to cope with the stress of new ideas.

$H13_a$: Organizational culture positively affects cost achievement in projects.

$H14_a$: Organizational culture positively affects timeline achievement in projects.

$H15_a$: Organizational culture positively affects objectives achievement in projects.

The $H13_a$ to $H15_a$ on the other hand, Directly et al. (2010), using a case from India, revealed that organizational culture is a critical success and performance factor of national researcher and development firms. Likewise, Belassi et al. (2007) investigated the effect of organizational culture on new product projects in 95 US organizations and found a significant effect of organizational culture on new product development projects (Belassi et al., 2007). They were able to establish that organizational culture had contributed to the success of these projects (Belassi et al., 2007).

$H16_a$: Cost achievement positively affects objectives achievement in projects.

$H17_a$: Timeline achievement positively affects objectives achievement in projects.

For $H16_a$ to $H17_a$, Well-timed completion of a project is considered a key criterion of project success by project managers, clients, and practitioners. It has been observed that time is a contentious issue among professionals in terms of its role as a determinant of project success (Dosumu & Onukwube, 2013). Assaf et al. (2014) argued that project management has the responsibility for completing project on time, as it assists in minimizing the costs and controls the quality of the project. They further stated that time, cost, and quality should be among the objectives that project managers should strive to meet in order to be considered successful. Most government projects are characterized by lengthy duration. This increases expenses, and if the completion of the projects is not timely, it can lead to massive losses, which translate to the failure of the project.

$H18_a$: Organizational culture has a moderating effect on the relationship between strategic factors and cost achievement.

$H19_a$: Organizational culture has a moderating effect on the relationship between strategic factors and timeline achievement.

$H20_a$: Organizational culture has a moderating effect on the relationship between strategic factors and objectives achievement.

$H21_a$: Organizational culture has a moderating effect on the relationship between tactical factors and cost achievement.

$H22_a$: Organizational culture has a moderating effect on the relationship between tactical factors and timeline achievement.

$H23_a$: Organizational culture has a moderating effect on the relationship between tactical factors and objectives achievement.

$H24_a$: Organizational culture has a moderating effect on the relationship between operational factors and cost achievement.

$H25_a$: Organizational culture has a moderating effect on the relationship between operational factors and timeline achievement.

$H26_a$: Organizational culture has a moderating effect on the relationship between operational factors and objectives achievement.

Finally, $H18_a$ to $H126_{a,}$ the aim of R&D projects is to develop new products. New product development has been found to rely on the integration of attributes of organizational culture. In a study to examine the impact of organizational culture on the successful development of new products, Belassi (2013) proved that organizational culture is linked to the success or failure of new product development, arguing that organizational culture dictates what the organization entails and how it operates. As such, the attempt to introduce new opportunities without careful consideration of organizational culture can yield negative results (Belassi, 2013).

2.6 Summary

According to literature, several hypotheses were assumed, therefore next chapter was build up to formalized the research methodology used in current research to achieve answers for hypotheses were either for acceptance or rejection.

Chapter 3: Research Design and Methodology

3.1 Introduction

This chapter reviews and discusses some possible research designs and methodologies in order to justify the selection of a specific approach in terms of its appropriateness and usefulness to the research project, where the research methodology steps summarized in Figure 3.

Each research methodology has its own strengths and weakness. The question of appropriate research methodology depends to a great extent on a study's research questions and objectives, and these vary across the whole research spectrum. Many factors are to be considered when choosing an appropriate research methodology. Chinelo (2016) pointed out that the topic to be researched and the specific research question are among the main drivers in the choice of research methodology. They also argued that the literature review should reveal not only a suitable problem to be researched but also a suitable research methodology.

Accordingly, for the present study, the research design will be justified and the methodology to be used will be explained on the basis of the literature review. This chapter also sets out the operationalization of the variables and the research survey, elaborating the data collection methods and the different phases of the collection process. The results of the data processing are described in the form of quantitative analysis, and the data are analyzed and interpreted in Chapters 4 and 5.

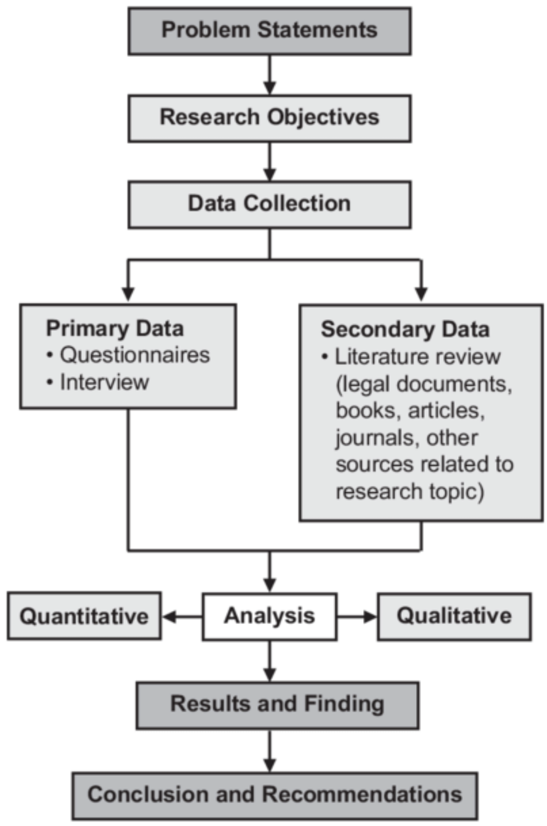

Figure 3: The Research methodology (Kadir et al., 2000)

3.2 Research Approaches and Methods

3.2.1 Research Approach

Research can be defined as the use of systematic and objective techniques in order to investigate a particular study topic or subject as a whole (Rajasekar & Raee, 2013), while Ahmad (2016, p1) defined research as a "systematic investigation, including research developments, testing and evaluation, designed to develop or contribute to generalizable knowledge." However, research often goes beyond its initially chosen subject, going from the sub-molecular level to the study of gigantic structures, in order to develop new ideas, confirm or reject old theories, and search for hypotheses (Ahmad, 2016).

The research design is the overall strategy chosen to integrate the different components of the study in a coherent and logical way. Therefore, a good research design will ensure that the research problem is addressed effectively; it constitutes the blueprint for the collection, measurement, and analysis of data (Neuman, 2006).

Research aims to establish facts and reach new conclusions. The basic tenets of research involve the gathering of data, information, and observations to advance our knowledge. The evolution of the human race and the technological advancement seen over recent decades are direct consequences of our increasing interest in and dependence on research. Although the human race is estimated to have existed for 200,000 years, most of our progress has occurred in the last 10,000 years. This advancement can be attributed to a better understanding of research methodologies (Ahmad, 2016).

Different research strategies have been classified under different taxonomies, including the categories of conceptual research and empirical research. Conceptual research is research that is related to certain abstract ideas or theory; it is commonly used by thinkers and philosophers to develop new concepts or to interpret existing concepts. Empirical research relies on experience or observation alone, without due regard for system or theory; it is data-based research, and it comes up with conclusion that are capable of being verified by experiment or observation. In empirical research, it is essential to obtain facts at first hand from their source and to take active steps to stimulate the production of the information required. Empirical methods are suitable when proof is sought that a small number of variables affect other variables in a certain manner (Kapur, 2018).

Empirical research is also known as experimental research. In such research, the researcher provides a working hypothesis and then works to obtain enough facts to prove or disprove the hypothesis. The researcher then sets up the experimental designs that allow the manipulation of materials and individuals in ways that bring forth the desired information. Such research is characterized by the researcher's control over the variables under study and by the deliberate manipulation of one variable to study its effects. This form of research is typically beneficial when proof is sought that certain variables affect other variables in a particular manner. Evidence gathered through experiments or empirical studies is considered vital for testing the relevant hypotheses.

Therefore, in this study, a hypothesis testing approach was used to frame the research, and the collected data were analyzed in order to accept or reject the hypotheses. The research design includes a model or framework for testing the CSFs for government-funded R&D projects. A research questionnaire was formulated and applied to examine the model, to test its propositions against the collected data, and to refine the model and its associated theories.

3.2.2 Research Method and Design

Research method and design is an essential element of any study, since they define the logical path connecting the research questions to the empirical data that are collected, leading finally to the conclusions that may be drawn on the basis of an understanding and assimilation of the study as a whole (Yin, 2013). Table 1 summarize the features and dissimilarities for both quantitative and qualitative methods.

Table 1: Qualitative and qualitative methods: features and dissimilarities

Dimension	Quantitative	Qualitative
Contact between researcher and informants	Brief or non-existent	Close contact with participants
Relationship between researcher and field	Outsider looking into field by applying pre-defined framework to investigate subject	Researcher has to get close and be an insider to the field being investigated
Theory/concepts	Operationalized	Emerges as research develops
Approach	Structured Researcher-driven	Open and unstructured Subject-driven
Findings	Time- and place-independent Rigid, hard, rigorous, and reliable	Relates to specific time periods and locales Rich and deep
Focus	Views the social world in a static manner and neglects the role and influence of change in social life	Views linkages between events and activities, and explores people's interpretations of factors that produce such connections

Source: Bryman (2012).

Qualitative methods are often small-scale and aim to elicit a richness of detail rather than statistical generalizations (Denzin & Lincoln, 2008). Qualitative data usually take the form of words rather than numbers and have been the staple of some fields in the social sciences, notably anthropology, history, and political science. In the past decade, however, more researchers in basic disciplines and applied fields have shifted to a more qualitative paradigm (Denzin & Lincoln, 2008). However, despite its strengths, qualitative research has its problems. Some of the difficulties in the practice of qualitative research include the following: problems of access, problems of interpretation (Bryman, 2012), and problems of data analysis (Miles & Huberman, 1994). Case study is a typical research method widely used for qualitative data collection in management research (Yin, 1989). It defines an empirical inquiry (1) that investigates a contemporary phenomenon within its real life context, (2) in which the boundaries between phenomenon and context are not clearly evident, and (3) in which multiple sources are used. On the other hand, there are problems with the approach, such as limited generalizability beyond the immediate case (Yin, 1989) (i.e., the question of external validity) and a lack of rigor (i.e., the biased views of the researcher may be allowed to influence the findings) (Yin, 1989). Therefore, while a case study approach provides comprehensive coverage and realistic descriptions of the sample being studied, it has the limitations of being unsuitable for research that seeks statistical generalizations or assessment (Cohen & Manion, 1994; Yin, 1989).

Quantitative research was originally developed in the natural sciences. It can be defined as research involving the use of structured questions where the response options have been predetermined and a large number of respondents are involved (Chinelo, 2016). Its emphasis is on the structural issues of measurement and the analysis of relationships between certain variables rather than on complex processes (Chinelo, 2016). It has been argued that quantitative approaches provide researchers with results that are narrow but hard and generalizable (Bernard 2012). The purpose of using quantitative methods is to generate precise measurements of social actions that can be described by the accumulation of statistical data. In this connection, Creswell (2013) highlighted the goals of quantitative research in terms of (1) providing precise measurements for social actions by explaining the causal relationships related to specific events, and (2) measuring events by objective criteria. Using statistical data analysis, quantitative methods provide objective and precise measurements for social actions by explaining the causal relationships related to specific events (Creswell, 2013). However, quantitative methods overlook social process and focus on social structure, isolating the research problem from its settings.

Researchers have reached a consensus that there is no restriction on using more than one method at a time. Undoubtedly, the proper selection of methods and the understanding of their application to the research context are vital to the success of any study. However, choosing between methods for a particular research study has always been problematic, and a decision on the appropriateness of a particular method cannot be made in isolation of the context in which the research problem exists (Neuman,2006).

As stated in Chapter 1, the objectives of the present study are as follows:

1. to explore the factors that affect R&D projects
2. to determine the effects of three types of factors (strategic, tactical, and operational) on project success
3. to distinguish between the effects of each factor on project success.

As stated in Chapter 2, there is a lack of constructive and comprehensive knowledge about the CSFs that most affect the achievement of R&D projects of the type that the researcher is focusing on in this study.

Contributions to the literature are therefore needed to guide governments on how they can successfully manage the R&D projects that they fund. Organizations need to identify the CSFs that affect the success of such projects. In this connection, the principal objective is to collect reliable, valid, and unbiased data from a representative sample, in a timely manner, and within given resource constraints.

Quantitative investigators pick up expectations and clarifications that apply to different locations and persons. Both primary and secondary data are gathered in accordance with the research objectives. Ajayi (2017) noted that primary information offers the researcher a more significant level of control. The primary data for this research were collected from a questionnaire, and the measures of the questionnaire were constructed according to the variables identified for the research.

Secondary data are data that already exist in some structure or other; they are the starting point for information accumulation, as they form the first sort of information to be gathered (Ajayi, 2017). Use of secondary data is known as documentary research, and it draws on the literature and academic articles to gain a significant understanding of relevant concepts and theories. The secondary data for this research come from the literature that was reviewed in Chapter 2. The relevant knowledge is derived from journal articles, previous research papers, and scholarly references, with a major critical focus on theoretical and methodological concepts of organizational restructuring, starting with its definitions, importance, relevant theories, variables, and constructs. Throughout the literature review, the research framework acted as a guide for identifying related variables, measured constructs, and items from questionnaires, so that the hypotheses could be created and a questionnaire designed.

Hence, the current study employs the type of quantitative research strategy that is appropriate for small-scale research because it applies a rational openness to the research problem. As discussed, the quantitative research strategy is founded on a traditional empiricist approach, where the researcher is subjective and the results depend on the researcher’s perspective. The justification for using such a strategy is based on the fact that it employs a formal approach and is value-free and free from bias. The quantitative strategy employs survey instruments or experiments to obtain the required data. This strategy is preferred for its accuracy, reliability, and validity.

Quantitative research encompasses the use of systematic empirical evaluation of observable situations against mathematical or statistical techniques. This research method aims to employ and develop mathematical theories and models concerning a particular situation, formulating a relationship between mathematical expression and empirical observations. The researcher hopes to attain an unbiased outcome that can be applied to a larger population sample.

The descriptive correlation survey method used in the current study is an ideal method for acquiring valid, statistically consistent information from the employees of selected companies. Scholars and researchers prefer this specific survey approach because of its accuracy and reliability in capturing information. In this case, the descriptive correlation survey method will be used to capture the CSFs in managing government-funded R&D projects. Therefore, the design of the questionnaire will cover the specific perceptions and thoughts of the employees, while outlining the numerous critical factors that are encountered in the management of government-funded research projects.

3.3 Research Instrument (Questionnaire)

Oppenheim (1966) stated that a survey is a form of planned data collection for the purpose of description or prediction, as a guide to action or for the purpose of analyzing the relationships between certain variables. Later, Remenyi et al. (1998) stated that a survey involves the collection of data from a large group of people or a population. It is often used as the sole or primary source of quantitative data in management research. It can be used for description, explanation, and/or hypothesis testing (Bryman, 2012).

A survey can be conducted in several ways, ranging from face-to-face interviews to a postal questionnaire. The survey method has the advantages of being economic, efficient, suitable for a possible large sample of respondents, supportive of generalization, versatile, standardized, easy to administer, and suitable for statistical analysis (Bernard 2012).

Questionnaire survey design is an art and a science that invariably results in economic considerations forcing the researcher to sacrifice what is ideally required in light of what practical resources are available. It should be accepted that no questionnaire survey is perfect. The key to a successful survey is the care taken in carrying out the time-consuming preparatory work (Remenyi et al., 1998). However, De Vaus (1996) stated that there have been some more serious criticisms of survey research, namely that it is (1) inherently positivistic, (2) incapable of getting at the meaningful aspects of social behavior, (3) prone to looking at "bits" of behavior and specific opinions out of the context in which they occur, (4) inherently atomistic, and (5) mindlessly empiricist. Even though, De Vaus pointed out that, in many cases, it is not the survey research design per se that is at fault; rather, it is the inappropriate use of the survey questionnaire that contributes to its undeservedly poor reputation.

Generally, questionnaire forms allow data to be gathered about aspects such as "what," "when," "where," "how much," or "how long" (Bryman, 2012). However, they are less valuable as a methodology when the research is seeking answers to the questions of "who," "how," and "why."

In choosing a questionnaire method, consideration needs to be given to the availability of an appropriate sampling frame and to anticipated response rates (McColl et al., 2001).

For the present study, in light of its aim and context, a questionnaire survey was used to collect the required data. According to Boynton and Greenhalgh (2004), questionnaires offer an objective means of collecting information about people's knowledge, beliefs, attitudes, and behavior. Moreover, large amounts of information can be collected from a large number of people in a short period of time, which is more convenient for organizations, avoids work disturbance, and encourages good response rates.

Privacy is a very important factor that must be considered when collecting data from employees, especially in projects that are critical for the country. Questionnaires allow for a good level of privacy if they are managed effectively. Prior research on privacy has found that individuals are willing to disclose information in exchange for some economic or social benefit subject to the "privacy calculus," an assessment that their information will subsequently be used fairly and that they will not suffer negative consequences (Lee, 2011).

According to McColl et al. (2001), close attention to issues of questionnaire design and survey administration can reduce errors and therefore deliver more objective data. By using survey methods, researchers can describe a situation, study relationships between variables, and easily generalize findings (Muijs, 2011). Therefore, the survey questionnaire method fits well with the requirements of this study.

3.3.1 Questionnaire Design

Based on the literature review and operationalization of variables, a questionnaire was developed to collect data from different sectors that enrolled in R&D projects funded by the Abu Dhabi government. Accordingly, specific measures were derived from the literature and were justified and edited to suit the field culture. These measures were introduced and classified in the questionnaire, and all were measured on a five-point Likert scale ranging from 5 (strongly agree) to 1 (strongly disagree) (see Appendix).

The questionnaire started with a covering letter providing an explanation of the aim of the study, the procedures for completing and returning it, and an assurance of anonymity to the responding participants. All questions were set out in tables, and each section has a separate and clear title, making it easy for the respondent to answer. Respondents were allowed to remain anonymous, although they were invited at the end of the questionnaire to provide their contact addresses in order to receive the key findings of the survey.

The questionnaire consisted of three sections, each focusing on one or more of the dimensions of interest. Section 1 addresses overall demographics and background information. Section 2 focuses on the CSFs of R&D projects. Section 3 focuses on R&D project success. All questions were carefully worded, and several revisions were carried out to ensure clarity of sentence structure.

3.3.2 Pre-Testing and Revision

Before the questionnaire was sent to the members of the organizations for the purpose of collecting data, it was pre-tested in order to understand how it would be received by the respondents. This was done to reveal discrepancies as well as any overall shortcomings in the questionnaire in terms of structuring, formatting, and the overall mode and clarity of articulation that was used for presenting the questions to the respondents (Figure 4).

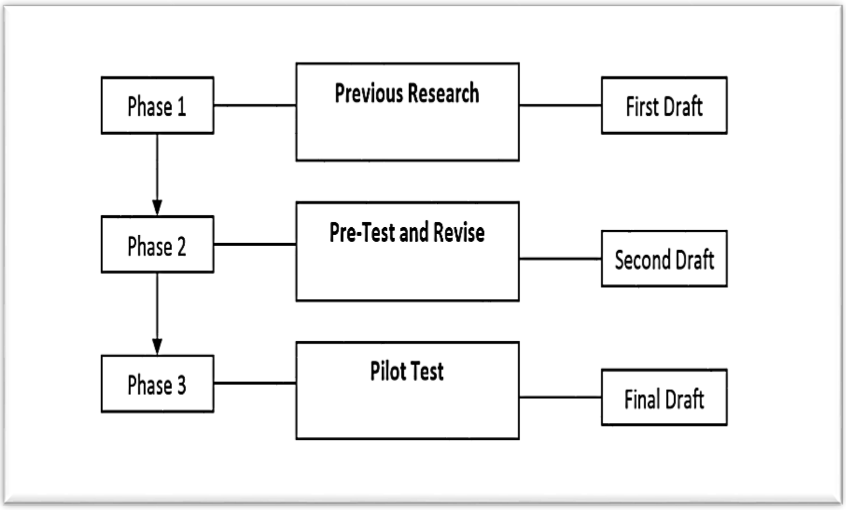

Figure 4: Questionnaire development process

In order to verify the validity and accuracy of the questionnaire, it was sent to a certain number of practitioners and academic researchers in order to obtain a complete and unbiased assessment of the questionnaire itself, including the inherent clarity of the questions, the overall reliability of each dimension, the overall articulation of the questionnaire, and the average time required to fill the questionnaire.

3.3.3 Operationalization and Scale Development

Chapter 2 provided a detailed review of the literature concerning several essential success factors for R&D projects. As discussed earlier, the objectives of the present study are as follows:

1. to explore the factors that affect R&D projects
2. to determine the effects of three types of factors (strategic, tactical, and operational) on project success
3. to distinguish between the effects of each factor on project success.

This is an attempt to operationalize the specified variables in terms of the factors that affect their relationships. The hypothesized relationships between these independent and dependent variables will be examined using the research framework model illustrated in Chapter 2.

According to Williams (2015), the operationalization of variables is the process of converting conceptual definitions to operational forms. Two main approaches are used in measuring concepts; it can be done either through conceptual definition or through operational definition. The first approach presents theoretical concepts, while the second approach states the characteristics of a conceptual definition to render it into a measurable definition (Churchill & Iacobucci, 2002).

It has been suggested that conceptual theories become operational when they are clearer and more realistic, and that this is the basis of designing and developing a questionnaire (Williams, 2015).

Hence, in this case, the research variables are measured by developing a scale. Each of the variables has item measures linked to a Likert scale. The related literature provided the scales with support in terms of reliability and validity, as the scale measure tables of each variable specify. Despite the scarcity of theoretical research on construct measurement, Table 2 shows all of the variables/constructs, along with statements of how they were measured by other authors.

Table 2: Variables/constructs measured by previous studies

Factor	Question	Source
1. Independent variable 1.1 Strategic factors		
A. Government analysis	A.1 R&D policies that guide the allocation of resources in R&D projects are set by the government. A.2 The government may intervene in R&D projects that are not running smoothly. A.3 There is a system that keeps stakeholders focused on the mission of the R&D project. A.4 There is a review and evaluation system by the government on the progress of the project.	Cunningham & Link, 2013; Okamuro & Nishimura, 2015
B. Economic analysis	B.1 The economic impact of the R&D program is evaluated before the commencement of the project. B.2 The R&D project products have a strong market. B.3 Both human and non-human costs are identified before the project begins. B.4 There is a review and evaluation system on the financial progress of the project.	Tassey, 2012; Nagesh and Thomas, 2015
C. Leadership	C.1 R&D projects leaders motivate other personnel to maximize their potential in service delivery. C.2 Project leaders provide guidance and solutions for challenging issues and situations that might arise during the R&D project. C.3 Project leaders help to generate ideas and support innovation. C.4 Project leaders allow smooth communication and coordination to collect the information necessary for the project.	Fernandez & Jawadi 2015; Elkins & Keller, 2003; Denti, 2013
D. Disruptive technology	D.1 Disruptive technology offers problem-solving capabilities, as well as enhancing the capacity to develop new ideas and opportunities. D.2 Disruptive technology leads to new commercial products. D.3 Disruptive technology contributes to thinking outside the norms of product development. D.4 Innovation from disruptive technology requires effective integration of knowledge and information about the R&D project.	Hang and Garnsey, 2011; Ebrahim et al., 2009

Table 2: Variables/constructs measured by previous studies (Continued)

Factor	Question	Source
1.2 Tactical factors		
E. Communication	E.1 Effective communication boosts team morale and offers clarification of goals, tasks, and responsibilities. E.2 The stages from budgeting through technical specification of the product are well communicated within the project team. E.3 Project members and clients communicate effectively to identify the technological needs for the project. E.4 Effective communication maintains the support and commitment of all R&D stakeholders.	Barragan-Ocana & Zubieta-Garcia, 2013; Heinz et al., 2006; Nagesh & Thomas, 2015;
F. Staff capability	F.1 Project members are well assessed for their skills and knowledge for handling the project before it begins. F2. Project members are provided with the training required before the project begins. F3. The occupational and educational skills of R&D staff are highly reliable in developing the intellectual property of the project. F.4 There is continuous performance evaluation for project team members throughout the project.	Andre, 2013; Quelin, 2000
1.3 Operational factors		
I. Realistic schedules	I.1 A specified timeline for R&D is clearly identified, including a schedule that shows all stages from initiation to completion. I.2 Project schedules are evaluated and adjusted continuously evaluated to ensure that they are realistic. I.3 Project schedules are evaluated and agreed with all team members and stakeholders. I.4 Each milestone in the project plan is evaluated continuously against the overall plan.	Hussein and Klakegg, 2014; McGevna, 2012; Tuzcu & Esatoglu, 2011
J. Project feasibility	J.1 There is a proper examination of whether a project is profitable or viable for an organization before conducting the project. J.2 There is detailed and comprehensive planning that accounts for potential difficulties with the project before it starts. J.3 There is a proper crisis management plan in place before the project starts. J.4 The scope of the project is clearly identified before it starts.	Bause et al., 2014; Nagesh & Thomas, 2015;

Table 2: Variables/constructs measured by previous studies (Continued)

Factor	Question	Source
K. Client involvement	K.1 Project plans are clearly explained to clients and adjusted accordingly before the project starts. K.2 There is continuous interaction between the clients and the project team throughout the project. K.3 The challenges of the project are clearly communicated to the client, and alternative solutions are always presented. K.4 The client conducts a comprehensive evaluation of the project team after each milestone and after the completion of the project.	Kujala, 2003; Tuzcu & Esatoglu, 2011; Hooge & Dalmasso, 2015
2. Dependent variables		
2.1 Project success factors		
L. Timeline achieved	L.1 The project timeline was defined on the basis of close cooperation with the project team and the stakeholders. L.2 The project timeline was rarely reviewed or adjusted in the course of the project. L.3 The milestones of the project were achieved according to the schedule for each milestone. L.4 The final product of the project was reviewed and adjusted before the final submission to the client within the overall project timeline.	Jiang, 2014; Allen et al., 2014; Muller & Turner, 2010
M. Objectives achieved	M.1 The goals and objectives of the project were in line with the general goals and objectives of the organization. M.2 The goals and objectives of the project were made clear to the project team before the initiation of the project. M.3 The client satisfaction with the final result was high. M.4 There was a clear audit activity throughout the project to ensure that that the objectives were met.	Borman & Jansenn, 2013; Kuen & Zailani, 2012; Yalegama, Chileshe, & Ma, 2016
N. Cost achieved	N.1 The project costs that were identified before the start of the project are equivalent to the costs of the project after completion. N.2 There were continuous project budget update meetings throughout the project. N.3 Cost performance reports were continuously prepared throughout the project. N.4 A clear budget contingency plan was in place before the initiation of the project.	Kuen & Zailani, 2012; Ashokkumar, 2014; Kendra & Taplin, 2004

Table 2: Variables/constructs measured by previous studies (Continued)

Factor	Question	Source
3. Moderating factors		
H. Organizational culture	H.1 The project team members have a common understanding of the values of the organization. H.2 The organization fosters a culture that enhances commitment among employees and help them to cope with stress and to come up with new ideas. H.3 The cultural values and demographic factors of the project team affect the success of the project. H.4 The organizational culture supports a learning environment.	Belassi, 2013; Tajudin et al., 2012; Saxena & Shah, 2008

Source: Designed by researcher.

3.3.4 Measurement

Multiple-item Likert scales were used to measure the variables in the present study because they offer an appropriate interval scale for measuring behavioral variables (Churchill, 1979). Undoubtedly, the reliability and validity of multi-item scales tend to improve as the number of items increases (Peter, 1979). A Likert scale is very commonly used in the context of human resources and organizational change. There are no specific rules for deciding on the type and number of scale points chosen. Either odd or even numbers are eligible, and the scales may range between five and 10 items. Parasurman (2007) reported that it would be better to test the existing literature on related studies. In this study, the number of scale points is restricted to five, for two reasons. First, this is consistent with some previous studies. Second, it is much quicker for respondents to answer using a five-point scale.

3.4 Population and Sample

As defined by Kothari (2004), a sample design is a method by which a particular group of individuals is selected from a population in order to facilitate the progress of the study by becoming the center of information that can be used to reach a cohesive conclusion. The individuals whose activities, responses, and inherent understanding contribute to an overall development of the study itself are deemed necessary for a systematic conclusion to be reached, owing to the kind of information that can be gathered by studying them or understanding them through methods including interviews and survey questionnaires (Wilson et al., 2014).

Accordingly, the aim in this study was to select a population representing government organizations in Abu Dhabi that have carried out R&D projects. The researcher approached the main sectors involved in R&D projects: health, energy, information security, and agriculture.

After selecting these sectors, researcher obtained the following information from each sector: the number of employees involved in R&D projects at all levels, and the organization structure detailing the names of all departments. In this way, the researcher targeted efforts to disseminate the survey online to all employees who met the research inclusion criteria.

Among the important defining factors in selecting a sample are the inherent parameters that a population has to fit in order to be suitable fit for the purpose of the study as a whole. For instance, a research topic may involve singling out the people within the population who represent or carry a particular characteristic or trait of interest to the study or to the research topic as a whole; alternatively, the study may focus on understanding some particular trend within the population itself through measurement of a particular trait or pattern within the population as a whole (Mugo, 2002). Therefore, survey responses received from anyone working outside of Abu Dhabi city were excluded, as the researcher wanted to focus on Abu Dhabi-based employees in the selected sectors to ensure similarity within the sample.

Consequently, 384 responses were obtained, of which 84 responses were excluded for incompleteness. Therefore, the final sample consisted of 300 respondents. In order to adhere to research ethics, and as desired by organizations involved in the research, the organizations remain anonymous and the researcher classifies respondents by the sector in which they work.

3.5 Data Collection

Before starting the data collection process, the researcher visited the selected sectors and met with authorized persons to discuss the research, explain the objectives and the aim of the study, and request their approval and support. Because the researcher had no professional connections with researchers within the government sector in Abu Dhabi, entry into organizations was difficult, owing to the large number of contacts and “personnel bridges” that were present in these sectors.

An email was sent to all employees to explain the aim and purpose of the survey and to request their participation and cooperation. In coordination with human resources departments, a schedule was prepared for the sample respondents to fill the questionnaire, bearing in mind the need to include a good number of participants from all sectors, and ensuring confidentiality for the participants.

In order to ensure a good response rate, the researcher reminded employees to respond with minimal interruption to work and to reduce the time they spent on it, if necessary. The “drop and collect” method was also used where appropriate. This method can yield a response rate similar to that of interviewing at a cost equivalent to that of questionnaire mailing (Trentelman et al., 2016). Moreover, personal contact with respondents permitted maximum flexibility when explaining the objectives of the survey and when administering the questionnaire.

The response rate was close to excellent (78%), as illustrated in Table 3. A number of factors seem to have encouraged this response rate: the drop and collect method, a degree of support from management in all sectors, and the majority of employees being interested in helping to improve the status of R&D projects. In addition, the questionnaire was attractive because it was built on a comprehensive review of the literature and the context of the study and validated by experts and practitioners.

Table 3: Survey questionnaire response

Sample size collected through online survey	Eligible for analysis	Approximate response rate (%)
384	300	78

The required sample size was collected in three months. The reliability of these responses was checked through data analysis. The process involved editing, coding, and entry into Statistical Package for the Social Science (SPSS®) version 24 to detect any errors and omissions, to correct them where needed, and to confirm that the relevant data quality standards had been met. The study variables were coded into SPSS-compatible formats for use in the data analysis, with each variable receiving a unique label so that the computer software could analyze the data. After each questionnaire had been checked for errors and omissions, the answers were manually entered into the computer and the data was ready for analysis.

In this study, item-to-total correlations were used to measure reliability. This method is the procedure most commonly used by researchers to guarantee the reliability of a multi-item scale (May, 1997). Furthermore, frequency analysis was used along with several other statistical techniques to study the research variables and their relationships. The next section briefly discusses these techniques.

3.6 Analysis Tools

3.6.1 Factor Analysis

It is an essential to use factor analysis specially when researchers have to reduce their data and interpret their results. Factor analysis is a generic name given to a class of multivariate statistical methods whose primary purpose is to define the underlying structure in a data matrix (Hair et al., 2017). Factor analysis identifies the problems of analyzing the structure of the interrelationships (correlations) between variables by defining a set of common underlying dimensions, known as factors. This tool is also used to check whether indicators bunch in ways proposed by the a priori specifications of the specified dimensions (Bryman & Cramer, 2001). Through this technique, several new variables called factors are set up. However, these variables cannot be observed, nor can they be explained in terms of observations made by the researcher.

To sum up, factor analysis brings up underlying dimensions that, when interpreted, can describe data in terms of fewer items than the original number of individual variables. The core purpose of factor analysis is to summarize the information contained in several original variables into smaller sets of new composite dimensions or variables (factors) with minimum loss of information (Field, 2013; Hair et al., 2017). Other related purposes of factor analysis including the following: (1) to select a subset of variables from a larger set based on which original variables have the highest correlations with the principal component factors;

(2) to create a set of factors to be treated as uncorrelated variables as one approach to handling multi-collinearity in such procedures as multiple regressions; (3) to validate a scale or index by demonstrating that its constituent items load onto the same factor and to drop proposed scale items which cross-load onto more than one factor; (4) to establish that multiple tests measure the same factor, thereby providing a justification for administering fewer tests; and (5) to determine network groups by determining the sets of people that cluster together.

3.6.1.1 Factor Analysis Requirements

Specific requirements have to be taken into consideration before factor analysis can be applied. These include sample size requirements, Bartlett's test of sphericity, and the Kaiser–Mayer–Olkin measure of sampling adequacy.

3.6.1.1.1 Sample Size Requirements

There are many issues to note when considering minimum sample sizes. The minimum sample size recommendation of 100 comes from simulation studies (Anderson & Gerbing, 1988) indicating that an unacceptable number of models failed to converge when the sample size was 50 and that a much more acceptable number (5% or less) failed to converge if the sample size was 100. Sufficient power to reject a model based on the chi-square test of the model is another important consideration, along with how alternative fit indices perform with different sample sizes (Hu & Bentler, 1995). Another consideration is sufficient power for individual parameter tests (loadings and paths). The ratio of cases to free parameters (N:q), which is sometimes stated in terms of indicators in the context of confirmatory factor analysis (CFA), is commonly employed for minimum recommendations, but may not be as important as other factors such as the overall sample size (> 200–400) and magnitude of the loadings (e.g., standardized value > .60) (Jackson, 2003). In fact, Wolf and colleagues (Wolf et al., 2013) showed that having more indicators per factor generally leads to smaller required sample sizes rather than larger required sample sizes. Whether the model has been misspecified (i.e., whether the true model differs from the one tested) is also critical in the decision of how many tests to perform under various sample size conditions. Absolute fit indices such as chi-square and root mean square error of approximation (RMSEA) appear to be more sensitive to misspecification than relative fit indices such as the confirmatory factor index. Hu and Bentler (1995) suggested that there may be a tendency for the combination rules of absolute and relative fit indices to overreject models when the sample size is less than or equal to 250. Jackson's results suggest a highly complex set of interactions among specific fit index, loading magnitude, misspecification, and the N:q ratio, making it clear that there is no simple rule to follow.

3.6.1.1.2 Bartlett's Test of Sphericity

This is a statistical tool that can be used to test the hypothesis that the correlation matrix is an identity matrix (a matrix in which all on-diagonal terms are 1 and all off-diagonal terms are 0). This test requires that the data be a sample from a multivariate normal population. The best results from this test are found when the value of the test statistics for sphericity (which is based on the chi-square transformation of the determinant of the correlation matrix) is large and the significance level is small (Nunnally & Bernstein, 1994).

3.6.1.1.3 The Kaiser–Meyer–Olkin (KMO) Test

The KMO test is a sampling measure of adequacy. It is also an index used to compare the magnitudes of the observed correlation coefficients to those of the partial correlation coefficients. The sum of the squared partial correlation coefficients between all pairs of variables ranges from 0.0 to 1.0, with small values indicating that factor analysis is not valid since the correlations between pairs of variables cannot be explained by the other variables. Kaiser (1974) described KMO measures in the 0.90s as “marvelous,” in the 0.80s as “creditable,” in the 0.70s as “middling,” in the 0.60s as “mediocre,” in the 0.50s as “miserable,” and below 0.50 as “unacceptable.” For Kinnear & Gray (1999), too, the measure should be greater than 0.50 for a satisfactory factor analysis.

3.6.1.2 Steps in Factor Analysis

The first and most important step in factor analysis is the computation of a correlation matrix for all variables to determine whether they have adequate relationships and, consequently, common factors. Factor loading is used to interpret new factors and is followed by the extraction of the factors through multiple iterations to determine the minimum number of common factors that will explain the observed correlations between the variables. Third come the factor rotations, which transform the initial matrix obtained through extraction into one that is easier to interpret (Norusis, 1993). The final step is the factor naming and interpretation process, discussed below.

3.6.1.2.1 Test of Appropriateness

Generally, the variables of factor analysis are assumed to be capable of metric measurement. Sproull (1988) claimed that factor analysis needs variables to be at least of interval, while Hair et al. (2017) suggested that, in some cases, dummy variables (coded 0–1), which are considered non-metric, can also be used; if all variables are dummy variables, then specialized forms of factor analysis are more appropriate. Further, it is important to consider that not all types of data can be used in factor analysis and that specific requirements should be met before factor analysis is implemented.

3.6.1.2.2 Factor Extraction

After the appropriateness of factor analysis has been verified, the method of factor extraction and the number of factors to be extracted should be determined. The core aims of factor extraction are to decide on the factors and to set a minimum number of common factors to satisfactorily explain the observed correlation among the observed variables (Norusis, 1993). Norusis (1993) reported several factor extraction methods: (1) principal component analysis (PCA), (2) principal axis factoring, (3) alpha factoring, (4) image factoring, and (5) maximum likelihood.

PCA is a factor model in which the factors are based upon total variance. PCA is suitable when a researcher is concerned about the minimum number of factors needed to account for the maximum portion of variance represented in the original set of variables (Hair et al., 2017). Unlike principal axis factoring, which analyses only common variance, PCA analyses all the variance of a score or variable, including its unique variance, provided that the test used to assess the variable is perfectly reliable and free from error (Bryman & Cramer, 2001).

Hence, in this study, PCA has been used throughout to ensure consistency in the factors and also to decide the number of factors needed to represent the data, when to end the extraction process, and to estimate the final number of factors to be extracted. A number of criteria, such as commonalities, eigenvalues, and scree plot, were measured.

Commonalities are used to measure the association between an original variable and all the other variables included in the analysis (Hair et al., 2017). Values can range between 0 and 1, where 0 indicates that the common variance factors explain none of the variance and 1 indicates that all the variance is fully explained by the common factors. High commonalities are the sign of a high degree of confidence in the factor solution (Norusis, 1993).

The eigenvalue represents the standard variability in the total data set (equal to the number of variables included), which is accounted for by an extracted factor in factor analysis. Only factors that account for variances greater than 1 should be included (Norusis, 1993).

Lastly, a scree plot is a graph that plots the amount of variance accounted for (in eigenvalues) by the factors initially extracted. The plot usually shows two distinctive slopes, a steep slope for the initial factors and a gentler one for the subsequent factors (Bryman & Cramer, 2001).

3.6.1.2.3 Factor Rotation

The purpose of rotation is to simplify the rows and columns of the factor matrix and to facilitate interpretation. However, no method of rotation enhances the degree of fit between the data and the factor structure, and any rotated factor solution explains exactly as much covariation in the data as the initial solution (Kim &

Mueller, 1978). Factor rotation also highlights the number of factor commonalities in each variable, the percentage of the total variance explained (eigenvalues), and the factor loading. The most common methods of rotation are Varimax orthogonal rotation and Oblimin oblique rotation. However, Varimax is considered the more popular of the two.

3.6.1.2.4 Factor Loading and Factor Naming Process

Interpretation of the factors is the final step, and most of the interpretations are based on the factor loading values. According to Hair et al. (2017), factor loading is the "correlation between the original variable and the key to understanding the nature of a particular factor; and squared factor loadings indicate what percentage of the variance in an original variable is explained by a factor." Additionally, to identify the factor, it is important to group the variables that have large loadings for the same factors. This can be done by sorting the factor pattern matrix so that variables with high loadings on the same factor appear together (Norusis, 1993). For this purpose, Comfrey and Lee (1973) presented useful guidelines; for example, any loading greater than +0.71 or –0.71 is excellent, + or –0.63 is very good, + or –0.55 is good, + or –0.45 is fair, and + or –0.32 is poor.

3.6.2 Other Variable Measurement Tests

Several measurement test are important to the success of any research. According to Peter (1979), assessing measurement is crucial because "behavioral measures are seldom if ever totally reliable and valid, but the degree of their validity and reliability must be assessed if research is to be truly scientific." Therefore, several measurement tests are discussed below.

3.6.2.1 Validity

Validity is concerned with assessing whether the scale measures what it is intended to measure (Cooper & Emory, 1995). It is concerned with whether the right concept is being measured. Parasuraman et al. (2007) defined the validity of a scale as “the extent to which it reflects the underlying variable it is attempting to measure.” Researchers can use various methods to test validity in this regard, including content validity, criterion-related validity, and construct validity.

3.6.2.1.1 Content Validity

Content validity is the extent to which the domain of the characteristics of a concept that one desires to measure are in fact captured by one’s measurement (Bagozzi & Yi, 1988). According to Nunnally and Bernstein (1994), a measure has content validity if there is general agreement among the subjects and researchers that the instruments have measurement items that cover the content domain of the variables being measured. The researcher can achieve content validity through careful definition of the research problem, the scaled items, and the scale used. This logical process is unique to each researcher (Emory, 1991).

However, the measurement scale must meet certain conditions before being applied in empirical work. As described by McDaniel and Gates (1996), these are: (1) defining specifically what is to be measured, (2) carefully conducting a literature review and interviews with the target population, (3) expert checking of the scale, and (4) ensuring that the scales are pre-tested and that open-ended questions are used to identify other items to be included.

3.6.2.1.2 Criterion-Related Validity

This is the degree to which the measurement instrument can predict a variable (assigned) criterion. Criterion-related validity is the extent of the correspondence between the measures being tested and other accepted measured measures. Bagozzi and Yi (1988) described this as "the degree of connectedness of a focal measure with other measures." Establishing concurrent validity or predictive validity can guarantee criterion-related validity. The former is concerned with the degree to which a measure is relevant to another measure (the criterion) when both are measured at the same time, whereas the latter examines the extent to which current scores on a given measure can predict the future scores of another measure (the criterion) (Diamantopoulos & Schlegelmilch, 2000).

3.6.2.1.3 Construct Validity

Construct validity is the most commonly cited type of validity assessment in the field of social science. It is established by relating a measuring instrument to a general theoretical framework in order to determine whether the instrument is tied to the concepts and the theoretical assumptions that the researcher is employing (Nachmias & Nachmias, 1996). It is significant because it can identify an unobservable dimension of the construct being measured. This measurement can be of two kinds, discriminant and convergent validity. Discriminant validity is concerned with demonstrating that a measure does not correlate with another measure from which it is supposed to be different. Convergent validity aims at measuring the degree of association among the scale items developed to measure the same concept (Churchill, 1979).

Factor analysis is the most common instrument for testing both types of construct validity, for two reasons: first, it identifies the underlying constructs in the data, and, second, it reduces the number of original variables to a smaller set of variates (factors) (McDaniel & Gates, 1996).

Several techniques were brought in to achieve this aim. The study instruments and the questionnaire were fully developed using a process based on the literature consulted at an earlier stage of this study. The questionnaire was tested and revised. Three academic researchers experienced in questionnaire design were asked to give their feedback, and the questionnaire was piloted by three field experts, who were asked to make suggestions concerning the clarity of the wording, the correct use of specific words, the ambiguity and consistency of the questions, and the overall presentation. As a result, some amendments were made to improve the questionnaire.

3.6.2.2 Reliability

Reliability refers to whether the measurement scale is consistent and stable. In other words, it is the degree to which a test produces similar results in constant conditions on all occasions (Bell, 1996). Price and Mueller (1986) posited that reliability is “the consistency of a measure,” because it focuses on the items forming the scale. Moreover, reliability is a contributor to validity, and it is a necessary but not sufficient condition of validity. Generally, there are three methods for measuring reliability: test–retest, alternative forms, and internal consistency (Davis & Cosenza, 1993). The major difference between them is the scale according to which they compute the reliability coefficient (Peter, 1979).

In the test–retest approach, the same scale is applied to the same subject at different times, and the correlation between the two sets of observations is computed.

While this method provides useful information about the stability of a measure, it leads to higher data-gathering costs and often reduces the number of usable responses because respondents are unwilling to engage in another test (McDaniel & Gates, 1996). In addition, using this approach may produce different results, owing to the time intervals between the two tests (Churchill, 1979). For these reasons, test–retest is not recommended as a sole method of reliability assessment. Besides, it is difficult to develop similar, but not identical, items that specifically measure the same construct. Parallel forms reliability is a measure of reliability obtained by administering different versions of an assessment tool (both versions must contain items that probe the same construct, skill, knowledge base, etc.) to the same group of individuals. The internal consistency approach deals with the homogeneity of individual items to other items measuring the same construct (Peter, 1979).

Hence, if two items are used to measure one construct, the item-to-item correlation should be high. Cronbach's alpha is the mean reliability coefficient for all the possible ways of separating a set of items into two halves. A high alpha value indicates greater internal reliability in a measurement scale, whereas a low alpha value indicates that the items used do not capture the construct and that some items may have to be eliminated. For Nunnally and Bernstein (1994), a reliability score of 0.5 to 0.6 is sufficient. Churchill (1979) claimed that this method is suitable for a scale of at least three items. Hence, in the present study, Cronbach's alpha was computed to evaluate the reliability of all scales consisting of three or more items.

3.6.3 Hypothesis Testing

3.6.3.1 Structural Equation Modeling

In recent years, structural equation modeling (SEM) has been increasingly used in the field of social sciences. It is a multivariate statistical method that involves the estimation of parameters for a system of simultaneous equations. It is a wide framework, as it includes regression, pathway, and factor analysis, as well as simultaneous econometric equations and latent growth curve models (Civelek, 2018).

SEM is a statistical method used to test the relationships between observed and latent variables. The observed variables are the variables measured in the data collection process, while the latent variables are the variables measured through the observed variables (because they cannot be measured directly). SEM consists of two basic components: a structural model and a measurement model (Meydan & Şen, 2011) (Figure 5).

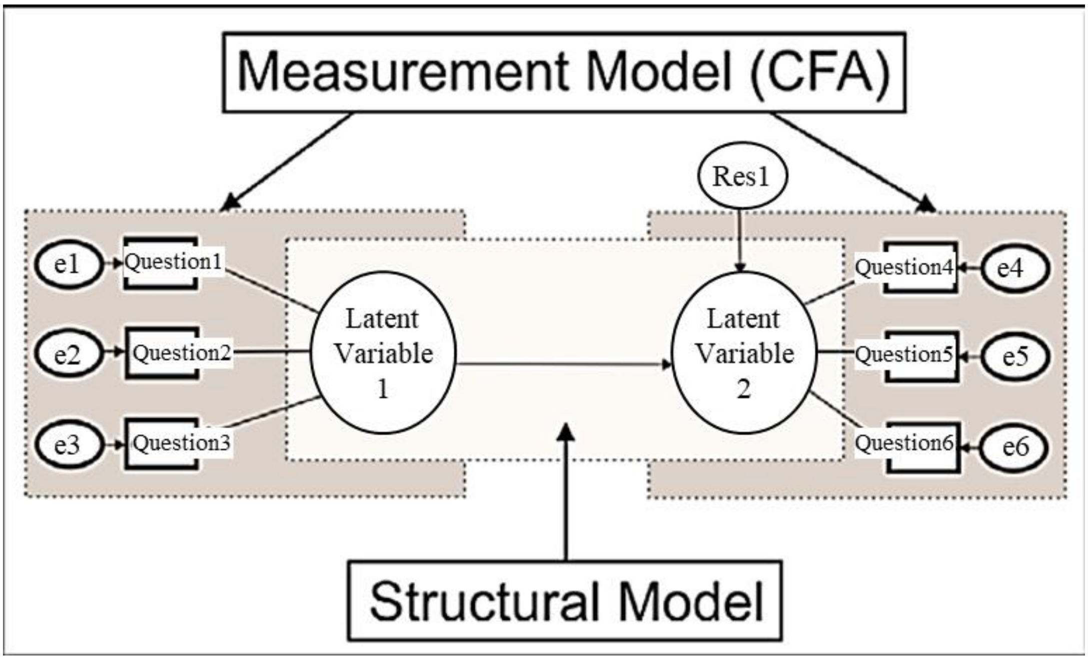

Figure 5: Demarcation between measurement model and structural model
Source: Byrne (2010).

The most important reason for the popularity of this statistical technique is that it allows the direct and indirect relationships among causal variables to be measured with a single model (Meydan & Şen, 2011). Another motive for using this method is its ability to take into account measurement errors and the relationships between errors in the observed variables; therefore, errors can be minimized. This contrasts with traditional regression analysis, where potential measurement errors are neglected. Another way that SEM models differ from regression models is that they are based on the covariance matrix. For this reason, in some sources, they are referred to as covariance structure modeling or analysis of covariance structure (Bayram, 2013). The correlation matrix is the basis of the regression. Covariance is a non-standardized measure of the relationship between two variables, so it can take values between $-\infty$ and $+\infty$. Correlation, however, can take values between -1 and $+1$, since it is standardized (Gujarati, 1999). SEM differs from some other multivariate statistical methods in that it is a confirmatory approach. Confirmatory approaches include analysis of variance, logistic regression, multiple regression, CFA, and covariance-based SEM, while explanatory approaches include cluster analysis, exploratory factor analysis (EFA), multidimensional scaling, and partial least squares modeling. Most statistical methods other than SEM try to discover relationships within the data set (Hair et al., 2017).

For this reason, it can be said that SEM is more suitable than other methods for testing hypotheses (Karagöz, 2016). SEM consists of a system of linear equations. The key in the regression analysis is to determine how much of the change in the dependent variable is explained by the independent variable or variables. Although multiple regression analysis can be carried out only on observed variables, the basic principles can be applied to SEM (Kline, 2011).

Unlike regression analysis, SEM allows research hypotheses to be tested in a single process, modeling complex relationships among many observed and latent variables. In traditional regression analysis, only direct effects can be detected; in SEM, direct and indirect effects are dealt with together.

In order to test the accuracy of the conceptual model, the most common method encountered in the literature on SEM is a two-stage method consisting of a measurement model and a structural model. In the first stage, the measurement model is tested; in the second stage, the structural model is tested. The measurement model measures how well hidden variables are represented by the observed variables. It mainly involves CFA, and it indicates the construct validity of scales. Therefore, if the measurement model fit indices are low, it will not make sense to test the structural model (Dursun & Kocagöz, 2010). As Figure 3 shows, SEM is a compound of factor analysis and regression analysis; the measurement model and the structural model are interwoven. Nevertheless, SEM is based on the confirmatory approach, as t is based on the statistical confirmation of the theoretical model. For this reason, the measurement model is CFA (discussed above).

The first step in SEM testing is visualizing the hypothesized model or creating a “path diagram” based on prior knowledge and/or theories. In path diagrams, rectangles represent observed or directly measured variables, and circles/ovals represent unobserved or latent constructs that are defined by measured variables. Unidirectional arrows represent causal paths (where one variable influences another directly), and double-headed arrows represent correlations between variables. Some prefer the term “arc” rather than “causal path” (McDonald & Ho, 2002; Pearl, 2000).

For general SEM analysis, a number of packages are available, including AMOS (an add-on to SPSS) One major consideration in the choice of software is the balance between ease of use and capability. A benefit of AMOS is that it allows the user to draw the SEM diagram that will be fitted. However, it is recommended that AMOS be used with extreme caution, since it is too easy to draw a path diagram without thinking through the parameterization and the theoretical implications. A comparison of the most commonly used SEM software packages is provided by Buhi, Goodson, and Neilands (2007).

In SEM, the measures that assess the compliance of the models with the data are called fit indices or fit statistics. There are many fit indices in the literature. The size of the sample should be considered in the analyses to be performed by the SEM, because many fit indices are affected by sample size. The minimum sample size to be used in the SEM method is at least 10 times the number of parameters that can be estimated in the model (Jayaram, Kannan, & Tan, 2004). In addition, the minimum sample size for SEM is suggested as 150 (Bentler & Chou, 1987). Some researchers have suggested that the sample size for SEM should be 200–500, and in any event no fewer than 200 (Çelik & Yılmaz, 2013).

CMIN is the likelihood ratio chi-square test. This test shows the correspondence between the proposed model and the actual model, and it is the most commonly used fit index. As a result of this test, it can be evaluated whether the covariance matrix of the sample with which the model is tested is equal to the population covariance matrix. Since this test is a test of difference, it is not desirable for the chi-square value to be significant. When the ratio of CMIN to degrees of freedom (DF) ratio is less than 3 and the chi-square value is insignificant, this indicates that the model’s overall fit is within acceptable limits (Meydan & Şen, 2011). The DF is calculated from the number of observations in a model and the number of the parameters that need estimation, assuming that the number of observed variables in a models equals p. Models with zero DF in the SEM are called saturated models, and these. have a perfect fit with the data. A negative DF indicates that the model cannot be defined; the model can be defined if the DF is not negative (i.e., zero or positive).

The comparative fit index (CFI) compares the saturated model with the independent model. In the independent model, there is no relationship among the dimensions that form the research model. CFI values can range from 0 to 1, with values above 0.90 and close to 1 showing good fit (Schermelleh-Engel, Moosbrugger, & Mülleret, 2003). CFI belongs to the group of fit indices based on independent models.

The adjusted goodness-of-fit (AGFI) index is calculated using the DF. It is affected by sample size; when the sample size increases, the value of the AGFI index also increases. AGFI takes a value between 0 and 1, with values over 0.90 indicating that the fit is good (Bayram, 2013).

The goodness-of-fit (GFI) index is a measure of the degree of variance and covariance that is explained by the model. The value of the GFI fit index rises as the sample size increases, a feature that can prevent accurate results when the sample size is low. The GFI value ranges from 0 to 1. Values above 0.90 are considered acceptable model indices and indicate that covariance is calculated among the observed variables. Both GFI and AGFI fit indices are based on the residuals (Bayram, 2013).

The root mean square error of approximation (RMSEA) is a measure of fit that compares the mean differences of each expected DF that can occur in the population. This scale is adversely affected by sample size. A value of 0.05 or less for the RMSEA fit index indicates good fit (Bayram, 2013), and values between 0.05 and 0.08 indicate acceptable fit (Byrne, 2010).

3.7 Summary

It is essential to discuss research methodology, because this directs the research to its main aim and objectives as much as the research questions do. The selection of particular approaches and strategies affects the overall quality and accuracy of the research; hence, researchers should define their research methodology clearly. The discussion here indicates that no single research approach or strategy can be regarded as the best; therefore, the focus should be on the research objectives and questions, so that an appropriate research approach and strategies can be identified and adopted.

In this case, the researcher used a survey questionnaire; this chapter has defined the questionnaire, justified its use as the primary source of data collection, and described the process of its construction. This chapter also discussed the population and the necessary steps for meeting the relevant population criteria in the sample. The statistical analysis techniques adopted and the use of the SPSS package to compute the data were also explained, thereby setting the foundation for the data collection.

3.8 Ethical Considerations

To ensure that ethical factors were taken into consideration, all the data gathered from the surveys were validated. Participants' identities will be kept anonymous to ensure that they are not affected. The supervisor and the co supervisor were updated continuously on the progress of this research. The ethical clearance processes in the university were followed.

Prior to the research, written approval was obtained from the management of the relevant government organizations to ensure proper access to the information and data required. Meetings were organized with the people concerned to ensure that there was support from the organizations under study.

Chapter 4: Purifications and Measures of Descriptive Analysis

4.1 Introduction

In this chapter, the researcher describes the data collected and the steps that were carried out to ensure they were of appropriate quality for statistical analysis. This process began with data screening, which included checking for accuracy, missing data analysis, checking for outliers, verifying the distribution assumptions, and testing for common method bias to ensure the accuracy and completeness of the data and their suitability for multivariate statistical analysis. The next step was descriptive analysis to obtain insight into the data in terms of their value and contribution to the aims of the research. The third step involved the purification of the measuring instruments, expressed by Cronbach's alpha as an indicator of the reliability of a scale measurement. Finally, the validity of the measures was considered, and factor analysis was used to examine them. Chapter 5 describes the subsequent analysis (i.e., hypothesis testing and interpretation of the findings in the context of the research aims).

4.2 Data Screening

According to Tabachnick and Fidell (2007), it is important to clean data before initiating the analysis. In this study, the first step was to prepare the data for analysis in terms of editing, coding, and entry to the SPSS® statistical package, version 24, after it was exported from the Excel spreadsheet provided by the online survey platform, Google Drive.

Screening for errors and omissions was performed to ensure the quality of the data. Next, the study variables were coded and entered into SPSS® in a certain format, with a unique label that distinguished each variable during the analysis.

4.2.1 Missing Data

It is important to identify the nature of missing values in data collected for research. Hair et al. (2017) and Tabachnick and Fidell (2007) stated that a large quantity of missing values has a serious impact on the quality of statistical analysis and can lead to unreliable and biased results. Enders (2010) pointed out that missing values are relatively common in the data sets used in the social, behavioral, and medical sciences and that some statistical analyses cannot be performed when values are missing. One option for handling missing data is to delete the cases or variables affected, provided these variables are not critical to the study; this method is recommended when the sample size is large and/or when the respondents have not answered all the questions in the survey (Tabachnick & Fidell, 2007).

Taking this into consideration, a careful search for missing values was conducted. From a total of 384 respondents, 84 cases of missing data were found. As enough complete responses were obtained (300 responses), the data were using the deletion procedure.

4.2.2 Normality and Outliers

Byrne (2016) and Kline (2005) defined the normality assumption as the shape of the data distribution for each variable being bell-shaped. In this study, a skewness–kurtosis approach was adopted to test univariate normality for each variable (Byrne, 2016; Kline, 2005).

Osborne and Overbay (2004) defined outliers as survey responses that have unusually high or low values that make them distinctly different from other responses for the same variable (univariate outliers). Tabachnick and Fidell (2007) characterized outliers as values that are extreme compared to the rest of the study data, where this affects data normality (as normality is an important assumption of many statistical tests). Generally, outliers are classified into two types: univariate and multivariate. Univariate outliers represent cases with an extreme value in one variable, while multivariate outliers are cases with strange combinations of scores on two or more variables (Tabachnick & Fidell, 2007). Osborne and Overbay (2004) pointed out that outliers could be a unique combination of several responses that stand out from other responses across multiple variables, as in the case of multivariate analysis (multivariate outliers). Outliers can distort the results of a statistical analysis by increasing error variance, reducing the power of statistical tests and biasing estimates of substantive interest. Therefore, outliers have to be detected and resolved to achieve adequate data quality.

There are several possible ways of dealing with outliers. One option is deletion; if there are a few outliers, those values may simply be deleted (Tabachnick & Fidell, 2007), especially if the item is not well constructed or if many outliers are found for this variable. As an alternative to deletion, the value may be changed to the next highest or lowest non-outlier value. Transformation of the entire variable is a further way of dealing with outliers.

In practical terms, univariate outliers in a data set can be detected by using the Kolmogorov–Smirnov and Shapiro–Wilks tests, which are considered useful ways to test the normality of data for purposes of statistical assessment. The current study focused on the Kolmogorov–Smirnov test, because the number of responses was

300; the Shapiro–Wilk test is considered suitable when the number of cases is lower than 50. The results of the Kolmogorov–Smirnov test (Table 4) for the current data were not statistically significant, indicating a significant difference from normal distribution (the significance value of the test was below 0.05).

Table 4: Kolmogorov–Smirnov test and Shapiro–Wilk tests of normality

	Kolmogorov–Smirnov			Shapiro–Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Mean_A_Gov_analysis	.228	300	.000	.860	300	.000
Mean_B_Eco_analysis	.156	300	.000	.900	300	.000
Mean_C_Leadership	.158	300	.000	.921	300	.000
Mean_D_Disruptive_tech	.155	300	.000	.943	300	.000
Mean_E_Comm	.203	300	.000	.915	300	.000
Mean_F_Staff_capability	.197	300	.000	.864	300	.000
Mean_I_Realistic	.136	300	.000	.935	300	.000
Mean_J_Project_feasibility	.201	300	.000	.923	300	.000
Mean_K_Client_involvement	.200	300	.000	.928	300	.000
Mean_Org_culture_factors	.243	300	.000	.826	300	.000
Mean_Cost_factors	.212	300	.000	.858	300	.000
Mean_Timeline_factors	.204	300	.000	.910	300	.000
Mean_Objective_achieved_factors	.222	300	.000	.880	300	.000

A further two characteristics of the data have to be checked, namely skewness and kurtosis. Skewness is a measure of lack of symmetry; the distribution of a data set is said to be symmetrical if it looks the same to the left and right of the center point (Lawrence, 1997). Hair et al. (2017) suggested that values of skewness between −1.5 and +1.5 should be considered quasi-normal. Kurtosis is a measure of whether the obtained data are heavy-tailed or light-tailed relative to a normal distribution. According to Lawrence (1997), data sets with high kurtosis tend to have heavy tails (more outliers), whereas data sets with low kurtosis tend to have light tails (fewer outliers). Westfall (2014) added that kurtosis is a measure of tail extremity reflecting either the presence of outliers in a distribution or a distribution’s propensity for producing outliers.

Table 5 shows that the skewness values for all the variables were in the range of +1.5 to −1.5, Furthermore, although the Kolmogorov–Smirnov indicated that the data differed significantly from normal distribution, it should be borne in mind that normality tests on large samples may yield significant results even when the deviation from normality is small (Field, 2013; and Oztuna, Elhan, & Tuccar, 2006). The closer the kurtosis value to zero, the more normal the distribution of scores. A distribution is more leptokurtic (peaked) when the kurtosis value is large and positive, and a distribution is more platykurtic (flat) when the kurtosis value is large and negative.

Table 5: Partial display of normality test results for all items

	N	Mean	STD	Skewness Skewness	Skewness Std. error	Kurtosis Kurtosis	Std. error
A_Government_analysis_1	300	4.19	0.826	-1.226	0.141	1.818	0.281
A_Government_analysis_2	300	4.21	0.828	-1.077	0.141	1.253	0.281
A_Government_analysis_3	300	4.21	0.873	-1.272	0.141	1.810	0.281
A_Government_analysis_4	300	4.17	0.723	-0.910	0.141	1.353	0.281
B_Economic_analysis_1	300	4.40	0.623	-0.535	0.141	-0.618	0.281
B_Economic_analysis_2	300	4.39	0.638	-0.568	0.141	-0.621	0.281
B_Economic_analysis_3	300	4.38	0.604	-0.416	0.141	-0.661	0.281
B_Economic_analysis_4	300	3.80	0.455	-0.727	0.141	0.328	0.281
C_Leadership_1	300	3.93	0.779	-0.988	0.141	2.032	0.281
C_Leadership_2	300	3.93	0.954	-0.782	0.141	-0.210	0.281
C_Leadership_3	300	4.01	0.985	-1.071	0.141	0.924	0.281
C_Leadership_4	300	4.05	0.878	-0.994	0.141	1.133	0.281
D_Disruptive_technology_1	300	4.04	0.794	-0.925	0.141	1.357	0.281
D_Disruptive_technology_2	300	4.04	0.700	-0.639	0.141	0.879	0.281
D_Disruptive_technology_3	300	4.12	0.735	-0.954	0.141	1.475	0.281
D_Disruptive_technology_4	300	4.09	0.839	-0.855	0.141	0.387	0.281
E_Communication_1	300	4.00	0.774	-0.485	0.141	-0.061	0.281
E_Communication_2	300	3.88	0.693	-0.382	0.141	0.300	0.281
E_Communication_3	300	3.86	0.757	-0.232	0.141	-0.317	0.281
E_Communication_4	300	4.07	0.747	-0.740	0.141	0.747	0.281
F_Staff_capability_1	300	4.15	0.771	-0.876	0.141	0.829	0.281
F_Staff_capability_2	300	4.22	0.734	-0.978	0.141	1.357	0.281
F_Staff_capability_3	300	4.26	0.679	-0.826	0.141	1.224	0.281
F_Staff_capability_4	300	4.22	0.713	-1.023	0.141	1.763	0.281
H_Organizational_culture_1	300	4.03	0.873	-1.220	0.141	1.882	0.281
H_Organizational_culture_2	300	3.96	1.070	-1.281	0.141	1.232	0.281
H_Organizational_culture_3	300	4.12	0.866	-1.360	0.141	2.650	0.281
H_Organizational_culture_4	300	4.07	0.875	-1.187	0.141	1.793	0.281
I_Realistic_schedules_1	300	3.59	0.680	-0.631	0.141	1.661	0.281
I_Realistic_schedules_2	300	2.85	0.900	0.577	0.141	-0.144	0.281
I_Realistic_schedules_3	300	3.69	0.611	-0.950	0.141	2.124	0.281
I_Realistic_schedules_4	300	2.84	0.866	0.658	0.141	0.041	0.281
J_Project_feasibility_1	300	4.04	0.944	-0.841	0.141	-0.113	0.281
J_Project_feasibility_2	300	3.97	0.606	-1.349	0.141	4.006	0.281
J_Project_feasibility_3	300	3.51	0.934	-0.463	0.141	-0.844	0.281
J_Project_feasibility_4	300	3.48	0.901	-0.537	0.141	-0.821	0.281
K_Client_involvement_1	300	4.04	0.928	-0.838	0.141	-0.052	0.281
K_Client_involvement_2	300	3.96	0.624	-1.300	0.141	3.527	0.281
K_Client_involvement_3	300	3.51	0.941	-0.463	0.141	-0.859	0.281
K_Client_involvement_4	299	3.45	0.898	-0.550	0.141	-0.871	0.281
L_Timeline_achieved_1	300	3.79	0.918	-0.225	0.141	-0.728	0.281
L_Timeline_achieved_2	300	3.20	0.955	-0.347	0.141	-1.397	0.281
L_Timeline_achieved_3	300	3.67	1.136	-0.531	0.141	-0.677	0.281
L_Timeline_achieved_4	300	3.53	0.824	-0.881	0.141	-0.230	0.281
M_Objectives_achieved_1	300	3.78	0.687	-0.815	0.141	1.006	0.281
M_Objectives_achieved_2	300	3.88	0.682	0.150	0.141	-0.846	0.281
M_Objectives_achieved_3	300	3.47	0.671	0.323	0.141	-0.142	0.281
M_Objectives_achieved_4	300	3.45	0.827	-0.430	0.141	-0.645	0.281
N_Cost_achieved_1	300	4.09	0.798	-1.076	0.141	1.726	0.281
N_Cost_achieved_2	300	4.19	0.809	-0.811	0.141	0.192	0.281
N_Cost_achieved_3	300	4.11	0.755	-0.789	0.141	1.010	0.281
N_Cost_achieved_4	300	4.18	0.785	-0.872	0.141	0.599	0.281

4.2.3 Common Method Bias

The term common method bias refers to the possibility that variance observed in an endogenous variable is due not to the relationships among the model constructs but to variance introduced by the measurement method. Common method bias may result from participants who wish to make their responses project socially desirable images of themselves, from simultaneous collection of data concerning both the independent and dependent variables, or from ambiguity in the survey items (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003). Non-biased responses may arise from some members of the target population who declined to participate in the survey holding very different views, opinions, or perceptions from those who participated (Malhotra, Kim, & Patil, 2006; Rogelberg & Stanton, 2007).

4.2.3.1 Harman's Single Factor

To check for potential common method variance, Harman's single factor test was run. Harman's single factor test includes all the items from all the constructs in a factor analysis to determine whether most of the variance can be accounted for by one general factor (Podsakoff et al., 2003). In this case, the program extracted factors individually to check whether any single factor could account for than 50% of the variance. The results shown in Table 6 indicate that no single factor could account for more than 16.164% of the variance, which is far less than the accepted threshold of 50% (Malhotra et al., 2006). This confirms that the survey responses were free from significant common method bias and that it was acceptable to proceed with the model analysis.

Table 6: Results of Harman's single factor test for common method bias/total variance explained

	Initial eigenvalues			Extraction sums of squared loadings		
Component	Total	% of variance	Cumulative %	Total	% of variance	Cumulative %
1	8.405	16.164	16.164	8.405	16.164	16.164
2	3.322	6.389	22.553			
3	2.936	5.646	28.199			
4	2.817	5.417	33.615			
5	2.607	5.014	38.629			
6	2.426	4.666	43.295			
7	2.186	4.203	47.498			
8	1.866	3.589	51.087			
9	1.752	3.368	54.456			
10	1.722	3.312	57.767			
11	1.510	2.903	60.671			
12	1.234	2.373	63.044			
13	1.216	2.338	65.382			
14	1.100	2.116	67.498			
15	1.060	2.038	69.536			
16	.960	1.846	71.382			
17	.939	1.807	73.188			
18	.881	1.694	74.882			
19	.825	1.586	76.468			
20	.758	1.458	77.926			
21	.719	1.382	79.308			
22	.687	1.321	80.630			
23	.672	1.293	81.922			
24	.616	1.185	83.108			
25	.610	1.172	84.280			
26	.559	1.074	85.354			
27	.531	1.021	86.376			
28	.517	.994	87.370			
29	.465	.894	88.264			
30	.441	.848	89.111			
31	.433	.833	89.945			
32	.411	.791	90.735			
33	.394	.757	91.493			
34	.389	.749	92.241			
35	.371	.713	92.954			
36	.340	.655	93.609			
37	.320	.616	94.225			
38	.313	.601	94.826			
39	.282	.542	95.369			
40	.271	.521	95.890			
41	.261	.502	96.391			
42	.249	.480	96.871			
43	.231	.445	97.316			
44	.218	.420	97.736			
45	.206	.395	98.131			
46	.197	.379	98.510			
47	.190	.365	98.876			
48	.165	.317	99.192			
49	.144	.276	99.469			
50	.116	.224	99.692			
51	.100	.191	99.883			
52	.061	.117	100.000			

Note. Extraction method: Principal component analysis.

4.2.3.2 Common Latent Factor

After Harman's single factor test, the common latent factor analysis in CFA was carried out using AMOS 24 in order to test the percentage of variance explained by a common latent factor. The analysis used the CFA model, which contained all the constructs and introduced a common latent factor. Accordingly, this assessment was conducted after CFA, with the purpose of examining data readiness. It connected all the observed variables in the model with the common latent factor and constrained the paths to be equal. According to the criteria, the common variance is estimated as the square of the common factor of each path before standardization. The common heuristic sets the threshold to 50%. The results demonstrated that this common latent factor explained less than 50% of the shared variance in most of the observed variables. Thus, the common latent factor analysis further confirmed that common method bias is not a major concern in the data used for the present study (Figure 6).

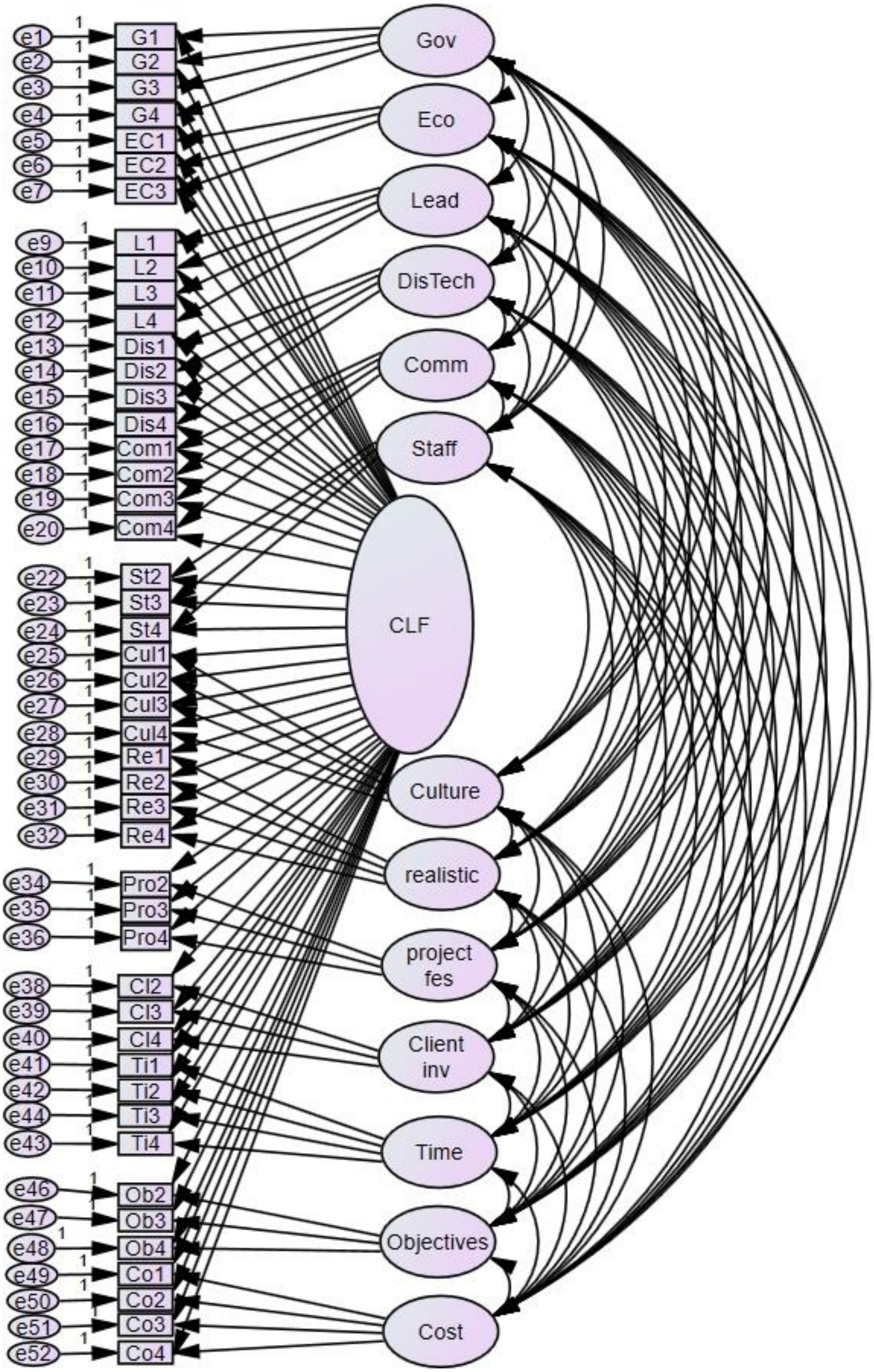

Figure 6: Common latent factor analysis

4.3 Descriptive Analysis

This section gives general information about respondents, with the aim of providing a profile of the study participants in terms of frequency and percentage analyses of the following characteristics: age, gender, level of education, monthly income, nationality, work experience, and the sectors they work in.

4.3.1 Age Groups

In terms of age, the biggest group of respondents (38.7%) were aged between 35 and 44, with a further 34.3% aged 25 to 34 years and 25% aged 24 or younger. It seems that only 2% from all respondents were older than 45 (Table 7).

Table 7: Respondents by age

		Frequency	Percent	Valid percent	Cumulative percent
Valid	24 or younger	75	25.0	25.0	25.0
	25–34	103	34.3	34.3	59.3
	35–44	116	38.7	38.7	98.0
	45–54	6	2.0	2.0	100.0
	Total	300	100.0	100.0	

4.3.2 Gender

The second descriptive analysis concerned the gender of respondents (Table 8). More than half of the respondents were men (60%), and 40% were women.

Table 8: Respondents by gender

		Frequency	Percent	Valid percent	Cumulative percent
Valid	Male	180	60.0	60.0	60.0
	Female	120	40.0	40.0	100.0
	Total	300	100.0	100.0	

4.3.3 Educational Level

Given the nature of subject, it is unsurprising that most of the respondents (53.7%) had completed postgraduate study, compared to 38.7% with a bachelor degree and only 7.7% with no more than a diploma (Table 9).

Table 9: Respondents by level of education

		Frequency	Percent	Valid percent	Cumulative percent
Valid	Diploma	23	7.7	7.7	7.7
	Bachelor	116	38.7	38.7	46.3
	Postgraduate	161	53.7	53.7	100.0
	Total	300	100.0	100.0	

4.3.4 Monthly Income

In terms of monthly income of respondents in US dollars, the majority of the respondents earned 3,000 to 4,999 USD/month, compared to 37.7% earning 2,000 to 2,999 USD/month, and 12% earning 1,000 to 1,999 USD/month (Table 10).

Table 10: Respondents by monthly income (USD)

		Frequency	Percent	Valid percent	Cumulative percent
Valid	1,000–1,999	36	12.0	12.0	12.0
	2,000–2,999	113	37.7	37.7	49.7
	3,000–4,999	151	50.3	50.3	100.0
	Total	300	100.0	100.0	

4.3.5 Nationality

In terms of nationality, only 35% of respondents were expatriates, with 65% from the UAE (Table 11). This could reflect the recent adoption of the UAE government’s policy of “Emiratization” within governmental organizations.

Table 11: Respondents by nationality

		Frequency	Percent	Valid percent	Cumulative percent
Valid	UAE	195	65.0	65.0	65.0
	Non-UAE	105	35.0	35.0	100.0
	Total	300	100.0	100.0	

4.3.6 Experience

As Table 12 indicates, most of the participating respondents (42.3%) had fewer than five years of work experience. A further 26.7% respondents had five to 10 years of experience, and only 18.7% and 12.3% had 11 to 15 years and more than 15 years of experience, respectively.

Table 12: Respondents by experience

		Frequency	Percent	Valid percent	Cumulative percent
Valid	Less than 5 years	127	42.3	42.3	42.3
	5–10 years	80	26.7	26.7	69.0
	11–15 years	56	18.7	18.7	87.7
	More than 15 years	37	12.3	12.3	100.0
	Total	300	100.0	100.0	

4.3.7 Employment Sector

With respect to the sector of employment, Table 13 shows that most respondents (42%) were working in the energy sector, compared to only 11.7% in information security and 19.7% in the in health sector. Other sectors accounted for 26.7% of participants.

Table 13: Respondents' work experience by sector

		Frequency	Percent	Valid percent	Cumulative percent
Valid	Health	59	19.7	19.7	19.7
	Energy	126	42.0	42.0	61.7
	Information security	35	11.7	11.7	73.3
	Other	80	26.7	26.7	100.0
	Total	300	100.0	100.0	

4.4 Reliability Analysis

After recording and filtration, it is important to perform validity and reliability tests for all constructs. According to Hair et al. (2017), there are a number of reasons for considering the reliability and validity of the constructs. The first reason is that reliable and valid constructs improve the methodological consistency of the research. The second is that reliable and valid constructs permit a co-operative research effort and provide support for triangulation of results. The final reason is that reliable and valid constructs provide a more meaningful explanation of the phenomena that are being investigated.

Item-to-total correlations were used in this study to measure reliability, with the aim of determining the relationship of a particular item to the rest of the items in the same dimension, and of removing items with low correlations (unless they represent an additional domain of interest). According to May (1997), this is the most appropriate method used by researchers to guarantee the reliability of a multi-item scale. In addition, this method helps to ensure that the items that make up the dimension have a common core.

In practical terms, Cooper and Emory (1995) suggested that each item to be retained for further analysis should have an item-to-total correlation score of 0.30 or above in order to be considered highly reliable. On the other hand, Nunnally and

Bernstein (1994) stated that reliability could be established on the basis of the average correlation among items within a dimension, which is a matter of internal consistency. The basic formula for determining reliability on the basis of internal consistency is the coefficient known as Cronbach's alpha. This technique has proved to be a good estimate of reliability in most research situations; according to Price and Mueller (1986), "item-to-total correlation and the Cronbach's Alpha coefficient are observed to be very popular in the field of social science research." Nunnally and Bernstein (1994) suggested that a Cronbach's alpha value of 0.60 is sufficient indication of reliability.

Therefore, in the current study, reliability was calculated for each variable, and the reliability coefficient and item–total correlations are given for all the study constructs. These reliability analyses were carried out for all the measuring constructs in the questionnaire: government analysis, economic analysis, leadership, disruptive technology, communications, staff capability, organizational culture, realistic schedules, project feasibility, client involvement, timeline achieved, objectives achieved, and cost achieved.

As Table 14 shows, all the items were found to have a high item-to-total correlation, above the acceptable level of 0.30 (correlations are significant at the 0.01 level). The reliability coefficients ranged from 0.667 to 0.858, which is significantly higher than the acceptable level of 0.60 (Nunnally & Bernstein, 1994). These results confirm the reliability of the scales used in this study.

Table 14: Reliability analysis for the research variables

Scale	Item	r	Cronbach's alpha
A. Government	A.1 R&D policies that guide the allocation of resources in R&D projects are set by the government.	.787**	.811
	A.2 The government may intervene in R&D projects that are not running smoothly.	.813**	
	A.3 There is a system that keeps stakeholders focused on the mission of the R&D project.	.840**	
	A.4 There is a review and evaluation system by the government on the progress of the project.	.754**	
B. Economy	B.1 The economic impact of the R&D program is evaluated before the commencement of the project.	.914**	.746
	B.2 The R&D project products have a strong market.	.839**	
	B.3 Both human and non-human costs are identified before the project begins.	.893**	
	B.4 There is a review and evaluation system on the financial progress of the project.	.257**	
C. Leader-ship	C.1 R&D project leaders motivate other personnel to maximize their potential in service delivery.	.831**	.858
	C.2 Project leaders provide guidance and solutions for challenging issues and situations that might arise during the R&D project.	.814**	
	C.3 Project leaders help to generate ideas and support innovation.	.869**	
	C.4 Project leaders allow smooth communication and coordination to collect the information necessary for the project.	.844**	
D. Disruptive tech	D.1 Disruptive technology offers problem-solving capabilities, as well as enhancing the capability to develop new ideas and opportunities.	.721**	.738
	D.2 Disruptive technology leads to new commercial products.	.838**	
	D.3 Disruptive technology contributes to thinking outside the norms of product development.	.666**	
	D.4 Innovation from disruptive technology requires effective integration of knowledge and information about the R&D project.	.776**	

Table 14: Reliability analysis for the research variables (Continued)

Scale	Item	r	Cronbach's alpha
E. Communications	E.1 Effective communication boosts team morale and offers clarification of goals, tasks, and responsibilities.	.651**	.667
	E.2 The stages from budgeting through technical specification of the product are well communicated within the project team.	.644**	
	E.3 Project members and clients communicate effectively to identify the technological needs for the project.	.671**	
	E.4 Effective communication maintains the support and commitment of all R&D stakeholders.	.620**	
F. Staff capability	F.1 Project members are well assessed for their skills and knowledge for handling the project before it begins.	.594**	.778
	F2. Project members are provided with the required training before the project begins.	.779**	
	F3. The occupational and educational skills of R&D staff are highly reliable in developing the intellectual property of the project.	.867**	
	F.4 There is continuous performance evaluation for project team members throughout the project.	.638**	
H. Organizational culture	H.1 The project team members have a common understanding of the values of the organization.	.786**	.820
	H.2 The organization fosters a culture that enhances commitment among employees and helps them to cope with stress and to come up with new ideas.	.878**	
	H.3 The cultural values and demographic factors of the project team affect the success of the project.	.775**	
	H.4 The organizational culture supports a learning environment.	.782**	
I. Realistic schedules	I.1 A specified timeline for R&D is clearly identified, including a schedule that show all stages from initiation to completion.	.659**	.754
	I.2 Project schedules are evaluated and adjusted continuously to ensure that they are realistic.	.897**	
	I.3 Project schedules are evaluated and agreed with all team members and stakeholders.	.528**	
	I.4 Each milestone in the project plan is evaluated continuously against the overall plan.	.890**	

Table 14: Reliability analysis for the research variables (Continued)

Scale	Item	r	Cronbach's alpha
J. Project feasibility	J.1 There is a proper examination of whether a project is profitable or viable for an organization before conducting the project.	.655**	.703
	J.2 There is detailed and comprehensive planning that accounts for potential difficulties with the project before it starts.	.600**	
	J.3 There is a proper crisis management plan in place before the project starts.	.824**	
	J.4 The scope of the project is clearly identified before it starts.	.825**	
K. Client involvement	K.1 Project plans are clearly explained to clients and adjusted accordingly before the project starts.	.650**	.711
	K.2 There is continuous interaction between the clients and the project team throughout the project.	.611**	
	K.3 The challenges of the project are clearly communicated to the client, and alternative solutions are always presented.	.822**	
	K.4 The client conducts a comprehensive evaluation of the project team after each milestone and after the completion of the project.	.842**	
L. Timeline achieved	L.1 The project timeline was defined on the basis of close cooperation with the project team and the stakeholders.	.824**	.764
	L.2 The project timeline was rarely reviewed or adjusted in the course of the project.	.749**	
	L.3 The milestones of the project were achieved according to the schedule for each milestone.	.772**	
	L.4 The final product of the project was reviewed and adjusted before the final submission to the client within the overall project timeline.	.735**	
M. Objectives achieved	M.1 The goals and objectives of the project were in line with the general goals and objectives of the organization.	.437**	.737
	M.2 The goals and objectives of the project were made clear to the project team before the initiation of the project.	.904**	
	M.3 The client satisfaction with the final result was high.	.821**	
	M.4 There was clear audit activity throughout the project to ensure that that the objectives were met.	.826**	

Table 14: Reliability analysis for the research variables (Continued)

Scale	Item	r	Cronbach's alpha
N. Cost achieved	N.1 The project costs that were identified before the start of the project were equivalent to the costs of the project after completion.	.828**	.823
	N.2 There were continuous project budget update meetings throughout the project.	.789**	
	N.3 Cost performance reports were continuously prepared throughout the project.	.821**	
	N.4 A clear budget contingency plan was in place before the initiation of the project.	.796**	

Note. r: Pearson correlation, **: Correlation is significant at the 0.01 level (two-tailed).

4.5 Validity Analysis

In this section, the tests of validity and scale development for the variables is illustrated through a sequence of steps. The EFA consisted of procedures undertaken to verify the reliability and validity of the data. To validate the constructs, each of the items included was submitted to factor analysis.

It is important to ensure that certain specific requirements are met before using factor analysis. The first requirement is that the constructs are measured using interval scales. Here, the use of a five-point Likert scale in the survey questionnaire fulfilled this requirement. According to Madsen (1989) and Schertzer and Kerman (1985), there are good reasons to use Likert scales. First, they communicate interval properties to the respondent and therefore produce data that can be assumed to be interval-scaled. The second reason is that in the human resources literature, Likert scales are almost always treated as interval scales (Deeg & Van Zonneveld, 1989; García-Cabrera, Lucia-Casademunt, Cuéllar-Molina, & Padilla-Angulo, 2018). Another important requirement is that the sample size should be greater than 100, since factor analysis cannot generally be used with fewer than 50 observations (Hair et al., 2017). This requirement was also fulfilled here, because there were 300 respondents.

4.5.1 Strategic Factor Backgrounds

On the basis of the literature review, four constructs have been identified as antecedents of strategic factors for R&D project success: government analysis, economic analysis, leadership, and disruptive technology.

As the specific requirements were met (Table 15), the researcher concluded that factor analysis was appropriate for this data set. Therefore, the procedures for factor analysis were performed, and the results are discussed below.

Table 15: Descriptive statistics for strategic factor items

	Mean	Std. deviation	Analysis N
G1	4.19	.826	300
G2	4.21	.828	300
G3	4.21	.873	300
G4	4.17	.723	300
EC1	4.40	.623	300
EC2	4.39	.638	300
EC3	4.38	.604	300
EC4	3.80	.455	300
L1	3.93	.779	300
L2	3.93	.954	300
L3	4.01	.985	300
L4	4.05	.878	300
Dis1	4.04	.794	300
Dis2	4.04	.700	300
Dis3	4.12	.735	300
Dis4	4.09	.839	300

4.5.1.1 Bartlett's Test of Sphericity and the Kaiser-Meyer–Olkin Measure of Sampling Adequacy

The 16 items representing the four predictors (antecedents of strategic factors) of the strategic factor model were submitted to the factor analysis. The results of EFA yielded a four-factor solution that accounted for 70.666% of the variance extracted. The result for Bartlett's test of sphericity (BTS) was high, at 2090.183, and the associated significance value was very low ($p = 0.000$). According to Snedecor and Cochran (1989), this indicates that the data are appropriate for factor analysis.

The Kaiser–Meyer–Olkin (KMO) test for measurement of sample adequacy (MSA) computed a value of 0.758, which is adequate, and above the acceptable level (i.e. more than 0.5) indicating that there is no sample issue problem (Snedecor & Cochran, 1989) (see Table 16).

Table 16: KMO and Bartlett's test for strategic factor items

Kaiser–Meyer–Olkin measure of sampling adequacy.		.758
Bartlett's test of sphericity	Approx. chi-square	2090.183
	Df	120
	Sig.	.000

Source: Analysis of survey data.

4.5.1.2 Results of Principal Component Analysis Extraction Process

Factor extraction results using PCA are given in Table 17. It should be noted that an eigenvalue of 1.0 is used as the benchmark in deciding the number of factors (Hair et al., 2017).

Table 17: Principal component analysis extraction results for strategic factor items

	Initial eigenvalues			Extraction sums of squared loadings		
Component	Total	% of variance	Cumulative %	Total	% of variance	Cumulative %
1	4.168	26.050	26.050	4.168	26.050	26.050
2	2.579	16.121	42.171	2.579	16.121	42.171
3	1.875	11.717	53.888	1.875	11.717	53.888
4	1.629	10.180	64.067	1.629	10.180	64.067
5	1.056	6.599	70.666	1.056	6.599	70.666

Note. Extraction method: Principal component analysis.

4.5.1.3 Extraction Method: Principal Component Analysis

Dimension reduction techniques seek to identify items with a shared variance, and it is advisable to remove any item with a communality score less than 0.2 (Child, 2006). Low communality scores may indicate the presence of additional factors, which could be explored in further studies by measuring additional items (Costello et al., 2005).

An initial (unrotated) solution identified 16 items and five factors with eigenvalues of more than 1, accounting for 70.666 % of the variance (see Table 17). As Table 18 shows, all 16 items scored communalities in the range of 0.493 to 0.885, which indicates that all the values are greater than 0.3 and that there is no problem with any individual question. Therefore, it can be concluded that a degree of confidence in the factor solution has been achieved.

Table 18: Communalities for strategic factor items

	Initial	Extraction
G1	1.000	.626
G2	1.000	.686
G3	1.000	.733
G4	1.000	.619
EC1	1.000	.885
EC2	1.000	.754
EC3	1.000	.861
EC4	1.000	.835
L1	1.000	.723
L2	1.000	.668
L3	1.000	.758
L4	1.000	.729
Dis1	1.000	.570
Dis2	1.000	.759
Dis3	1.000	.493
Dis4	1.000	.608

Note. Extraction method: Principal component analysis.

4.5.1.4 Factor Rotation and Factor Loading

Factor loadings are an important issue, and Tabachnick and Fidell (2007) recommended ignoring factor loadings with an absolute value of less than 0.32 (representing 10% of the shared variance), following the advice of Field (2013): “we recommend suppressing factor loadings less than 0.3.” Retained factors should have at least three items with a loading greater than 0.4. These items should also not cross-load highly on other factors. If the above rules are used for factor suppression and retention, a consistent cross-factor loading cutoff is a maximum of 75% of any factor loading. Any items that load onto more than two factors would require a lower cutoff value.

There is a relationship between sample size and acceptable factor loadings. According to Stevens (2012), for a sample size of 100, factor loadings are significant at the 0.01 level when they are larger than 0.512; for a sample of 200, they are significant when they are larger than 0.364; and for a sample of 300, they are significant when they are larger than 0.298. According to Peter (2016), a factor with four loadings greater than 0.6 is stable for sample sizes greater than 50, and a factor with ten loadings greater than 0.4 is stable for a sample size greater than 150.

The number of factors to be retained needs to be decided, and there are different criteria for making this decision. It is probably sensible to use the SPSS default rule to start with. This cuts off factor eigenvalues less than 1. The item loadings onto each factor should then be examined. Any item that does not load above 0.3 onto any factor should be removed and the analysis should then be re-run. Items that load less than 0.4 onto any factor should be removed one at a time in reverse order of highest factor loading. Cross-factor loadings should then be considered using the cutoff rules described above, and the number of factors can be adjusted. All retained factors should have at least three items with a loading greater than 0.4. The proportion of the total variance explained by the retained factors should also be noted; as a general rule this should be at least 50% (Peter, 1979).

On the basis of the considerations above, a loading of all the items within the five factors was examined, and the results are summarized in Table 19.

Table 19: Rotated component matrix for strategic factor items

	Component				
	1	2	3	4	5
L3	.837				
L4	.830				
L1	.803				
L2	.801				
G3		.820			
G2		.816			
G1		.761			
G4		.699			
EC1			.939		
EC3			.926		
EC2			.866		
Dis2				.864	
Dis4				.761	
Dis1				.695	
Dis3				.637	
EC4					.913

Note. Extraction method: Principal component analysis. Rotation method: Varimax with Kaiser normalization. Rotation converged in five iterations.

All items were loaded onto the factors for which they were designed. The factor loadings were all higher than 0.60, so each item loaded more highly onto its associated construct than onto any other construct. As suggested by Hair et al., (2017), a factor loading higher than 0.35 is considered statistically significant at an alpha level of 0.05. This is supported by the discriminant validity of the measurement.

4.5.1.5 Factor Naming and Interpretation Process

The interpretation of the five-factor solution was accomplished by relating the five factors to the theoretical concepts. The factors can be characterized as follows.

Factor 1 consists of four items and fits very well with “leadership.” This factor consists of the following items: (L1) R&D projects leaders motivate other personnel to maximize their potential in service delivery; (L2) Project leaders provide guidance and solutions for challenging issues and situations that might arise during the R&D project; (L3) Project leaders help to generate ideas and support innovation; and (L4) Project leaders allow smooth communication and coordination to collect the information necessary for the project. The values are closely grouped, with the highest loading being 0.837 for (L3) and the lowest loading being 0.801 for (L2).

The second factor consists of four items. This factor represents the respondents’ opinions regarding “government analysis.” It covers the following variables: (G1) R&D policies that guides the allocation of resources in R&D projects are set by the government; (G2) The government may intervene in R&D projects that are not running smoothly; (G3) There is a system that keeps stakeholders focused on the mission of the R&D project; and (G4) There is a review and evaluation system by the government on the progress of the project. The values are closely grouped, with the highest loading being 0.820 for (G3) and the lowest loading being 0.699 for (G4).

The third factor consists of four items. This factor represents the respondents’ opinions regarding “economic analysis.” It covers the following items: (EC1) The economic impact of the R&D program is evaluated before the commencement of the project; (EC2) The R&D project products have a strong market; and (EC3) Both human and non-human costs are identified before the project begins. The values are closely grouped, with the highest loading being 0.939 for (EC1) and the lowest loading being 0.866 for (EC2).

The fourth factor consists of four items. This factor represents the respondents' opinions regarding "disruptive technology." It covers the following items: (Dis1) Disruptive technology offers problem-solving abilities, as well as enhancing the capacity to develop new ideas and opportunities; (Dis2) Disruptive technology leads to new commercial products; (Dis3) Disruptive technology contributes to thinking outside the norms of product development; and (Dis4) Innovation from disruptive technology requires effective integration of knowledge and information about the R&D project. The values are closely grouped, with the highest loading being 0.864 for (Dis2) and the lowest loading being 0.637 for (Dis3).

The last factor contained only one item question named (EC4): There is review and evaluation system on the financial progress of the project. According to the criteria discussed above, factor 5 was deleted, as was item (EC4).

4.5.2 Tactical Factor Backgrounds

On the basis of the literature review, four constructs were identified as antecedents of tactical factors for R&D project success. These factors are communication and staff capability.

In terms of the requirements for the initiation of factor analysis, Table 20 confirms that factor analysis is appropriate for this data set. Therefore, the procedures for factor analysis were performed, and the results are discussed below.

Table 20: Descriptive statistics for tactical factor items

	Mean	Std. deviation	Analysis N
Com1	4.00	.774	300
Com2	3.88	.693	300
Com3	3.86	.757	300
Com4	4.07	.747	300
St1	4.15	.771	300
St2	4.22	.734	300
St3	4.26	.679	300
St4	4.22	.713	300

4.5.2.1 Bartlett's Test of Sphericity and the Kaiser–Meyer–Olkin Measure of Sampling Adequacy

The eight items representing the two predictors (antecedents of tactical factors) of the tactical factor model were submitted to factor analysis. The results of the EFA yielded a two-factor solution that accounted for 56.944% of the variance extracted. The result for BTS was large, at 804.356, and the associated significance value was very small ($p = 0.000$). According to Snedecor and Cochran (1989), this shows that the data were appropriate for factor analysis. The KMO for MSA gives the computed KMO as 0.705, which is adequate and above the acceptable level (i.e., more than 0.5), which indicates that there is no sample issue problem) (Snedecor & Cochran, 1989) (see Table 21).

Table 21: KMO and Bartlett's test for tactical factor items

Kaiser–Meyer–Olkin Measure of Sampling Adequacy.		.705
Bartlett's Test of Sphericity	Approx. chi-square	804.356
	Df	28
	Sig.	.000

Source: Analysis of survey data.

4.5.2.2 Results of Principal Component Analysis Extraction Process

Factor extraction results using PCA are given in Table 22. It should be noted that an eigenvalue of 1.0 is used as the benchmark in deciding the number of factors (Hair et al., 2017).

Table 22: Principal component analysis extraction results for tactical factor items

	Initial eigenvalues			Extraction sums of squared loadings		
Component	Total	% of variance	Cumulative %	Total	% of variance	Cumulative %
1	3.034	37.922	37.922	3.034	37.922	37.922
2	1.522	19.023	56.944	1.522	19.023	56.944

Note. Extraction method: Principal component analysis.

4.5.2.3 Extraction Method: Principal Component Analysis

An initial (unrotated) solution identified eight items and two factors with eigenvalues of more than 1, accounting for 56.944% of the variance (see Table 22). As Table 23 shows, all eight items score communalities that range from 0.380 to 0.830, which indicates that all values are greater than 0.3 and that there is no problem with any individual question. Therefore, it can be concluded that a degree of confidence in the factor solution has been achieved.

Table 23: Communalities for tactical factor items

	Initial	Extraction
Com1	1.000	.380
Com2	1.000	.590
Com3	1.000	.541
Com4	1.000	.479
St1	1.000	.521
St2	1.000	.826
St3	1.000	.830
St4	1.000	.388

Note. Extraction method: Principal component analysis.

4.5.2.4 Factor Rotation and Factor Loading

Following these satisfactory results for the two chosen factors, a loading of all the items within the two factors was examined. The Varimax technique for rotated component analysis was used with a cutoff point for interpretation of the factors at 0.50 or greater (Snedecor & Cochran, 1989). The results are summarized in Table 24.

Table 24: Rotated component matrix for tactical factor items

	Component	
	1	2
St3	.911	
St2	.903	
St4	.610	
St1	.584	.425
Com2		.767
Com3		.719
Com4		.673
Com1		.612

Note. Extraction method: Principal component analysis. Rotation method: Varimax with Kaiser normalization. Rotation converged in three iterations.

All items were loaded onto the factors for which they were designed. Most of the factor loadings were higher than 0.60, so that each item loaded more highly onto its associated construct than onto any other construct. As suggested by Hair et al., (2017), a factor loading higher than 0.35 is considered statistically significant at an alpha level of 0.05. This is supported by the discriminant validity of the measurement.

4.5.2.5 Factor Naming and Interpretation Process

The interpretation of the two-factor solution was accomplished by relating them to the theoretical concepts. The two factors can be characterized as follows.

Factor 1 consists of four items and fits very well with “staff capability.” This factor comprises the following items: (St1) Project members are well assessed for their skills and knowledge for handling the project before it begins; (St2) Project members are provided with the required training before the project beings; (St3) The occupational and educational skills of R&D staff are highly reliable in developing the intellectual property of the project; and (St4) There is continuous performance evaluation for the project team members throughout the project. The values are closely grouped, with the highest loading being 0.911 for (St3) and the lowest loading being 0.584 for (St1).

The second factor consists of four items. This factor represents the respondents' opinions regarding "communication." It covers the following items: (Com 1) Effective communication boosts team morale and offers clarification of goals, tasks, and responsibilities; (Com2) The stages from budgeting through technical specification of product are well communicated within the project team; (Com3) Project members and clients communicate effectively to identify the technological needs for the project; and (Com4) Effective communication maintains the support and commitment of all R&D stakeholders. The values are closely grouped, with the highest loading being 0.767 for (Com2) and the lowest loading being 0.612 for (Com1).

However, it was observed that one item, (St1), was cross-loaded between two factors. Therefore, it was decided to remove the item and re-run the analysis with a new extraction sum of square loadings (% of variance).

4.5.3 Operational Factor Backgrounds

On the basis of the literature review, three constructs were identified as antecedents of operational factors for R&D project success. These factors are realistic schedule, project feasibility, and client involvement.

In terms of the requirements for factor analysis initiation, Table 25 confirms that factor analysis was appropriate for this data set. Therefore, the procedures for factor analysis were performed, and the results are discussed below.

Table 25: Descriptive statistics for operational factor items

	Mean	Std. deviation	Analysis N
Re1	3.59	.680	300
Re2	2.85	.900	300
Re3	3.69	.611	300
Re4	2.84	.866	300
Pro1	4.04	.944	300
Pro2	3.97	.606	300
Pro3	3.51	.934	300
Pro4	3.48	.901	300
Cl1	4.04	.928	300
Cl2	3.96	.624	300
Cl3	3.51	.941	300
Cl4	3.45	.900	300

4.5.3.1 Bartlett’s Test of Sphericity and the Kaiser–Meyer–Olkin Measure of Sampling Adequacy

The 12 items representing the two predictors (antecedents of operational factors) of the operation factor model were submitted to factor analysis. The results of the EFA yielded a four-factor solution that accounted for 64.734% of the variance extracted. The result for BTS was large, at 1272.777, and the associated significance value was very small ($p = 0.000$). According to Snedecor and Cochran (1989), this indicates that the data were appropriate for factor analysis. The KMO for MSA computed a value of 0.649, which is adequate and above the acceptable level (i.e., more than 0.5), indicating that there is no sample issue problem) (Snedecor & Cochran, 1989) (see Table 26).

Table 26: KMO and Bartlett’s test for operational factor items

Kaiser–Meyer–Olkin Measure of Sampling Adequacy		.649
Bartlett’s Test of Sphericity	Approx. chi-square	1272.777
	Df	66
	Sig.	.000

Source: Analysis of survey data.

4.5.3.2 Results of Principal Component Analysis Extraction Process

Factor extraction results using PCA are given in Table 27. It should be noted that an eigenvalue of 1.0 is used as the benchmark in deciding the number of factors (Hair et al., 2017).

Table 27: Principal component analysis extraction results for operational factor items: total variance explained

	Initial eigenvalues			Extraction sums of squared loadings		
Component	Total	% of variance	Cumulative %	Total	% of variance	Cumulative %
1	2.836	23.631	23.631	2.836	23.631	23.631
2	2.319	19.321	42.952	2.319	19.321	42.952
3	1.600	13.334	56.286	1.600	13.334	56.286
4	1.014	8.449	64.734	1.014	8.449	64.734

Note. Extraction method: Principal component analysis.

4.5.3.3 Extraction Method: Principal Component Analysis

An initial (unrotated) solution identified 12 items and four factors with eigenvalues of more than 1, accounting for 64.734% of the variance (see Table 27). As Table 28 shows, all 12 items scored communalities ranging from 0.272 to 0.853, which indicates that all values are more than 0.3, except for item (Re3). This means that there was no problem for any individual item, with the exception of item (Re3). Therefore, it could be concluded that a degree of confidence in the factor solution has been achieved.

Table 28: Communalities for operational factor items

	Initial	Extraction
Re1	1.000	.514
Re2	1.000	.853
Re3	1.000	.272
Re4	1.000	.847
Pro1	1.000	.645
Pro2	1.000	.643
Pro3	1.000	.680
Pro4	1.000	.744
Cl1	1.000	.479
Cl2	1.000	.621
Cl3	1.000	.690
Cl4	1.000	.780

Note. Extraction method: Principal component analysis.

4.5.3.4 Factor Rotation and Factor Loading

Following these satisfactory results for the four chosen factors, a loading of all the items within the four factors was examined. The Varimax technique for rotated component analysis was used with a cutoff point for interpretation of the factors at 0.50 or greater (Snedecor & Cochran, 1989). The results are summarized in Table 29.

Table 29: Rotated component matrix for operational factor items

	Component			
	1	2	3	4
Re2	.896			
Re4	.892			
Re1	.673			
Re3	.487			
Cl4		.874		
Cl3		.803		
Cl2		.712		
Pro4			.815	
Pro2			.787	
Pro3			.719	
Pro1				.757
Cl1		.447		.500

Note. Extraction method: Principal component analysis. Rotation method: Varimax with Kaiser normalization. Rotation converged in five iterations.

All items were loaded onto the factors for which they were designed. Factor loadings were mostly higher than 0.60, except for items (Re3) and (Cl1), where values were 0.487 and 0.500, respectively. This indicates that each item loaded more highly onto its associated construct than onto any other construct. As suggested by Hair et al., (2017), a factor loading higher than 0.35 is considered statistically significant at an alpha level of 0.05. This is supported by the discriminant validity of the measurement.

4.5.3.5 Factor Naming and Interpretation Process

The interpretation of the four-factor solution was accomplished by relating them to the theoretical concepts. The four factors can be characterized as follows.

Factor 1 consists of three items that fit very well with “realistic schedules.” This factor consists of the following items: (Re1) A specified timeline for R&D is clearly identified, including a schedule that shows all stages from initiation to completion; (Re2) Project schedules are evaluated and adjusted continuously to ensure that they are realistic; and (Re4) Each milestone in the project plan is evaluated continuously against the overall plan. The values are mostly closely grouped, with the highest loading being 0.896 for (Re2) and the lowest loading being 0.487 for (Re3).

The second factor consists of three items. This factor represents the respondents’ opinions regarding “client involvement.” It covers the following items: (Cl2) There is continuous interaction between the clients and the project team throughout the project; (Cl3) The challenges of the project are clearly communicated to the client and alternative solutions are always presented; and (Cl4) The client conducts a comprehensive evaluation of the project team at the end of each milestone and after the completion of the project. The values are closely grouped, with the highest loading being 0.874 for (Cl4) and the lowest loading being 0.712 for (Cl2).

The third factor consists of three items. This factor represents the respondents' opinions regarding "project feasibility." It covers the following items: (Pro2) There is detailed and comprehensive planning that accounts for potential difficulties with the project before it starts; (Pro3) There is a proper crisis management plan in place before the project starts; and (Pro4) The project scope is clearly identified before it starts. The values are closely grouped, with the highest loading being 0.815 for (Pro4) and the lowest loading being 0.719 for (Pro3).

The fourth factor consists of two items (Pro1): There is a proper examination of whether a project is profitable or viable to an organization before conducting the project; and (Cl1) Project plans are clearly explained to the clients before the commencement of the project and adjusted accordingly.

4.5.4 Organizational Culture Factor Backgrounds

On the basis of the literature review, organizational culture can be considered as a mediating factor for achieving success in R&D projects. In terms of the requirements for factor analysis, Table 30 confirms that factor analysis was appropriate for this data set. Therefore, the procedures for factor analysis were performed, and the results are discussed below.

Table 30: Descriptive statistics for organizational culture factor items

	Mean	Std. deviation	Analysis N
Cul1	4.03	.873	300
Cul2	3.96	1.070	300
Cul3	4.12	.866	300
Cul4	4.07	.875	300

4.5.4.1 Bartlett's Test of Sphericity and the Kaiser–Meyer–Olkin Measure of Sampling Adequacy

The four items representing the single predictor (antecedents of organizational culture factor) of the organizational factor model were submitted to factor analysis. The results of the EFA yielded a one-factor solution that accounted for 65.028% of the variance extracted. The result for BTS was large, at 440.624, and the associated significance value was very small ($p = 0.000$). According to Snedecor and Cochran (1989), this shows that the data were appropriate for factor analysis. The KMO for MSA was computed at 0.748, which is adequate and above the acceptable level (i.e., more than 0.5), which indicates that there is no sample issue problem (Snedecor & Cochran, 1989) (see Table 31).

Table 31: KMO and Bartlett's test for organizational culture factor items

Kaiser–Meyer–Olkin Measure of sampling adequacy		.748
Bartlett's test of sphericity	Approx. chi-square	440.624
	Df	6
	Sig.	.000

Source: Analysis of survey data.

4.5.4.2 Results of Principal Component Analysis Extraction Process

Factor extraction results using PCA are given in Table 32. It should be noted that an eigenvalue of 1.0 is used as the benchmark in deciding the number of factors (Hair et al., 2017).

Table 32: Principal component analysis extraction results for organizational culture factor items: total variance explained

	Initial eigenvalues			Extraction sums of squared loadings		
Component	Total	% of variance	Cumulative %	Total	% of variance	Cumulative %
1	2.601	65.028	65.028	2.601	65.028	65.028

Note. Extraction method: Principal component analysis.

4.5.4.3 Extraction Method: Principal Component Analysis

Table 33 shows that all four items scored communalities ranging from 0.609 to 0.756. This indicates that all the values are greater than 0.3, which means that there was no problem with any individual question. Therefore, it can be concluded that a degree of confidence in the factor solution has been achieved.

Table 33: Communalities for organizational culture factor items

	Initial	Extraction
Cul1	1.000	.619
Cul2	1.000	.756
Cul3	1.000	.609
Cul4	1.000	.617

Note. Extraction method: Principal component analysis.

An initial (unrotated) solution identified four items and one factor with eigenvalues of more than 1, accounting for 65.028% of the variance (see Table 32). However, as only one component was extracted, the solution could not be rotated, and only component matrix was observed (Table 34).

Table 34: Component matrix for organizational culture factor items

	Component 1
Cul2	.870
Cul1	.787
Cul4	.785
Cul3	.780

Note. Extraction method: Principal component analysis. One component extracted.

All items were loaded onto the factors for which they were designed. The factor loadings were higher than 0.60, indicating that each item loaded more highly onto its associated construct than onto any other construct. As suggested by Hair et al., (2017), a factor loading higher than 0.35 is considered statistically significant at an alpha level of 0.05. This is supported by the discriminant validity of the measurement.

4.5.4.4 Factor Naming and Interpretation Process

The interpretation of the one-factor solution was accomplished by relating it to the theoretical concepts. The factor can be characterized as follows.

Factor 1 consists of four items and fits very well with “organizational culture.” This factor comprises the following items: (Cul1) The project team members have a shared understanding of the values of the organization; (Cul2) The organization fosters a culture that enhances commitment among employees and helps them to cope with stress and to come up with new ideas; (Cul3) The cultural values and demographic factors of the project team affect the project success; and (Cul4) The organization culture supports a learning environment. The values are closely grouped, with the highest loading being 0.870 for (Cul2), and the lowest loading being 0.780 for (Cul3).

4.5.5 R&D Project Success Factors Backgrounds

On the basis of the literature review, three constructs were identified as antecedents of R&D project success factors. These factors are cost achievement, timeline achievement, and objectives achievement.

In terms of the requirements for factor analysis, Table 35 confirms that factor analysis was appropriate for this data set. Therefore, the procedures for factor analysis were performed, and the results are discussed below.

Table 35: Descriptive statistics for R&D project success factor items

	Mean	Std. deviation	Analysis N
Ti1	3.79	.918	300
Ti2	3.20	.955	300
Ti3	3.67	1.136	300
Ti4	3.53	.824	300
Ob1	3.78	.687	300
Ob2	3.88	.682	300
Ob3	3.47	.671	300
Ob4	3.45	.827	300
Co1	4.09	.798	300
Co2	4.19	.809	300
Co3	4.11	.755	300
Co4	4.18	.785	300

4.5.5.1 Bartlett's Test of Sphericity and the Kaiser–Meyer–Olkin Measure of Sampling Adequacy

The 12 items representing the three predictors (antecedents of R&D project success factors) of the R&D project success factor model were submitted to factor analysis. The results of the EFA yielded a four-factor solution that accounted for 72.837% of the variance extracted. The result for BTS was large, at 1481.853, and the associated significance value was very small ($p = 0.000$). According to Snedecor and Cochran (1989), this shows that the data were appropriate for factor analysis.

The KMO for MSA was computed KMO at 0.692, which is adequate and above the acceptable level (i.e., more than 0.5) which indicates that there is no sample issue problem (Snedecor & Cochran, 1989) (see Table 36).

Table 36: KMO and Bartlett's test for R&D project success factor items

Kaiser–Meyer–Olkin measure of sampling adequacy		.692
Bartlett's test of sphericity	Approx. chi-square	1481.853
	Df	66
	Sig.	.000

Source: Analysis of survey data.

4.5.5.2 Results of Principal Component Analysis Extraction Process

Factor extraction results using PCA are given in Table 37. It should be noted that an eigenvalue of 1.0 is used as the benchmark in deciding the number of factors (Hair et al., 2017).

Table 37: Principal component analysis extraction results for R&D project success factor items: total variance explained

	Initial eigenvalues			Extraction sums of squared loadings		
Component	Total	% of variance	Cumulative %	Total	% of variance	Cumulative %
1	2.970	24.752	24.752	2.970	24.752	24.752
2	2.477	20.641	45.393	2.477	20.641	45.393
3	2.242	18.684	64.077	2.242	18.684	64.077
4	1.051	8.760	72.837	1.051	8.760	72.837

Note. Extraction method: Principal component analysis.

4.5.5.3 Extraction Method: Principal Component Analysis

An initial (unrotated) solution identified 12 items and four factors with eigenvalues of more than 1, accounting for 72.837% of the variance (see Table 37). As Table 38 shows, all 12 items scored communalities ranging from 0.601 to 0.915, which indicates that all values were more than 0.3 and that there was no problem with any individual question. Therefore, it can be concluded that a degree of confidence in the factor solution has been achieved.

Table 38: Communalities for R&D project success factor items

	Initial	Extraction
Ti1	1.000	.716
Ti2	1.000	.642
Ti3	1.000	.702
Ti4	1.000	.618
Ob1	1.000	.915
Ob2	1.000	.850
Ob3	1.000	.796
Ob4	1.000	.874
Co1	1.000	.697
Co2	1.000	.601
Co3	1.000	.701
Co4	1.000	.629

Note. Extraction method: Principal component analysis.

4.5.5.4 Factor Rotation and Factor Loading

Following these satisfactory results for the four chosen factors, a loading of all the items within the four factors was examined. The Varimax technique for rotated component analysis was used with a cutoff point for interpretation of the factors at 0.50 or greater (Snedecor & Cochran, 1989). The results are summarized in Table 39.

Table 39: Rotated component matrix for R&D project success factor items

	Component			
	1	2	3	4
Co1	.830			
Co3	.826			
Co4	.789			
Co2	.774			
Ob4		.927		
Ob3		.891		
Ob2		.847		
Ti1			.812	
Ti4			.759	
Ti3			.753	
Ti2			.739	
Ob1				.932

Note. Extraction method: Principal component analysis. Rotation method: Varimax with Kaiser normalization. Rotation converged in five iterations.

All items loaded onto the factors for which they were designed. The factor loadings were higher than 0.60, indicating that each item loaded more highly onto its associated construct than onto any other construct. As suggested by Hair et al., (2017), a factor loading higher than 0.35 is considered statistically significant at an alpha level of 0.05. This is supported by the discriminant validity of the measurement.

4.5.5.5 Factor Naming and Interpretation Process

The interpretation of the four-factor solution was accomplished by relating them to the theoretical concepts. The four factors can be characterized as follows.

Factor 1 consists of four items and fits very well with "cost achieved." This factor comprises the following items: (Co1) The project costs that were identified before the start of the project were equivalent to the costs of the project after completion; (Co2) There were continuous project budget update meetings throughout the project; (Co3) Cost performance reports were continuously prepared throughout the project; and (Co4) A clear budget contingency plan was in place before the initiation of the project. The values are closely grouped, with the highest loading being 0.830 for (Co1) and the lowest loading being 0.74 for (Co2).

The second factor consists of three items. This factor represents the respondents' opinions regarding "objectives achieved." It covers the following items: (Ob2) The goals and objectives of the project were made clear to the project team before the initiation of the project; (Ob3) The client satisfaction with the final result was high; and (Ob4) There was clear audit activity throughout the project to ensure that its objectives were met. The values are closely grouped, with the highest loading being 0.927 for (Ob4) and the lowest loading being 0.847 for (Ob2).

The third factor consists of four items. This factor represents the respondents' opinions regarding "time achieved." It covers the following items: (Ti1) The project timeline was defined on the basis of close cooperation with the project team and the stakeholders; (Ti2) The project timeline was rarely reviewed or adjusted during the course of the project; (Ti3) The milestones of the project were achieved according to the schedule for each milestone; and (Ti4) The final product of the project was reviewed and adjusted before the final submission to the client within the overall project timeline. The values are closely grouped, with the highest loading being 0.812 for (Ti1) and the lowest loading being 0.739 for (Ti2).

It will be observed that factor 4 is represented by only one item, (Ob1): The goals and objectives of the project were in line with the general goals and objectives of the organization. According to the criteria discussed above, this item will be deleted, as it is the only one item for factor 4

4.6 Summary

This chapter has provided a preliminary analysis of the collected survey responses. The data were first encoded, edited, and entered into SPSS. This was followed by screening for missing data, and then checks for normality, outliers, and common method bias were performed. The researcher examined the general descriptive analysis of the respondents' profile and their response distribution. In addition, some initial interpretations were put forward as a starting point for the data analysis process.

The reliability and validity analyses covered all the research constructs and showed that the measures were both reliable and valid. Item-to-total correlations were calculated for each variable. This showed that all the variables had an adequate level of reliability, with values significantly higher than the acceptable level of 0.60 (Nunnally & Bernstein, 1994), and were therefore suitable for further analysis. The content and construct validity of the measures were also discussed.

In the next chapter, a number of statistical techniques will be used to explore the relationships between the CSFs and the antecedents and consequences of R&D project success in order to test the study model and hypotheses.

Chapter 5: Quantitative Analysis: Model and Hypothesis Testing

5.1 Introduction

The previous chapter described the cleaning and validation of the data that was collected from the fieldwork and presented an exploratory analysis of different aspects of CSFs for government-funded R&D projects in Abu Dhabi. In this chapter, the main analysis stage, the testing of the hypotheses, is discussed. SPSS®, AMOS®, and MACRO process version 24 were used to analyze the data.

Chapter 1 defined the main research objective as follows: What CSFs are appropriate for managing government-funded R&D projects in the Emirate of Abu Dhabi? To develop a better understanding of the impact of CSFs on R&D project success in Abu Dhabi, this study tests a model that integrates CSFs with R&D success factors. In this way, the study will address its other three objectives: exploring the factors that affect R&D projects; examining the effects of strategic, tactical, and operational factors on project success; and differentiating the effects of each factor on project success. Chapter 4 provided partial answers to these questions, which the present chapter will address in full.

5.2 Measurement Models

As recommended by Anderson and Gerbing (1988), before testing the full latent model, an EFA was conducted using PCA with Varimax rotation (Chapter 4). For the antecedents of the CSFs, the results of the EFA yielded a four-strategic-factor solution that accounted for 64.067% of the variance extracted (after deletion of item EC4), a two-tactical-factors solution that accounted for 59.074% (after deletion of item St1), and a three-operational-strategic-factors solution that accounted for 63.246% (after deletion of items Cl1 and Pro1). EFA also yielded a one-organizational-culture-factor solution that accounted for 65.028% of the variance extracted. Lastly, for the consequences of R&D project success, EFA yielded a three-factor solution that accounted for 64.077% of the variance extracted (after deletion of the item Ob1). The remaining items were highly loaded onto their intended constructs.

5.2.1 Confirmatory Factor Analysis

Before examining the whole model, which considers all the constructs together, it is important from a methodological point of view to note that individualized analyses of each of the factors (dimensions) were carried out (the measurement model), in order to refine the items used in their measurement. After the different measures were established, a CFA was conducted. This research used both a measurement model (in which each construct has a separate model) and a structural model (which includes all the constructs in one model) (Hair et al., 2017).

5.2.1.1 Confirmatory Factor Analysis for the Antecedents of CSFs

As discussed in the methodology section (Chapter 3), the strategic factor construct is a second-order construct that consists of four first-order components—government analysis, economic analysis, leadership, and disruptive technology—measured by four, three, four, and four items, respectively.

Similarly, the tactical factor construct, also discussed in Chapter 3, is a second-order construct that consists of two first-order components—staff capability and communication—measured by three and four items, respectively.

Lastly, the operational factor construct, also discussed in Chapter 3, is a second-order construct that consists of three first-order components—realistic schedules, project feasibility, and client involvement—measured by four, three, and three items, respectively. The results, shown in Figure 7 support the proposed second-order factors solution comprising CSFs.

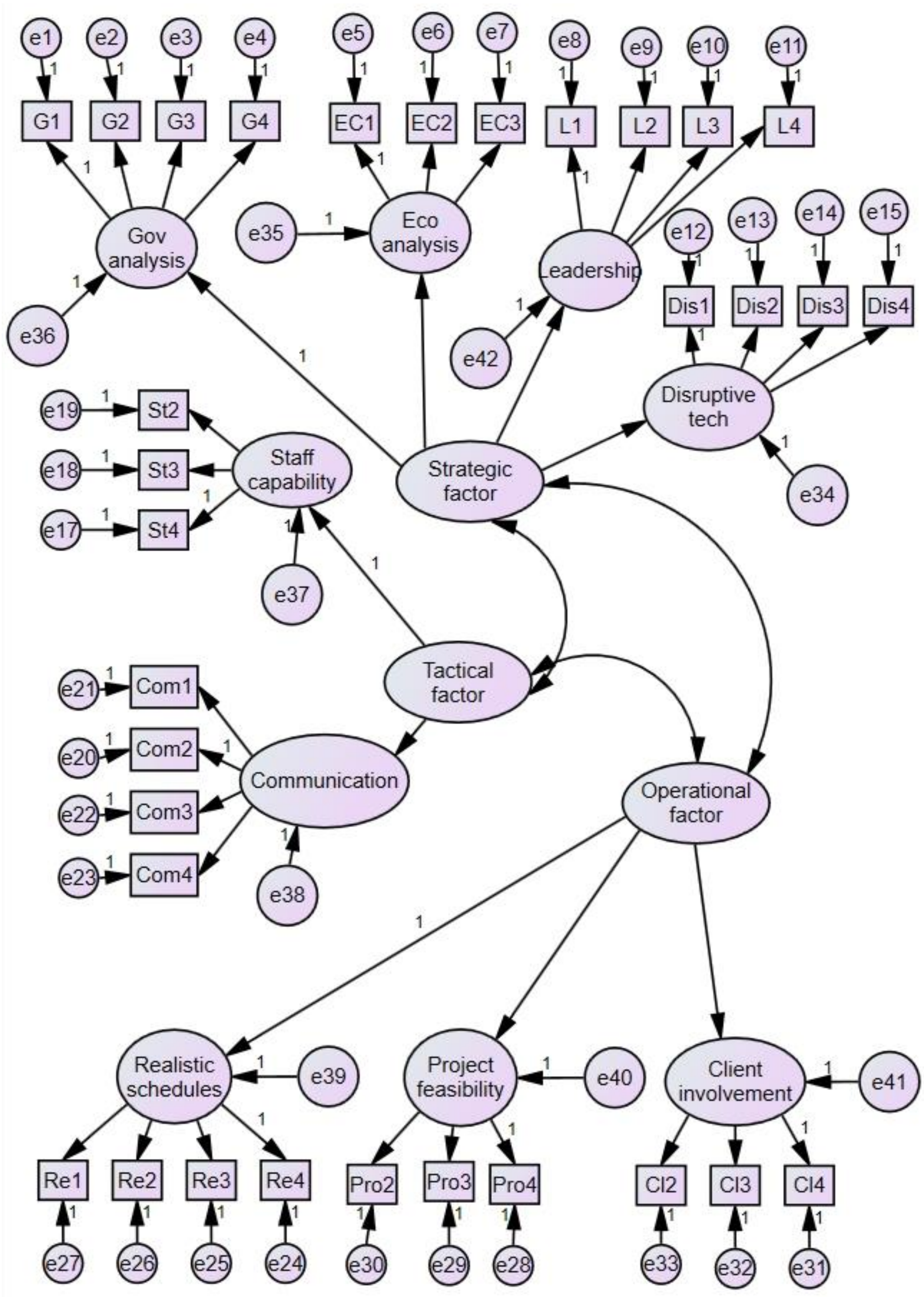

Figure 7: The main constructs and sub-constructs of CSFs antecedents

CFA was conducted to verify the theorized construct of the observed variables, namely the main antecedents (strategic, tactical, and operational factors) of the CSFs and the nine sub-constructs (government analysis, economic analysis, leadership, disruptive technology, staff capability, communication, realistic schedule, project feasibility, and client involvement). SPSS® AMOS was used to carry out the confirmatory factor analysis. Figure 7 shows the main antecedents (strategic, tactical, and operational factors) of the CSFs.

It was decided to exclude items with factor loadings and R^2 less than 0.5. All the factor loadings on the main construct and sub-constructs were high. All the factor loadings and R^2 values were reasonably high. Table 40 shows the results of the measurement model, which are the indicators of the latent variable (Bian, 2011) of Figure 7.

Table 40: Fitness indices for antecedents of CSFs

Statistic	Index value obtained	Suggested acceptable level
CMIN/DF	1.909	< 3
AGFI	0.828	> 0.80
CFI	0.911	> 0.90
RMSEA	0.052	< 0.10

5.2.1.2 Confirmatory Factor Analysis for R&D Project Success Factors

Similarly, CFA was conducted to verify the theorized construct of the observed variables of R&D project success factors: cost achieved, timeline achieved, and objectives achieved. The results, shown in Table 41, support the proposal that the three constructs comprise the success of an R&D project.

Table 41: Fitness indices for antecedents of CSFs

Statistic	Index value obtained	Suggested acceptable level
CMIN/DF	2.892	< 3
AGFI	0.898	> 0.80
CFI	0.941	> 0.90
RMSEA	0.080	< 0.10

The results support the proposed solution comprising R&D project success factors. CFA was conducted to verify the theorized construct of the observed variables (cost, timeline, and objectives achieved) of R&D project success. SPSS® AMOS was used to carry out the confirmatory factor analysis. Figure 8 shows the main antecedents (cost, timeline, and objectives achieved factors) of R&D project success.

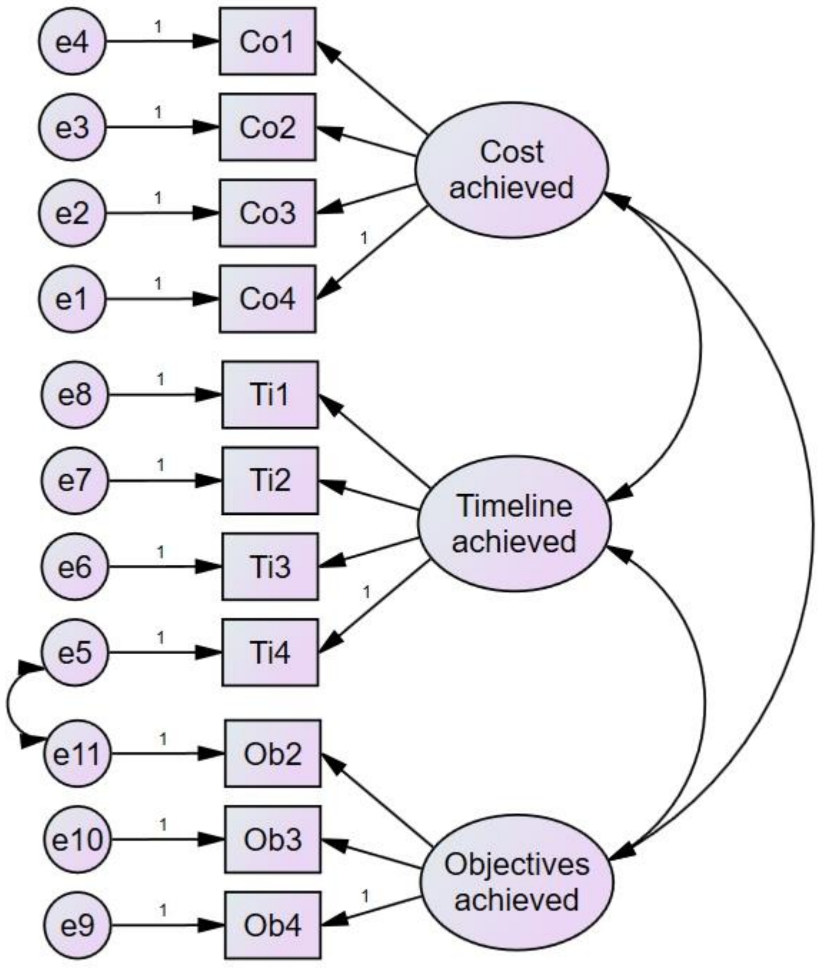

Figure 8: R&D project success factors

As with the components of the R&D project success factor antecedents, it was decided that items with factor loadings and R^2 of less than 0.5 would be excluded. All the factor loadings on the three constructs were high. All the factor loadings and R^2 values were reasonably high.

5.2.1.3 Confirmatory Factor Analysis for Organizational Culture (Moderating Variable)

Similarly, CFA was conducted to verify the theorized construct of the observed variable of organizational culture as a moderating variable. The results, shown in Table 42, support the proposal that the three constructs comprise the success of an R&D project.

Table 42: Fitness indices for organizational culture (moderating variable)

Statistic	Index value obtained	Suggested acceptable level
CMIN/DF	3.764	< 3
AGFI	0.938	> 0.80
CFI	0.994	> 0.90
RMSEA	0.096	< 0.10

Figure 9 shows the organizational culture construct and supports the proposed factor solution comprising four items.

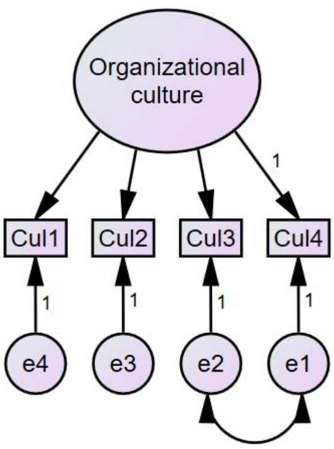

Figure 9: Organizational culture (moderation)

5.2.2 Convergent and Discriminant Validity Analysis

According to Hair et al. (2017), convergent validity is the extent to which items of a specific dimension or construct converge or share a high proportion of variance. Several scholars have identified three different criteria for evaluating convergent validity (Čater & Čater 2010; Fornell & Larcker 1981; Hair et al., 2017; Hooper, Coughlan, & Mullen, 2008; Liang & Wang 2004). According to these, the first criterion is related to the factor loading for an item, which should have a minimum value of 0.6. The second criterion is related to construct reliability, with a minimum value of 0.60 (as in Table 14). The last criterion is related to the average variance extracted (AVE) for a construct, which should be greater than 0.5.

Discriminant validity is the distinctiveness of two conceptually similar constructs (Hair et al., 2017). It indicates that each construct should share more variance with its items than it shares with other constructs. Discriminant validity is present when the variances extracted by the constructs (AVE) from each construct are greater than the correlations.

SPSS® AMOS was used to investigate convergent and discriminant validity; the outputs are given in Figure 10, Table 43, and Table 44.

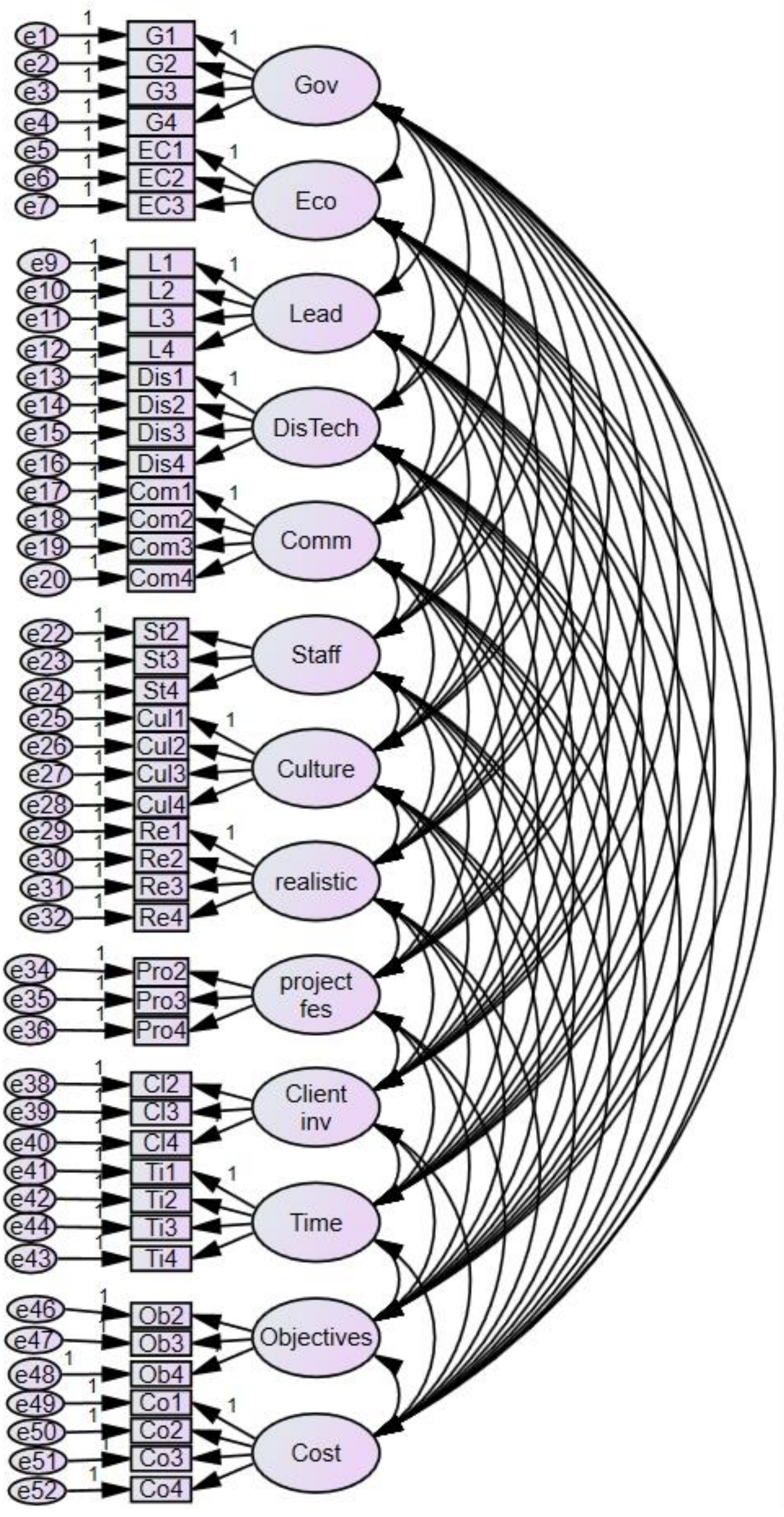

Figure 10: Convergent and discriminant analysis

It can be seen from Tables 43 and 44 that the results of the convergent validity analysis were mostly acceptable. Most scales had an acceptable level of convergent validity, except for disruptive technology, communication, projects feasibility, and time achieved, where the AVE values were close to 0.5. Most of the constructs appeared to be empirically distinct (Fornell & Larcker, 1981), except for government and cost constructs.

Table 43: Convergent analysis

	CR	**AVE**	**MSV**	**MaxR(H)**
Client_inv	0.774	0.546	0.061	0.863
Gov	0.812	0.521	0.691	0.819
Eco	0.905	0.762	0.006	0.941
Lead	0.861	0.609	0.230	0.868
DisTech	0.760	0.450	0.118	0.815
Comm	0.673	0.354	0.086	0.726
Staff	0.821	0.628	0.367	0.926
Culture	0.824	0.542	0.314	0.840
Realistic	0.772	0.514	0.118	0.956
Project_fes	0.732	0.495	0.061	0.869
Time	0.770	0.465	0.112	0.837
Objectives	0.876	0.702	0.016	0.888
Cost	0.824	0.540	0.691	0.826

Note. Reliability: CR for Comm is less than 0.70. Convergent validity: AVE for DisTech, Comm, Project_fes, and Time is less than 0.50. Discriminant validity: AVE for Gov is less than MSV; For Gov and Cost, the square root of the AVE is less than the absolute value of the correlations with another factor. Discriminant validity: AVE for Cost is less than MSV.

Table 44: Discriminant analysis

	Client _inv	Gov	Eco	Lead	Dis Tech	Comm	Staff	Culture	Realistic	Project _fes	Time	Objectives	Cost
Client_inv	**0.739**												
Gov	0.142	**0.722**											
Eco	0.015	0.026	**0.873**										
Lead	-0.049	0.470	0.013	**0.781**									
DisTech	0.130	0.284	-0.079	0.267	**0.671**								
Comm	0.200	0.166	-0.014	0.046	0.158	**0.595**							
Staff	0.061	0.606	-0.014	0.411	0.203	0.294	**0.792**						
Culture	0.066	0.484	0.010	0.480	0.265	0.149	0.358	**0.736**					
Realistic	-0.046	-0.344	-0.036	-0.070	-0.011	-0.078	-0.163	-0.058	**0.717**				
Project_fes	0.246	0.058	0.033	-0.082	0.073	0.077	-0.012	-0.015	-0.019	**0.704**			
Time	-0.013	0.182	-0.029	0.161	0.179	0.036	0.096	0.335	0.034	-0.019	**0.682**		
Objectives	0.003	0.025	0.073	0.026	0.122	-0.073	0.016	-0.063	0.035	-0.126	-0.092	**0.838**	
Cost	0.077	0.831	-0.030	0.428	0.344	0.145	0.564	0.560	-0.304	0.082	0.212	-0.001	**0.735**

5.3 Hypothesis Testing

The empirical examination of several sets of relationships, using path analysis to analyze the data in the form of linear causal models, is a multivariate analytical methodology (Duncan, 1986). According to Pedhazur (1982), the principal aim of path analysis is to test the direct and indirect relationships of each hypothesis on the basis of knowledge and theoretical concepts.

Path analysis does not establish causal relations with certainty, but it is useful for quantitative interpretations of potential causal relationships (Borchgrevink & Boster, 1998). A path diagram represents the proposed antecedents and consequents among the variables in the model. Arrows are used to symbolize the hypothesized relationships and the direction of influence. When specifying a path model, a distinction is drawn between exogenous variables and endogenous variables. Exogenous variables (independent variables) have influence outside the model, and endogenous variables (dependent variables) have influence within the model. In this case, the antecedents of CSFs and organizational culture (as mediator) are treated as the sole exogenous variables, while R&D project success factors are the endogenous variables (Figure 11).

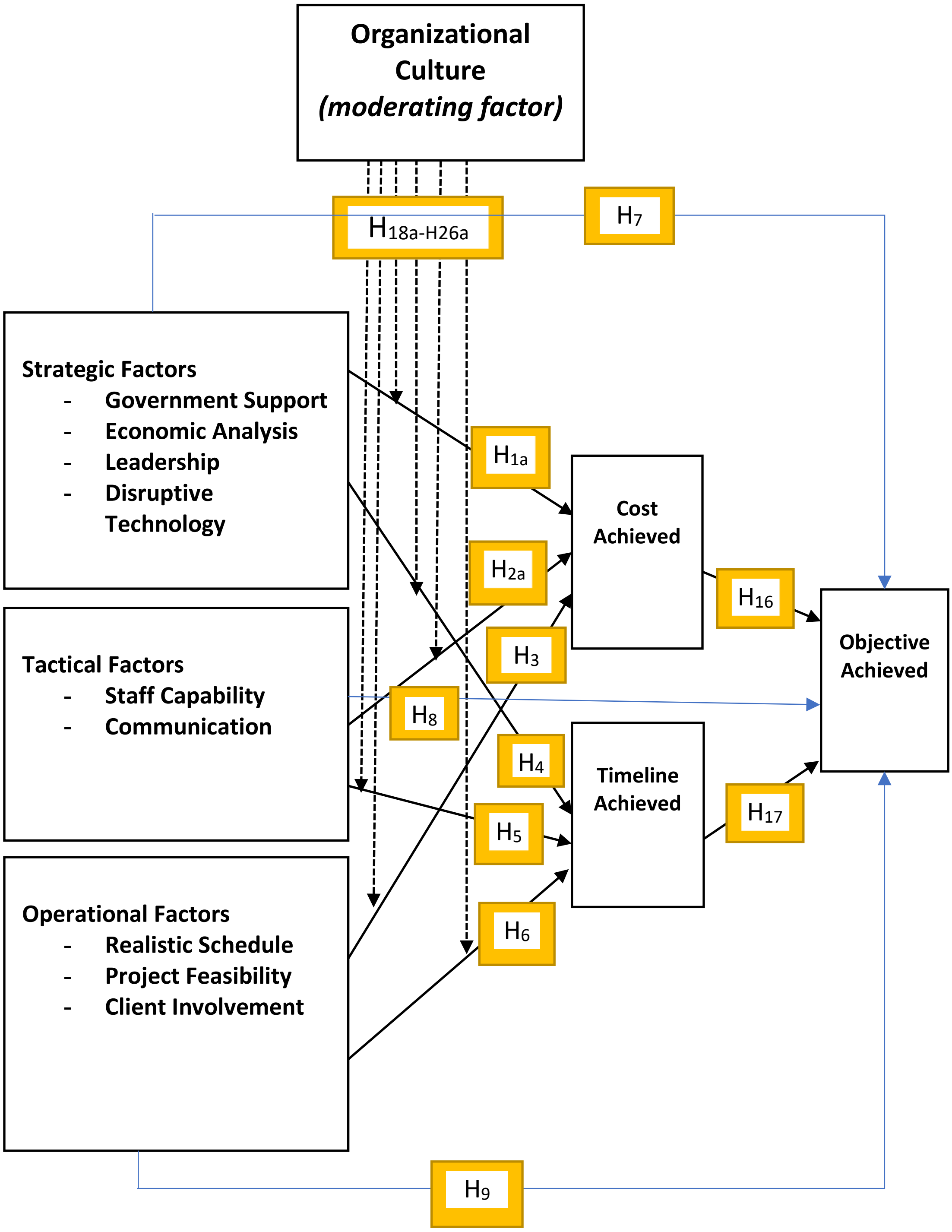

Figure 11: Research model with identification of hypotheses

5.3.1 Structural Model Testing

Given that the purpose of the study was to test the hypothesized causal relationships among the constructs of the model, the SEM package AMOS 24® was used (see Figure 8). The factor means were employed as single-item indicators to perform path analysis, applying the maximum likelihood estimates (MLE) method and following the guidelines suggested by Joreskog and Sorbom (1982).

According to Bagozzi and Yi (1988), if the MLE method is to be used, the constructs must satisfy the criterion of multivariate normality. Therefore, for all the constructs, tests of normality (i.e. skewness and kurtosis) were conducted (Table 45). The results indicate no departure from normality, as most of the values are close to 1 (i.e., +/−1) (Bagozzi & Yi, 1988).

Table 45: Assessment of normality

				Skewness		Kurtosis	
	N	Mean	Std. deviation	Skewness	Std. error	Kurtosis	Std. error
Gov analysis	300	4.1942	0.65045	-1.134	0.141	0.667	0.281
Eco analysis	300	4.2442	0.44016	-0.660	0.141	0.194	0.281
Leadership	300	3.9783	0.75538	-0.981	0.141	1.095	0.281
Disruptive tech	300	4.0750	0.57414	-0.577	0.141	0.410	0.281
Communication	300	4.0000	0.57104	-1.048	0.141	1.290	0.281
Staff capability	300	4.2708	0.53765	-1.437	0.141	2.847	0.281
Realistic	300	3.2442	0.58743	0.234	0.141	1.744	0.281
Project feasibility	300	3.7475	0.62370	-0.392	0.141	-0.613	0.281
Client involvement	300	3.7408	0.62831	-0.377	0.141	-0.631	0.281
Strategic factors	300	4.1229	0.37939	-0.815	0.141	0.618	0.281
Tactical factors	300	4.1354	0.41734	-1.241	0.141	2.888	0.281
Operational factors	300	3.5778	0.37940	-0.246	0.141	-0.398	0.281
Org culture	300	4.0450	0.74515	-1.712	0.141	3.602	0.281
Cost	300	4.1408	0.63611	-1.138	0.141	0.579	0.281
Timeline	300	3.5483	0.73845	0.057	0.141	-1.030	0.281
Objective achieved	300	3.6458	0.53765	0.185	0.141	-0.908	0.281

Once normality was confirmed for all the constructs, it was decided to proceed with the MLE method to estimate the model. The reliability of the constructs was assessed using item-to-total correlations and Cronbach's alpha coefficient (see Chapter 4) (Nunnally & Bernstein, 1994).

The results for testing hypotheses H1 to H17 using the MLE-SEM approach are illustrated in Figure 12.

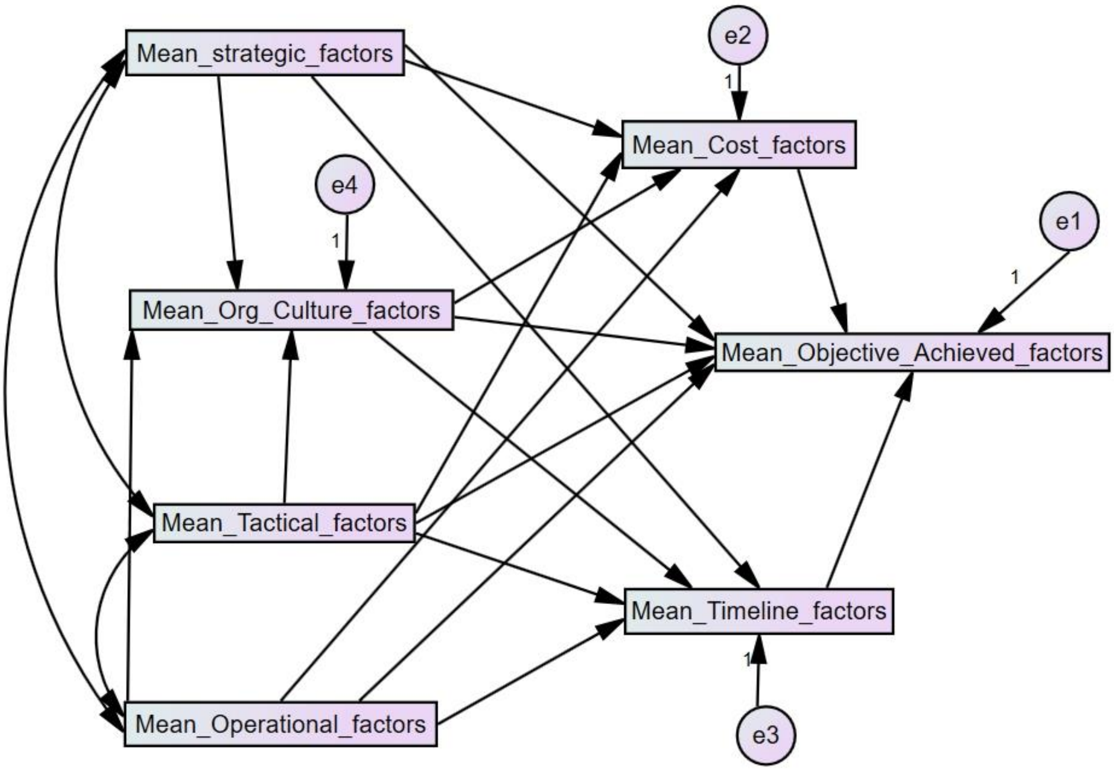

Figure 12: Results of hypothesis testing

As there is no definitive standard of fit, a variety of indices are provided along with suggested guidelines. The χ^2 test was not statistically significant at the 1% level (probability level = 0.613), which indicates an adequate fit. The other fit indices, together with the squared multiple correlations, indicate a good overall fit with the data (GFI = 1.000, CFI = 1.000, AGFI = 0.993, TLI = 1.048, RMSEA = .000, and RMR = 0.002). Since these indices confirm that the overall fit of the model to the data was good, it was concluded that the structural model was an appropriate basis for hypothesis testing (Table 46).

Table 46: Model fit analysis

Statistic	**Suggested**	**Obtained**
Chi-square significance	≥ 0.01	0.613
Goodness-of-fit index (GFI)	≥ 0.90	1.000
Adjusted goodness-of-fit index (AGFI)	≥ 0.80	0.993
Comparative fit index (CFI)	≥ 0.90	1.000
Tucker–Lewis coefficient (TLI)	≥ 0.90	1.048
Root mean square residual (RMR)	≤ 0.05	0.002
Root mean square error of approximation (RMSEA)	≤ 0.10	0.000

Table 47 gives the standardized regression weights. These show that the model explains 26% for organizational culture, 42% for cost achievement, 7% for timeline achievement, and 3.4% for objectives achievement, indicating that it has a stronger prediction capacity for cost achievement.

Table 47: Standardized regression weights

Predictor variables	Criterion variables	Hypothesized relationship	Standardized coefficient	R^2
Strategic factors	Organizational culture	**H10$_a$**	0.404***	
Tactical factors	Organizational culture	**H11$_a$**	0.174***	**0.257**
Operational factors	Organizational culture	**H12$_a$**	0.039	
Organizational culture	Cost achieved	**H13$_a$**	0.212***	
Strategic factors	Cost achieved	**H1$_a$**	0.392***	**0.420**
Tactical factors	Cost achieved	**H2$_a$**	0.211***	
Operational factors	Cost achieved	**H3$_a$**	-.074	
Organizational culture	Timeline achieved	**H14$_a$**	.237***	
Strategic factors	Timeline achieved	**H4$_a$**	.062	**0.069**
Tactical factors	Timeline achieved	**H5$_a$**	-.031	
Operational factors	Timeline achieved	**H6$_a$**	.017	
Organizational culture	Objectives achieved	**H15$_a$**	-.181***	
Strategic factors	Objectives achieved	**H7$_a$**	.155***	
Tactical factors	Objectives achieved	**H8$_a$**	-.039	**0.034**
Operational factors	Objectives achieved	**H9$_a$**	-.024	
Timeline achieved	Objectives achieved	**H17$_a$**	.074	
Cost achieved	Objectives achieved	**H16$_a$**	.016	

Note. *** indicates $P \leq 0.01$.

To test the 17 hypotheses, a structural model was used. The results give support for some of the hypotheses, and Table 47 shows the estimated standardized parameters for the causal paths. First, the strategic factors variable and tactical factors (H10a and H11a) positively affected organizational culture (standardized estimate = 0.404 and 0.174, respectively; $P \leq 0.01$), while the operational factor (H12a) had no effect on organizational culture (standardized estimate = 0.039; $P \geq 0.01$). Therefore, H10a and H11a are supported, whereas H12a is not supported.

The suggested factors positively affected the cost achievement of projects, namely organizational culture (H13a) (standardized estimate = 0.212; $P \leq 0.01$), strategic factors (H1a) (standardized estimate = 0.392; $P \leq 0.01$), and tactical factors

(H2a) (standardized estimate = 0.211; $P \leq 0.01$). However, a non-significant negative affect was seen for operational factors (H3a) on cost achievement (standardized estimate = −0.074; $P \geq 0.01$). Therefore, H13a, H1a, and H2a are supported, whereas H3a is not supported.

Only one suggested factor positively affected the timeline achievement of projects, namely organizational culture (H14a) (standardized estimate = 0.237; $P \leq 0.01$), while strategic factors (H1a), and operational factors (H6a) had effects on time line achievement that were positive but not significant (standardized estimates = 0.062 and 0.017, respectively; $P \geq 0.01$). The tactical factors (H5a) had a negative effect on timeline achievement of projects, but this was not significant (standardized estimate = 0.031; $P \geq 0.01$). Therefore, H14a is supported, whereas H1a, H6a, and H5a are not supported.

Only one suggested factor positively affected the achievement of objectives, namely strategic factors (H7a) (standardized estimate = 0.155; $P \leq 0.01$), while another factor had a negative effect, namely organizational culture (H15a). The tactical factors (H8a) and operational factors (H9a) had effects that were negative but not significant (standardized estimate = −0.039, and −0.024, respectively; $P \geq 0.01$). The timeline (H17a), and cost (H16a) achievement factors had effects that were positive but not significant (standardized estimate = 0.74, and 0.16, respectively; $P \geq 0.01$).

The results of the path analysis show that, among the independent variables, strategic factors were the key driver behind the achievement of R&D projects ($\beta = 0.155$). These results give strategic factors top priority among the factors that affect the success of R&D projects.

5.3.2 Moderation Hypotheses

The statistics literature distinguishes three main types of hypothesis: incremental validity, moderation, and mediation hypotheses. As a field matures, the questions that scientists are trying to answer tend to become more nuanced and specific. Hence, direct effects hypotheses using incremental validity (direct hypotheses) can be exciting in the early stages of research to show the existence of a new effect. As the field matures, moderation hypotheses become more popular, as they propose that “the size of a relationship between two variables changes depending upon the value of a third variable, known as a moderator.” Finally, mediating hypotheses present a scenario where we may know that X leads to Y, but the mediation hypothesis proposes a mediating, or intervening variable (that is, X leads to M, which in turn leads to Y) (Westfall & Judd, 2015).

Baron and Kenny (1986) defined a moderating relationship or mechanism as “the moderator function of third variables, which partitions a focal independent variable into subgroups that establish its domains of maximal effectiveness in regard to a given dependent variable.” They emphasized that, generally speaking in social science studies, a moderator is a qualitative variable (e.g., gender, race, or class) or a quantitative variable (e.g., level of reward) that affects the direction and/or strength of the relationship between an independent (predictor) variable and a dependent (criterion) variable.

Using organizational culture as a mediator, the moderation hypotheses of the present study were tested using the MACRO process developed by Hayes & Preacher (2013), which is very useful for testing models with indirect or interaction effects.

Hypotheses H18a to H26a of the present study predict a moderating effect of organizational culture on the relationship between the identified antecedents (strategic factors, tactical factors, and operational factors) and cost achievement, timeline achievement, and objectives achievement, as follows:

$H18_a$: Organizational culture has a moderating effect on the relationship between strategic factors and cost achievement.
$H19_a$: Organizational culture has a moderating effect on the relationship between strategic factors and timeline achievement.
$H20_a$: Organizational culture has a moderating effect on the relationship between strategic factors and objectives achievement.
$H21_a$: Organizational culture has a moderating effect on the relationship between tactical factors and cost achievement.
$H22_a$: Organizational culture has a moderating effect on the relationship between tactical factors and timeline achievement.
$H23_a$: Organizational culture has a moderating effect on the relationship between tactical factors and objectives achievement.
$H24_a$: Organizational culture has a moderating effect on the relationship between operational factors and cost achievement.
$H25_a$: Organizational culture has a moderating effect on the relationship between operational factors and timeline achievement.
$H26_a$: Organizational culture has a moderating effect on the relationship between operational factors and objectives achievement.

The results of the analysis are given in Table 48. The moderation was considered significant at $P \leq 0.05$; therefore, there was no significant moderating effect of organizational culture on the relationship between tactical factors and objectives achievement (P-value ≥ 0.05). Likewise, there was no significant moderating effect of organizational culture on the relationship between operational factors and objectives achievement (P-value $\geq$ 0.05). However, the rest of hypotheses were found to have a moderating effect of organizational culture.

Table 48: Moderation outcome

Moderation		Hypothesis	Coeff.	SE	P	Indirect effect
Cost	Strategic	H18a	.7718	.0871	0.000	.1978
	Org culture		.2106	.0444	0.000	
Timeline	Strategic	H19a	.1012	.1241	.4154	.2164
	Org culture		.2304	.0632	.0003	
Objectives achieved	Strategic	H20a	.2177	.0923	.0190	-.1143
	Org culture		-.1217	.0470	.0101	
Cost	Tactical	H21a	.4818	.0786	.0000	.1890
	Org culture		.3048	.0440	.0000	
Timeline	Tactical	H22a	-.0208	.1058	.8444	.1607
	Org culture		.2591	.0593	.0000	
Objectives achieved	Tactical	H23a	.0092	.0794	.9082	-.0437
	Org culture		-.0705	.0444	.1138	
Cost	Operational	H24a	-.0902	.0861	.2959	.0585
	Org culture		.4019	.0438	.0000	
Timeline	Operational	H25a	.0276	.1094	.8011	.0370
	Org culture		.2540	.0557	.0000	
Objectives achieved	Operational	H26a	-.0374	.0821	.6486	-.0098
	Org culture		-.0673	.0418	.1083	

However, to find a moderation effect of organizational culture in regards to the relationship between of strategic, tactical, and operational factors with either cost or timeline achievement factors, further analysis were performed accordingly.

Table 49 and Figure 13 illustrated that strategic factors have a significant effect on cost factors (P-value <0.05), as well as organizational culture factors has a significant effect on cost factors (P-value < 0.05), and the interaction effect was significantly affected with P-value less than 0.05. Accordingly, it can be concluded that moderating effect of organizational culture on the relationship between strategic factors and cost factors is statistically significant (P-value less than 0.05).

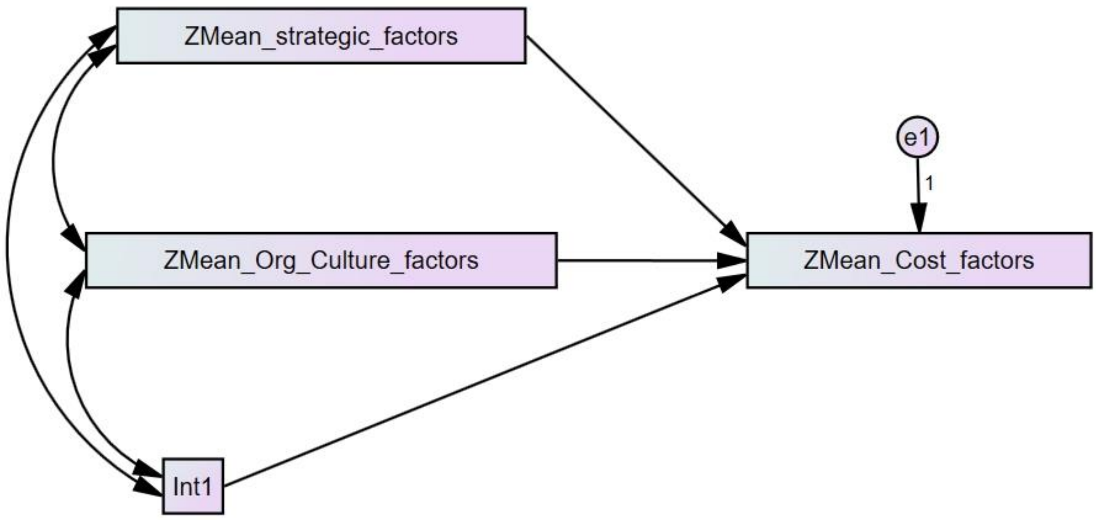

Figure 13: Moderating effect of organizational culture into strategic factors and cost factors

Table 49: Moderating effect of organizational culture into strategic factors and cost factors

			Estimate	S.E.	C.R.	P
ZMean_Cost_factors	<---	ZMean_strategic_factors	.389	.053	7.346	***
ZMean_Cost_factors	<---	ZMean_Org_Culture_factors	.176	.053	3.332	***
ZMean_Cost_factors	<---	Int1	-.144	.033	-4.333	***

While in Table 50 and Figure 14 illustrated that tactical factors have a significant effect on cost factors (P-value <0.05), as well as organizational culture factors has a significant effect on cost factors (P-value < 0.05), and the interaction effect was significantly affected with P-value less than 0.05. Accordingly, it can be concluded that moderating effect of organizational culture on the relationship between Tactical factors and cost factors is statistically significant (P-value less than 0.05).

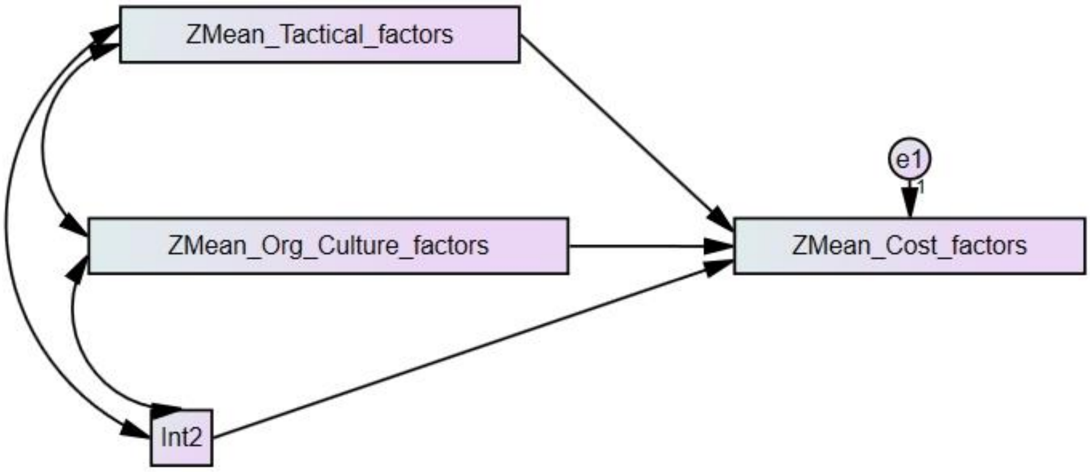

Figure 14: Moderating effect of organizational culture into tactical factors and cost factors

Table 50: Moderating effect of organizational culture into tactical factors and cost factors

			Estimate	S.E.	C.R.	P
ZMean_Cost_factors	<---	ZMean_Tactical_factors	.246	.053	4.644	***
ZMean_Cost_factors	<---	ZMean_Org_Culture_factors	.308	.051	5.995	***
ZMean_Cost_factors	<---	Int2	-.148	.037	-4.051	***

Table 51 and Figure 15 showed that operational factors do not have a significant effect on cost factors (P-value > 0.05), however organizational culture factors have a significant effect on cost factors (P-value < 0.05), and the interaction effect was not significantly affected with P-value more than 0.05. Accordingly, it can be concluded that moderating effect of organizational culture on the relationship between operation factors and cost factors is not statistically significant (P-value more than 0.05).

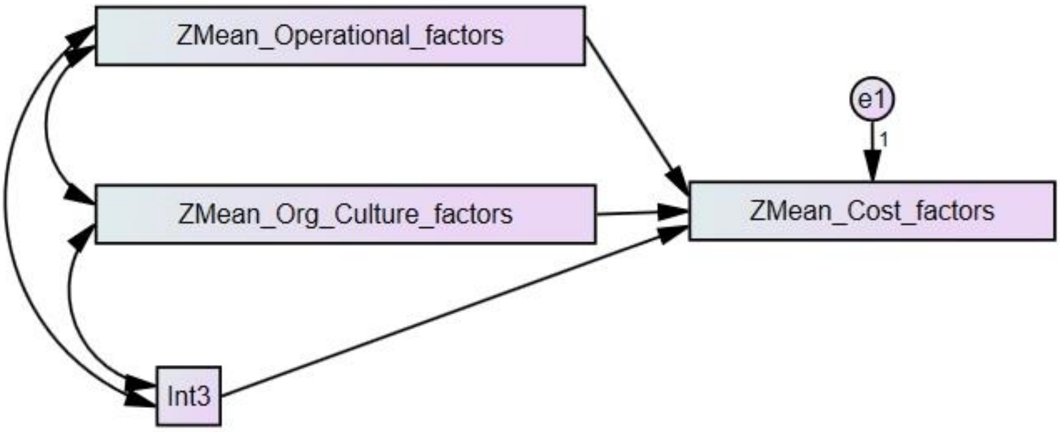

Figure 15: Moderating effect of organizational culture into operational factors and cost factors

Table 51: Moderating effect of organizational culture into operational factors and cost factors

			Estimate	S.E.	C.R.	P
ZMean_Cost_factors	<---	ZMean_Operational_factors	-.061	.051	-1.184	.236
ZMean_Cost_factors	<---	ZMean_Org_Culture_factors	.468	.051	9.166	***
ZMean_Cost_factors	<---	Int3	-.077	.050	-1.546	.122

Furthermore, strategic factors do not have a significant effect on timeline achievement factors (P-value = 0.216, however organizational culture factors have a significant effect on timeline achievement factors (P-value < 0.05), and the interaction effect was not significantly affected with P-value more than 0.05. Accordingly, it can be concluded that moderating effect of organizational culture on the relationship between strategic factors and timeline achievement factors is not statistically significant (P-value more than 0.05), see Table 52 and Figure 16.

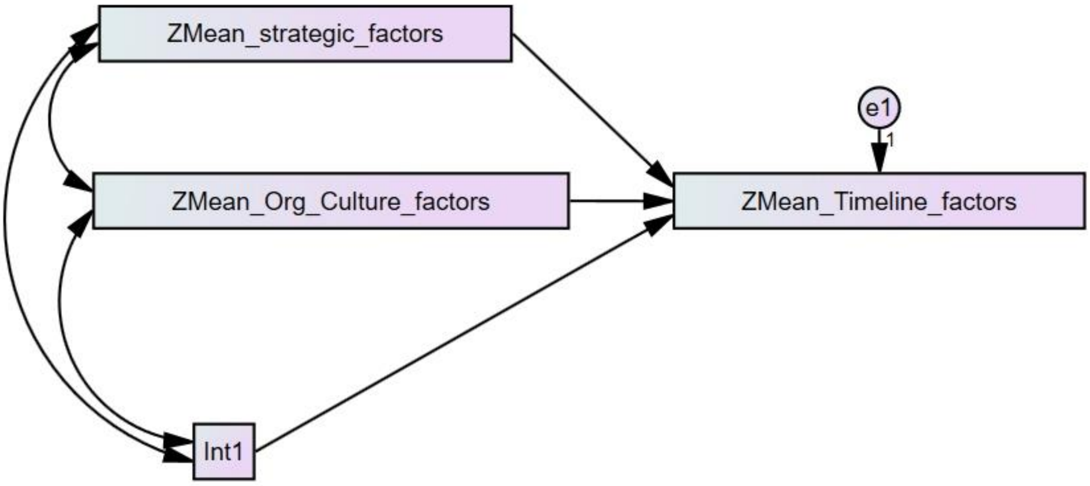

Figure 16: Moderating effect of organizational culture into strategic factors and time line achievement factors

Table 52: Moderating effect of organizational culture into strategic factors and time line achievement factors

			Estimate	S.E.	C.R.	P
ZMean_Timeline_factors	<---	ZMean_strategic_factors	.083	.067	1.238	.216
ZMean_Timeline_factors	<---	ZMean_Org_Culture_factors	.263	.067	3.944	***
ZMean_Timeline_factors	<---	Int1	.061	.042	1.464	.143

Tactical factors do not have a significant effect on timeline achievement factors (P-value = 0.914, however organizational culture factors have a significant effect on timeline achievement factors (P-value < 0.05), and the interaction effect was not significantly affected with P-value more than 0.05. Accordingly, it can be concluded that moderating effect of organizational culture on the relationship between tactical factors and timeline achievement factors is not statistically significant (P-value more than 0.05), see Table 53 and Figure 17.

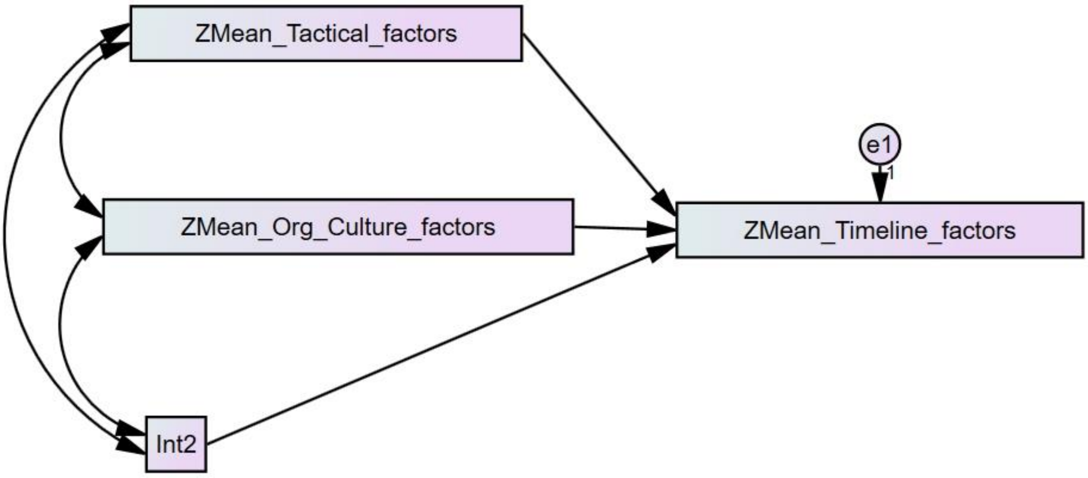

Figure 17: Moderating effect of organizational culture into tactical factors and time line achievement factors

Table 53: Moderating effect of organizational culture into tactical factors and time line achievement factors

			Estimate	S.E.	C.R.	P
ZMean_Timeline_factors	<---	ZMean_Tactical_factors	-.007	.063	-.108	.914
ZMean_Timeline_factors	<---	ZMean_Org_Culture_factors	.265	.061	4.323	***
ZMean_Timeline_factors	<---	Int2	.010	.044	.241	.810

Lastly, in Table 54 and Figure 18, operational factors do not have a significant effect on timeline achievement factors (P-value = 0.822, however organizational culture factors have a significant effect on timeline achievement factors (P-value < 0.05), and the interaction effect was not significantly affected with P-value more than 0.05. Accordingly, it can be concluded that moderating effect of organizational culture on the relationship between operational factors and timeline achievement factors is not statistically significant (P-value more than 0.05).

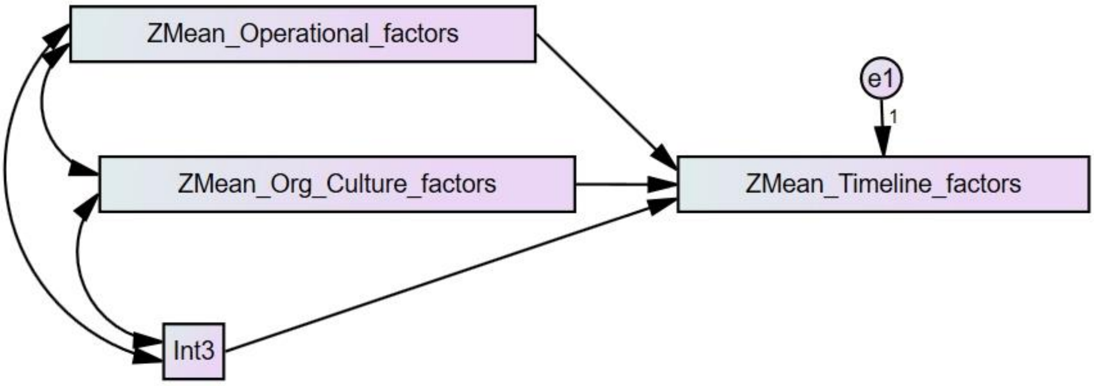

Figure 18: Moderating effect of organizational culture into operational factors and time line achievement factors

Table 54: Moderating effect of organizational culture into operational factors and time line achievement factors

			Estimate	S.E.	C.R.	P
ZMean_Timeline_factors	<---	ZMean_Operational_factors	.013	.056	.225	.822
ZMean_Timeline_factors	<---	ZMean_Org_Culture_factors	.256	.056	4.560	***
ZMean_Timeline_factors	<---	Int3	-.017	.055	-.314	.754

5.4 Conclusion and Summary of Key Findings

This chapter has reported the inferential statistics that enable the researcher to draw conclusions that extend beyond the immediate data. This chapter has described the procedures and findings of the CFA, path analysis, and hypothesis testing that were carried out for analytic purposes.

CFA for all factors was undertaken, first, to validate the measures in each stage, and second, to reduce the specific factors tested to a more general classification to enrich the theoretical development of the CSFs. Regarding the strategic factor antecedents, CFA indicated that there were two second-order variables: job demands, a second-order construct that consists of four first-order components (government analysis, economic analysis, leadership, and disruptive technology) and tactical factors, a second-order construct that consists of two first-order components (staff capability, and communication). The last antecedent was operational factors, which is a second-order construct that consists of three first-order components (realistic schedule, project feasibility, and client involvement). Regarding the factors in the success of projects, CFA indicated that project success is as second-order construct that includes three sub-constructs: cost achievement, timeline achievement, and objectives achievement. Finally, organizational culture was considered as a moderating variable.

In light of the CFA of the below mentioned factors the results of the hypothesis testing are summarized in Table 55:

- Government analysis
- Economic analysis
- Leadership
- Disruptive technology
- Communication
- Staff capability
- Realistic
- Project feasibility
- Client involvement
- Organizational culture
- Cost
- Timeline
- Objectives achieved

Table 55: Results of hypothesis testing

Hypothesis	**Result**
$H1_a$: Strategic factors positively affect cost achievement in projects.	Accepted
$H2_a$: Tactical factors positively affect cost achievement in projects.	Accepted
$H3_a$: Operational factors positively affect cost achievement in projects.	Rejected
$H4_a$: Strategic factors positively affect timeline achievement in projects.	Rejected
$H5_a$: Tactical factors positively affect timeline achievement in projects.	Rejected
$H6_a$: Operational factors positively affect timeline achievement in projects.	Rejected
$H7_a$: Strategic factors positively affect objectives achievement in projects.	Accepted
$H8_a$: Tactical factors positively affect objectives achievement in projects.	Rejected
$H9_a$: Operational factors positively affect objectives achievement in projects.	Rejected
$H10_a$: Strategic factors positively affect organizational culture in projects.	Accepted
$H11_a$: Tactical factors positively affect organizational culture in projects.	Accepted
$H12_a$: Operational factors positively affect organizational culture in projects.	Rejected
$H13_a$: Organizational culture positively affects cost achievement in projects.	Accepted
$H14_a$: Organizational culture positively affects timeline achievement in projects.	Accepted
$H15_a$: Organizational culture positively affects objectives achievement in projects.	Accepted
$H16_a$: Cost achievement positively affects objectives achievement in projects.	Rejected
$H17_a$: Timeline achievement positively affects objectives achievement in projects.	Rejected
$H18_a$: Organizational culture has a moderating effect on the relationship between strategic factors and cost achievement.	Accepted
$H19_a$: Organizational culture has a moderating effect on the relationship between strategic factors and timeline achievement.	Accepted
$H20_a$: Organizational culture has a moderating effect on the relationship between strategic factors and objectives achievement.	Accepted
$H21_a$: Organizational culture has a moderating effect on the relationship between tactical factors and cost achievement.	Accepted
$H22_a$: Organizational culture has a moderating effect on the relationship between tactical factors and timeline achievement.	Accepted
$H23_a$: Organizational culture has a moderating effect on the relationship between tactical factors and objectives achievement.	Rejected
$H24_a$: Organizational culture has a moderating effect on the relationship between operational factors and cost achievement.	Accepted
$H25_a$: Organizational culture has a moderating effect on the relationship between operational factors and timeline achievement.	Accepted
$H26_a$: Organizational culture has a moderating effect on the relationship between operational factors and objectives achievement.	Rejected

Source: Analysis of survey data.

Chapter 6: Discussion and Conclusions

The purpose of this chapter is to summarize the findings of the data analysis in relation to the theoretical body of knowledge and to draw conclusions from them. The practical and academic implications of this study are discussed, with an emphasis on its limitations. Finally, possibilities for future research are suggested.

6.1 Goal of the Study

It is a challenge to develop public projects, as they require time to implement, may be costly, and are likely to involve smart objectives. Therefore, the ability to manage such development is necessary and takes precedence over traditional methods. It has been very challenging to clarify the various factors that contribute to the success of R&D projects funded by governments (Yamazaki et al., 2012).

Accordingly, the goal of the current study is to clarify the CSFs that primarily affect the success of R&D projects that the Abu Dhabi government involved in. Therefore, although it has evaluated a number of factors in such projects, the main concern has been to identify the CSFs that play a vital role in achieving the objectives of government-funded R&D projects.

6.2 Contribution to the Literature

This study contributes to the literature by providing insight into the factors that generate R&D project success in the UAE. There is a gap in the literature with regard to evaluating such models, and this study explored success factors from the perspective of employees. The relevant factors are, first, strategic factors (the goal and the relevance of its content and material to the success of an R&D project); second, tactical factors; and third, operational factors. This study looked at R&D

project success in the light of three different factors: achievement in terms of costs, achievement in terms of timeline, and achievement in terms of objectives.

This study has investigated the effect of organizational culture as a mediating factor for the relationship between strategic factors, tactical factors, and operational factors with achievement in terms of cost, timeline, and objectives. In addition, this study analyzed the effect of selected CSFs on the success of R&D projects.

The United Arab Emirates have heavily invested in the research and development projects to fasten her economic growth. The main purpose of this investment is to encourage innovation especially in the private sector which is very critical to helping the government achieve its vision. However, managing most of these projects is not always easy, there are several critical factors that determine whether a project will be successful or not. It is therefore very important for the government to ensure that the project managers are competent and have a reputable track record before being assigned the management task. In addition to that, The United Arab Emirates have heavily invested in the research and development projects by getting the equipment needed to accomplish the goals of the project. When undertaking the projects with fewer chances of success, project managers are always putting innovative measures to ensure that the project is successful against the odds. The managers can either put some measures to reduce the costs of running a new project or rework on an old project using the latest technology.

6.3 Summary of Findings

Table 56: Summary of hypotheses tested

Hypothesis	Path	Remark
$H1_a$:	Strategic factors → Cost achievement	Supported
$H2_a$:	Tactical factors → Cost achievement	Supported
$H3_a$:	Operational factors → Cost achievement	Not supported
$H4_a$:	Strategic factors → Timeline achievement	Not supported
$H5_a$:	Tactical factors → Timeline achievement	Not supported
$H6_a$:	Operational factors → Timeline achievement	Not supported
$H7_a$:	Strategic factors → Objectives achievement	Supported
$H8_a$:	Tactical factors → Objectives achievement	Not supported
$H9_a$:	Operational factors → Objectives achievement	Not supported
$H10_a$:	Strategic factors → Organizational culture	Supported
$H11_a$:	Tactical factors → Organizational culture	Supported
$H12_a$:	Operational factors → Organizational culture	Not supported
$H13_a$:	Organizational culture → Cost achievement	Supported
$H14_a$:	Organizational culture → Timeline achievement	Supported
$H15_a$:	Organizational culture → Objectives achievement	Significant but not supported
$H16_a$:	Cost achievement of project → Objectives achievement	Not supported
$H17_a$:	Timeline achievement of project → Objectives achievement	Not supported
$H18_a$:	Moderating effect of organizational culture: Strategic factors → Cost achievement	Supported
$H19_a$:	Moderating effect of organizational culture: Strategic factors → Timeline achievement	Supported
$H20_a$:	Moderating effect of organizational culture: Strategic factors → Objectives achievement	Supported
$H21_a$:	Moderating effect of organizational culture: Tactical factors → Cost achievement	Supported
$H22_a$:	Moderating effect of organizational culture: Tactical factors → Timeline achievement	Supported
$H23_a$:	Moderating effect of organizational culture: Tactical factors → Objectives achievement	Not supported
$H24_a$:	Moderating effect of organizational culture: Operational factors → Cost achievement	Supported
$H25_a$:	Moderating effect of organizational culture: Operational factors → Timeline achievement	Supported
$H26_a$:	Moderating effect of organizational culture: Operational factors → Objectives achievement	Not supported

As shown in the summary of hypothesis testing (Table 56), this dissertation provides empirical evidence for several hypotheses. First, strategic factors (i.e., government analysis, economic analysis, leadership, and disruptive technology) had a positive effect on the cost achievement of projects, as did tactical factors (i.e., staff capability and communication). However, operational factors (i.e., realistic schedule, project feasibility, and client involvement) had no significant effect on the cost achievement of projects. Second, the timeline achievement of projects was not significantly determined by strategic, tactical, or operational factors. Third, the achievement of project objectives was significantly determined by strategic factors, although tactical and operational factors had no significant effect in this area.

Fourth, strategic factors and tactical factors influenced organizational culture, and organizational culture influenced the cost achievement and timeline achievement of projects. Fifth, operational factors had no significant effect on organizational culture, and sixth, organizational culture had a negative effect on achieving project objectives. Seventh, cost achievement and timeline achievement factors had no significant effect on the achievement of project objectives.

Eighth, the findings show that organizational culture played a major role as moderating factor between strategic factors and achieving the cost, timeline, and objectives of projects. Ninth, organizational culture played a major role as moderating factor between tactical factors and achieving the cost and timeline of projects; however, it was not a significant moderator for achieving project objectives. Tenth, organizational culture played a major role as moderating factor between operational factors and achieving the cost and timeline of projects; however, it was not a significant moderator for the achievement of project objectives.

6.4 Interpretation of Results

The success of R&D projects is affected by the following factors:

1. the strategic and tactical factors that support cost achievement
2. the strategic factors that support objectives achievement
3. the strategic and tactical factors that support organizational culture, which in turn supports cost and timeline achievement
4. the moderating effect of organizational culture in achieving the cost, timeline, and objectives via strategic factors
5. the moderating effect of organizational culture in achieving the cost and timeline via tactical factors
6. the moderating effect of organizational culture in achieving the cost and timeline via operational factors.

As several other studies have indicated, it is important to identify certain internal and external CSFs are important before conducting R&D project activities (Camilleri, 2011; Carter et al., 2011; Centre for Volunteering, 2008).

According to the findings of this study, government support is an essential factor in success and efficiency in R&D projects in Abu Dhabi. The findings are thus in line with the UAE dream, manifested in its adoption of Vision 2021 with the aim of enlarging socio-economic development. The UAE aims to transform itself into a diversified and knowledge-based economy by 2021 and to achieve the recognition that goes with that status. In order to facilitate the objectives of Vision 2021, the UAE government has recently announced a funding injection of $82 billion for innovations in the field of technology, with a view to transforming the UAE into a universal innovation hub (in addition to the combined efforts of the government and private partnerships to enhance the development of innovation across the UAE).

The importance of Vision 2021 is also evidenced by the launch in 2015 of the UAE government's Science, Technology and Innovation policy, which aims to prepare the UAE for the post-oil world. The policy is exclusive and identifies the requirements and challenges faced by exceptional university researchers and technical entrepreneurs. These challenges include limited access to advanced and specialized R&D infrastructure, high laboratory costs, and lack of availability of prototyping facilities, to name a few. The Science, Technology and Innovation policy supports start-ups not only by funding innovations but also by ensuring the availability of R&D facilities for advanced research. It also aims to enhance the world-class innovation ecosystem, to make technology transfer possible, and to foster innovation. In terms of implementation, the government established a committee known as the National Science, Technology and Innovation Committee policy to make the UAE one of the most innovative countries in the world, owing to the advanced and innovative talent, resources, legislations, and infrastructure it enjoys.

The results of this study are thus supported by Kang and Park (2012), Okamuro and Nishimura (2015), who emphasized the importance of policies and guidelines set by government for allocating resources to R&D projects (and thus for the support they can provide for any project and its completion). Therefore, this kind of support can take a project to the profitability stage, as Einio (2009) argued, government support can improve the profitability of R&D projects, and support through subsidies encourages companies to carry out R&D projects that could not have been profitable otherwise. Thus, it is clear that government support not only ensures the success of an R&D project but also its commencement, as such supports stimulate internal R&D and smoothens upstream and downstream collaborations. Therefore, without the government support, the funding itself is likely to be terminated (Kang & Park, 2012). The results also indicate that government support helps to achieve R&D project objectives. This is consistent with the findings of Cunningham and Link (2016), who argued that government support enhances the performance of R&D projects. However, the findings of the present study contradict those of Aoshima et al. (2011), who argued that government support can influence the progress of R&D projects negatively. This contradiction can be explained in terms of government employees being overdependent on government resources instead of dealing with other external resources.

6.4.1 Implications on Economic Growth

The present study has also shown that the economic situation is a critical success factor for cost allocation in R&D projects funded by the Abu Dhabi government. This finding is consistent with the UAE government's adoption of effective economic policies that have minimized the effects of the recent profound changes casting a shadow over the global economy in general, and over oil-producing and -exporting countries in particular. Despite signs of recovery in some countries, many major economies in the East and the West continue to lag behind. Alongside the continued volatility of oil prices, political and economic challenges are disrupting international trade and investment flows, leading to more difficulty in anticipating prospects for economic growth. The UAE economy has proven its resilience and its ability to sustain growth despite such pressures and economic difficulties (UAE Ministry of Economy, 2017).

The UAE has maintained its position as the second-largest economy in the Arab World and one of the most important regional destinations for trade, investment, and economic activities. This privilege is a result of the leading economic model adopted by the UAE under the directives of wise leadership and in line with the objectives of UAE Vision 2021 to establish a diversified and globally competitive economy based on knowledge and innovation and led by national competencies.

According to statistics and data generated in various sectors, the UAE's GDP, particularly in its non-oil components, has achieved significant growth at current and constant prices, as the policy of economic diversification continues to gain momentum in line with ongoing endeavors to build a post-oil economy. According to international reports, the UAE has maintained its regional leadership and prominent global positions in many indices, including those related to development, competitiveness, advanced infrastructure and e-infrastructure, entrepreneurship, innovation, ease of doing business, trade and tourism, import and export of goods and services, re-exports, and incoming and outgoing foreign investments (UAE Ministry of Economy, 2017).

Major efforts and strategic investments are ongoing to develop vital sectors of the country's economy further, such as infrastructure, small- and medium-sized enterprises, manufacturing, transport, renewable energy, tourism, and education. The current focus is on building the foundations for future development, with initiatives and leading projects aimed at enhancing investment associated with innovation, technological advancement, R&D, artificial intelligence applications, and the concepts of the Fourth Industrial Revolution in line with the objectives of the

Science, Technology and Innovation Higher Policy, the National Strategy for Innovation, and UAE Centennial 2071.

The present results reinforce Tassey's findings that the primary impact of government-funded research projects is economic impact (Tassey, 2012). This implies that all aspects of economic analysis (i.e., markets, finances, resource allocation, and project size evaluation) are important for effective completion and success of R&D projects, especially those that are publicly funded. These attributes determine the initial, intermediate, and final stages of R&D projects if properly sustained, maintained, and managed (Milosevic et al., cited in Alias et al., 2014).

6.4.2 The Impact of Strong Leadership

Another important factor that emerges from the findings is the importance of leadership competency in the ensuring success of government-funded R&D projects, and specifically in achieving maximum utilization of project resources; this finding is consistent with the work of Nagesh and Thomas (2015). The UAE's institutional leadership is the federal monarchy. Power is centralized, and senior public leaders locate their roles as nested in followership of their royal rulers; the purpose of leadership is framed in terms of the delivery of change strategies set out by the rulers and in terms of improving outcomes for society. Leaders do this within a complex and shifting strategic environment, in which social and economic changes are driven by fast-paced, globalized trends. UAE public leadership is distinguished from leadership in the private sector by this purpose and by the essential socially oriented values of service to Their Highnesses and to the community, although public leaders are also expected to embrace managerial values. These twin sets of values also shape the bureaucratic rules that characterize government organizations and which public leaders must master (Mathias, 2017). The UAE's public leadership combines managerial and relational practices. UAE public leaders primarily describe their day-to-day activities in terms of management practices (such as leading change, communicating, alignment, developing strategies and running the organization), although they operate routinely across multiple arenas within and beyond their own agencies (Mathias, 2017). They must combine strong managerial competencies with relational practices that enable them to work across these multiple arenas. The picture that emerges from Mathias's (2017) study is of day-to-day UAE public leadership bearing many characteristics consistent with the broader contemporary public leadership perspective: the fast-changing public leadership environment that is shaped by international dynamics that are to a significant degree outside the control of national governments.

It could be inferred from this that top management is the group with the most influence on project implementation success, and Chan and Swatman (2000) stated that those who are responsible for a project's implementation are the most crucial element in its success. The results also show that leadership had an effect on the achievement of the objectives of the R&D projects, which matches the findings of Doraszelski and Jaumandreu (2013), who identified a correlation between improved R&D productivity and leadership support. It is agreed that R&D project leaders have an influence on other personnel and motivate them to maximize their potential in service delivery in their respective areas with the overall aim of achieving the set goals and mission. Therefore, great leadership maintains a smooth process of service delivery and ensures positive outcomes by providing guidance and solutions for the challenges that might arise during the R&D project (Fernandez & Jawadi 2015). In terms of the finding that leadership had an influence on organizational culture, Pashah (2016) had the same results, according to which leadership affects organizational culture (the behaviors, interaction, and cooperation among employees). Therefore, organizational culture can have an effect on the achievement of R&D projects in terms of cost and timeline achievement, and this implies that organizational culture also dictates employee performance and interaction.

6.4.3 The Role of Disruptive Technology

Another crucial factor emerging from the present study is the effect of disruptive technology on achieving the cost and objectives of R&D projects in Abu Dhabi. This is consistent with the large number of initiatives adopted by the UAE government, mainly in Dubai and Abu Dhabi, through research centers such as the Khalifa Innovation Centre (established by Khalifa University of Science & Technology) and the UAEU Science & Innovation Park (established by the United Arab Emirates University). A number of innovation incubators and accelerators have also been established and initiated throughout the UAE. For example, the Dubai Future Accelerators program (the “Program”) aims to attract and support entrepreneurs and start-up companies from across the globe and to link them to local sponsors (mainly governmental entities) in various industrial fields, with the objective of developing innovative technologies. Each round of the Program lasts for three months and receives around 30 entrepreneurs, most of whom come from outside the country. The first round, which took place from to December 2016, brought these entrepreneurs contracts to a value of around AED 130 million.

Certain government-initiated innovation incubation and acceleration schemes, such as the Program, are open to international entrepreneurs and companies. These international entities are provided with the opportunity to connect and work with local entities on projects of common interest; this can lead to business opportunities while giving entrepreneurs the opportunity to develop, test, and deploy their innovations inside the UAE. International companies continually show interest in opportunities inside the UAE because of its potential to become a regional and international innovation hub. However, certain government-initiated innovation incubation and acceleration programs are open only to UAE and/or GCC nationals. International companies can consult and review the eligibility conditions of the different governmental programs that are available. Private innovation incubators and accelerators also exist and are increasingly present in the UAE. These are normally open to foreign entrepreneurs and offer a good starting point for business support and networking in the UAE. In addition, there are a number of corporate incubators that provide physical environments and infrastructure for the establishment of companies in the UAE free zone with 100% ownership rights, including Dubai Science Park, Dubai Techno Park, Dubai Silicon Oasis, D3, Masdar City, Dubai Internet City, and Dubai Biotechnology & Research Park (DuBiotech). Another example is provided by Dubai SME, which instituted innovation incubation programs through its innovation arm, Hamdan Innovation Incubator, with the objective of backing entrepreneurs in the development, protection, and commercialization of their innovations. In Abu Dhabi, the Takamul program of the Abu Dhabi Department of Economic Development supports and funds Emirati inventors, universities, and companies in the protection and commercialization of their innovations.

Therefore, the presents findings are consistent with several studies that have considered disruptive technology as an important factor in achieving innovation (Selhofer et al., 2012), achieving creativity, and resource conversion (Hang &

Garnsey, 2011), measuring performance (Selhofer et al., 2012), and offering problem-solving capacity, as well as enhanced development of new ideas and opportunities (Hang & Garnsey, 2011). Consequently, it could be inferred that disruptive technology has a significantly effect on the market and on the economic activities of organizations within that market.

6.4.4 The Importance of Effective Communication

The findings also indicate that effective communication enables the success of R&D projects, as discussed by Sapienza (2015) and Kern (2006), who explained that the robust nature of a communication plan makes an R&D project more consistent with regard to its handling. As Nagesh and Thomas (2015) stated, for an R&D project to succeed, there is a need for project management success, product success, and market success. The collaboration between these three attributes is a prerequisite of effective communication. Likewise, Alias et al. (2014), Yang and Kassekert (2009) argued that adequate communication channels are CSFs for R&D projects in that they help to resolve conflicts between participants, as well as to maintain the support and commitment of all R&D stakeholders. Moreover, the findings show that effective communication is an influencing factor on organizational culture, which also affects the success of R&D projects. This is in line with the work of Yang and Kassekert (2009), who found that effective communication contributes to positive cultural adjustments that favor R&D project success. This implies that effective communication allows a collective understanding among team members that enables them to work as a unit. Other interactions observed to support R&D project success are effective communication interaction between project members and clients that promotes the interpretation of technological needs for the project; in R&D projects, conflicts arise between members or different stakeholders exist, and the resolution of these conflicts requires communication (Barragan-Ocana & Zubieta-Garcia, 2013).

6.4.5 The Staff Capability and the Support of Organizational Culture

Staff capability factor was one of the CSFs found to affect the success of R&D projects. Likewise, Liu & Tsai (2008) found that effective management of an R&D project requires project personnel to possess certain skills, such as professional R&D technological skills, so that they can apply their existing knowledge to new technological ideas. Moreover, they need to possess IT skills, communication and coordination skills, leadership skills, organizing and promotion skills, and integration skills (Liu & Tsai, 2008). It follows from these findings that staff capacity is critical in R&D success, in the sense that the presence of employees with high levels of competency decreases uncertainty and shortens R&D cycles (Quelin, 2000).

In the UAE, it seems that the human resource management function faces at least four challenges that are common to each of the other GCC countries. The first test is to align human resource strategies and practices with organizational strategic goals effectively. Scott-Jackson et al. (2014) found that while 80% of GCC business leaders recognize that human resource is crucially important for the success of their enterprise, their country, and the GCC as a whole, only 25% rated the practice of their discipline in the GCC region as excellent compared to global best practice. In an article focusing on the strategic role of human resource management in the UAE, Zahi (2013) studied the role of human resource managers in UAE educational institutions and found that the two immediate priorities for human resource departments in these organizations were building leadership capabilities and driving cultural and behavioral behavior. However, most human resource activities actually focused on the routine administrative aspects of human resource management, leading the author to conclude that the role of human resource management in UAE educational institutions is not that of a strategic partner. Moreover, it was observed that the role of human resource as a contributor to corporate strategy is acknowledged at an executive level, although many organizations in both the public and private sectors struggle to operationalize key concepts of strategic human resource management. One government department had more than 10% of its staff devoted specifically to strategy, but no explicit human capital goals were included in its list of more than a dozen objectives. The second challenge is to improve the effectiveness of human resource processes, particularly in key areas identified as most important by business. Human resource management departments in the UAE are struggling to establish objective and efficient human resource systems (Zahi, 2013; Al Ariss, 2014). The third challenge is to improve the professionalism of human resource practitioners; human resource professionals in the GCC lack relevant experience and education (Scott-Jackson et al., 2014). A fourth significant challenge is related to the development of human resource management processes that are relevant for the UAE and that meet the specific needs of national or organizational cultures and management models in the country. As for the GCC nations generally, these requirements are usually related to local talent management processes, including recruitment, development, engagement, and retention of local citizens (Scott-Jackson et al., 2014). However, management of expatriates and diversity management are critical topics in this context (Al Ariss, 2014). In a transient environment with high turnover and the lack of a corporate culture providing expatriate employees with training or defined career paths (Al-Ali, 2008), the long-term engagement and retention of these workers becomes a key consideration. Finally, women, both local and expatriate, form an educated talent pool that has yet to be fully engaged.

From another perspective, Belassi (2013) characterized organizational culture as the shared beliefs and values within an organization that shape the behavior and attitude of employees. Tan (2007) observed that an organization's culture may be viewed from the angles of process orientation, governance, training, and responsibilities. Tan (2007) explained that an organization that follows a scalable process of managing a project has a high success rate; successful projects then result in the adoption of a single culture and structure that an organization perfects over the years. However, Cox (2009) explained that the existence of processes and cultures is not enough to guarantee success and that governance is also necessary. Management ensures that people follow the procedures that they are supposed to follow and that they make adjustments where necessary. Tan (2007) regarded changes to culture as due to training, project specifications, and technological developments. Both Tan (2007) and Cox (2009) examined people's knowledge about their roles in the processes adopted over the years. Sponsors, clients, and the management are better informed about their roles if there is a consistent culture.

R&D projects are intended to develop new products. New product development has been found to rely on the integration of attributes of organizational culture. In a study to examine the impact of organizational culture on successful development of new products, Belassi (2013) showed theoretically that organizational culture is linked to the success or failure of new product development. The argument is that organizational culture dictates what the organization entails and how it operates (Belassi, 2013). As such, an attempt to introduce new opportunities without careful consideration of the organizational culture can yield negative results (Belassi, 2013).

According to Belassi (cited in Tajudin et al., 2012), organizational culture determines three important performance measures in projects. First, it dictates the commercial outcome of projects; second, it determines the technical outcome of projects; and third, it determines the level of customer satisfaction in new product production (Belassi, 2013, cited in Tajudin et al., 2012). In their study, Tajudin et al. (2012) found that entrepreneurial culture had an impact on new product production, a major component of R&D projects.

It is important to note that personnel in R&D projects experience stressful conditions, such as performance pressure, time pressure, the competitiveness and demands of R&D projects, and social isolation. Therefore, they tend to develop the behavior of learned helplessness, which can affect their performance. Organizational culture has been found to counteract this behavior. Saxena and Shah (2008) found that organizational culture correlated negatively with attributes of learned helplessness. Moreover, they found that organizational culture played an important role in removing learned helplessness and that organizational culture was crucial for predicting the outcome of learned helplessness (Saxena & Shah, 2008). Singh &Vishal. (2016), from a case study in India, revealed that organizational culture was a critical success and performance in of national R&D firms. In this connection, Belassi et al. (2007) investigated the effects of organizational culture on new product projects in 95 US organizations and found a significant effect of organizational culture on new product development projects (Belassi et al., 2007). The study revealed that organizational culture contributed to the success of these projects (Belassi et al., 2007).

From this point of view, it can be concluded that successful development of products in R&D projects requires organizations to foster a culture that enhances commitment among employees and helps them to cope with the stress that comes with new ideas. The findings of the present study show that organizational culture was a moderating factor in the relationship between CSFs and R&D project success in Abu Dhabi. Therefore, it can be inferred that R&D projects rely on the integration of certain attributes of organizational culture. Belassi (2013) proved theoretically that organizational culture is linked to success or failure of new product development, adding that a lack of careful consideration of organizational culture can yield negative results. Organizational culture comes into play when personnel in R&D projects experience stressful conditions, such as performance pressure, time pressure, competitiveness and demand of R&D projects, and social isolation. Therefore, they tend to develop learned helplessness behavior, which can affect their performance. Organizational culture has been found to counteract this behavior (Saxena & Shah, 2008). Therefore, since 2015, in view of the spread of a culture of innovation, the UAE government has designated a week each November as innovation week. The objective of innovation week is to educate and encourage public and private entities to take the initiative in fostering and developing innovations with a number of programs that give accolades to innovators for their initiatives.

The findings of the present study show no clear effect of project feasibility on R&D project success. However, Jacobsen et al. (2008) stressed that a project should have a reasonable degree of feasibility and regarded this factor as vital to a project’s success. Other findings contradict the current results; for example, Mukherjee and Roy (2017) claimed that careful review of any proposal is essential before the design and development phase. Depending on the results of the initial investigation result, the survey may serve as an extended feasibility study. Thus, a feasibility study may be considered as a systematic proposal depending on the characteristics of the work, as it measures the impact on the business organization, which helps to meet user demands and ensure proper utilization of resources. As Ionut (2015) observed, the entire life cycle of an investment project is drawn up on the basis of documentation (such as prefeasibility studies and feasibility studies) which must be carried out in a coherent manner and closely tailored to the general and specific conditions of the project and the organization. On the basis of the conclusions of the feasibility study, the makers decide to abandon, continue, or re-evaluate the project, perhaps considering alternative assumptions. It should be noted that the role of a business plan is not only to prove that the deal is worth funding; its primary purpose is to guide the entrepreneur in all operational phases of the business.

This prompted the researcher to undertake another investigation, the findings of which showed no significant effect of realistic scheduling on the success of R&D projects. This contradicts the claims of Hussein and Klakegg (2014) that project success can be attributed to realistic schedules and that the absence of realistic schedules is correlated with numerous problems, including incomplete development of success criteria, unrealistic criteria, and ambiguity. The present negative findings may be due to respondents not having a positive perception of the realistic dimension and its effect on project achievement; this would lead to misinterpretation of information, or underestimation of project procedures and overestimation of outcomes. The results also contradict the findings of Baldwin and Bordoli (2014), who stated that regardless of the definition chosen, project planning has the objective of achieving a number of common factors, including the production of realistic schedules and costs, the completion of a project to defined standards of quality, design criteria, project resources, health and safety, and meeting project stakeholders' expectations. Therefore, managers should be alert to the fact that unrealistic schedules lead to unrealistic targets that cannot be achieved even under ideal conditions.

Even in the negative effect of direct operational factors (i.e. realistic schedule, project feasibility) on the success of R&D projects, organizational culture was found to be a moderating factor, playing a role in cost and timeline achievement of R&D projects through operational factors. Therefore, it seems that a realistic schedule may have an indirect effect on the cost and timeline achievement of a project. As Korzaan (2009) pointed out, accurate schedule estimates provide a realistic schedule and help to reduce the cost of a project; with a realistic schedule, project managers and team members can realize a shift away from the schedule and resolve any issues (Korzaan, 2009). Interestingly, Mikulskiene (2014) was consistent with current observations in suggesting that some R&D projects require unrealistic plans, as unrealistic plans have a higher chance of stimulating better results.

Lastly, for client involvement, the findings showed no significant effect on R&D project success. Kharbanda and Pinto (1996) emphasized that for a successful project the user must be strongly committed to the project goals and be involved in the project management process. Subsequently, several studies found a link between the success of an R&D project and the involvement of different stakeholders in its essential phases (Brafield & Eckersley, 2008; Mosey & Wiley Inter Science, 2009; Majava et al. (2015). Likewise, and still in contradiction with the current outcomes, Alsolaiman (2014) stated that effective and appropriate involvement on the part of clients influences good outcomes, and the degree of client involvement is influenced by, inter alia, taking the right decisions at appropriate phases of the project.

Therefore, effective client involvement requires flexible guidance throughout the project life cycle. Al-Kharashi and Skitmore (2009) suggested a link between ineffective involvement on the part of project participants (clients included) and poor project outcomes.

The current study also showed that the organizational factor can be considered as a moderating factor between client involvement and the cost and timeline achievement of R&D projects. This finding is in line with the work of Hooge and Dalmasso (2015), who conducted a longitudinal study to examine the involvement of stakeholders in engineering R&D organizations; their findings clearly show the importance of stakeholder involvement in R&D projects, although they suggested that was is highly dependent on the legitimate perception of the organization owners. Therefore, from a personal perspective, it seems that client involvement creates confidence in an R&D project member to the extent that they have a detailed requirement portfolio for the anticipated product.

6.5 Limitations and Recommendations for Future Research

The current study used only one method to determine which CSFs most affect the success of R&D projects. However, there are several methods and techniques for determining CSFs (Chen, 2011), including environment scanning, industry structure analysis, opinions of experts in the industry, analysis of competitors, analysis of the industry's dominant firm, and a specific assessment of the company. Therefore, it is suggested that future studies employ different methods to determine precisely which CSFs have the greatest effect on the success of R&D projects.

It should be noted that several difficulties were encountered during the collection of data from firms undertaking government-funded R&D projects. The researcher engaged in a lot of traveling to meet managers and made a large number of phone calls to set up survey and interview dates. Therefore, a lot of time was required to complete the data collection. This researcher's advice to decision-makers is to ensure that CSFs are predetermined for each project. This will improve information accessibility for interested stakeholders, which is consistent with ethical requirements.

All the participants in this study were from public organizations in Abu Dhabi, which implies that the findings may not be generalizable to the other Emirates. Therefore, further studies should involve a greater diversity of participants. For example, Hsu and Hsueh (2009) found that the efficiency of government-funded R&D was greatly affected by organization size, external industry, and budget.

Some recommended studies for the future could include the impact of the factors identified and tested in this study on other kinds of projects such as mega projects. Also, one more study could include a comparative analysis between the R&D projects in Abu Dhabi and the R&D projects in a different country in the region. Further studies could include identifying more factors such as environmental analysis, innovation, digitization or knowledge transfer and its impact on the success of R&D projects.

6.6 Implications

6.6.1 Theoretical Implications

The findings of this study have significant theoretical implications, as several CSFs have been identified as contributors to the success of a R&D project. Future research should consider such factors as key components and as providing a platform for building a success strategy that increase the likelihood of R&D project success.

However, several of the factors under investigation did not appear to an effect on the success of R&D projects; therefore, further investigation is required to establish the reasons for this, which may relate to the theoretical perspectives adopted.

Project feasibility was not found to contribute to the success of R&D projects, despite feasibility studies being recognized as an essential step before the start of any new project regardless of its size. In today's business environment, feasibility studies are strategic documents prepared and executed by managers, who focus on the best resource allocations and aim provide consistent on-target delivery of projects. The principal function of a feasibility study is to establish whether a project should go ahead. Given the importance of the feasibility study for evaluating the practicability of a project, business venture, or idea, future studies should examine the reasons for the present result.

Despite the current results, the researcher is of the opinion that feasibility studies are strategically important; they evaluate projects from different points of view, covering the key aspects that must be considered carefully before moving forward and committing time and resources. The researcher also believes that feasibility studies provide an improved understanding of the project itself, ensuring that potential issues and risks surface at an early stage before any damage is done. From the financial point of view, they underline the impact on cash flow, clarify the requirements for funding, highlight the burden on current resources, and set out the need for additional resources. Whatever the industry or market, time pressures continue to increase; using feasibility studies as a matter of policy will help to improve business performance in the long term and to streamline focus on the most promising projects. Therefore, future studies should review different theories and case studies that explore the importance of feasibility study for the success of R&D projects.

It is also important to investigate the situation regarding realistic schedules for R&D projects in Abu Dhabi. Although a project plan contains more than just a schedule, the schedule is arguably the most important aspect of the plan; it defines what the project team need to do and when they need to do it. Outside of the project team, it is the most visible manifestation of the plan (and many stakeholders consider it to be the plan). The project team is tasked with creating the end-product of the project. The schedule, developed with their input, lays out how they, as a team, are to go about creating it. It should reflect the project priorities, the best sequence of activities, and how the work of individual contributors will be integrated into the outcome. A good schedule will do more than predict the delivery date; it will also impact the final quality of the end-product, and no project is really over until the customer is satisfied with the quality of the product. Management need to be completely familiar with the key milestones, especially the completion date of the project. Then they set the customers' expectations of when they can expect to receive the deliverables (information that may, in turn, drive the customers' schedules). With realistic schedules, customer expectations on timing, quality, and scope can be met; with optimistic schedules, unrealistic expectations result in disappointed customers. Many organizations create a roadmap of future projects and use this to set long-term goals, which are also shared with customers so that they can do their own long-term planning. In fact, the roadmap frequently reflects the needs of key customers, as meeting those needs can be very important in a competitive environment. Nonetheless, the roadmap is driven by the availability of the necessary resources, and it is important to know when those resources will be available (that is, when will they complete their current assignments). Therefore, future studies should review different theories and case studies that explore the importance of realistic schedules in the success of R&D projects in Abu Dhabi.

Finally, to increase the effectiveness of client involvement in projects, emphasis should be placed on team contributions to the construction process (for example, in the exchange of ideas). Since it is well known that clients have a high level of influence on project outcomes, it is imperative to focus on their involvement in projects and to determine more precisely the reasons behind the current findings. If clients are to be involved in projects effectively and efficiently, they should have the appropriate knowledge and skills.

6.6.2 Practical Implications

Identifying the economic status of a project has a strategic impact on its conduct and assessment. In particular, most government-funded R&D programs do not anticipate the magnitude or scope of intervention required in an R&D program, and adequate financial budget is a CSF for R&D projects. Therefore, there is a need to evaluate the significant economic costs of completing a study, including the resources used on personnel in terms of training or hiring, project size, and the degree of difficulty of the R&D project (Nagesh & Thomas, 2015).

It is important to identify the list of the CSFs for stakeholder involved with government -funded R&D in order to ensure successful implementation of these projects. Moreover, it will support the researchers and project managers to achieve the desired outcome.

Potentially, leadership roles are important in the generation of innovative ideas in R&D projects. Therefore, it suggested that leadership becomes involved in the generation of ideas, dealing with entrepreneurs, leading projects, gatekeeping, and coaching. This will ensure that effective leaders are able to communicate, set the tone, plan, and interface with effectively the project group (Elkins & Keller, 2003).

Leaders have to create an environment that is conducive to the revelation of the multiple ideas that lead to innovation, and effective leaders motivate project team members, organize the project, and coordinate its members (Elkins & Keller, 2003). Accordingly, it is necessary to build a healthy culture through effective leadership, which will allow all R&D team members to view themselves as part of a group rather than as unfairly treated individuals (Pashah, 2016). Leadership style is an essential consideration, since it is a combination of the traits, skills, and behaviors that leaders use in their interactions with those whom they lead. In addition, the style approach expands the study of leadership to a variety of contexts, and specifically to the implementation of government-funded R&D projects.

Innovation from disruptive technology requires effective integration of knowledge and information about the R&D project on the part of the R&D project team (Ebrahim et al., 2009).

Staff capability is another practical implication that has to be considered. Andre (2013) argued that the development of an effective intellectual property strategy is highly dependent on the occupational and educational skills of R&D staff. It is, therefore, justifiable to conclude that without a very capable R&D staff, the chances of project success are limited.

Culture building is another attribute that plays an essential role in the success of R&D projects. Tajudin et al. (2012) found that entrepreneurial culture has an impact on new product production, which is a major component of R&D projects. From this point of view, it can be concluded that successful development of products in R&D projects requires the fostering of a culture that enhances commitment among employees and helps them to cope with the stress associated with new ideas.

The final practical implications concerns scheduling. A realistic schedule reduces the pressure of meeting dates, allowing the project team to take time to undertake the project without shortcuts (McGevna, 2012). Therefore, with a realistic schedule, there is less likely to be a delay in obtaining access to resources, which means that projects are more likely to be delivered on time (McGevna, 2012). Moreover, a realistic schedule ensures customer satisfaction by providing end-products of high quality (McGevna, 2012). This generates market acceptance of the outcome, further enhancing the success of the project (McGevna, 2012).

6.7 Conclusions

On the basis of the present findings, a number of CSFs are important for fulfilling the objectives or mission of an R&D project. It is observed that CSFs are important because their absence or misinterpretation may ultimately lead to the failure of a project or may prevent an organization from completing its mission or objective. Therefore, the adoption of CSFs and careful management practices based on these variables greatly increases the chances of success for these projects.

Even after funded has been secured, R&D projects need to be continuously supported to ensure that no political obstacles or challenges block their successful completion. Government-funded R&D projects involve different stakeholders with conflicting interests. As such, promoting the success of an R&D project requires a system that keeps all stakeholders focused on the mission. Leadership has a significant impact in terms of supporting R&D departments with resource allocation and in terms of developing the vision and objectives that R&D departments should follow.

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Appendix

Questionnaire

<u>Critical success factors in managing government-funded R&D projects</u>

Dear Survey Participant,

We would like you to participate in this study to determine the critical success factors of managing government-funded R&D projects in the UAE. This research is conducted as part of the Doctorate of Business Administration Degree at the United Arab Emirates University (UAEU). This study is intended to better understand the factors impacting the success of government-funded R&D projects in the UAE. A summary of the report will be available to all interested participants. Please indicate your interest by providing us with your email address in the specified section.

Your participation is critical for the success of this study and to contribute to the field of business research in the UAE. Please be assured that your responses will be held in strict confidence. Only overall summary results in anonymous form will be reported, with no reference made to individual responses, respondents, or organizations.

If you have questions regarding this study, please do not hesitate to contact the researcher directly using the contact information below.

Thank you in advance for your valuable contribution to this important study.

<u>General instructions for completing the survey</u>

- Please select one research and development project funded by the government that you have been involved with and that has been completed within the last three years.
- Please answer all the questions to the best of your knowledge.
- In your response, please describe exactly what the situation in the selected project was, not what you believe it should have been.

1: Background Information

<u>Please put a tick in the appropriate box</u>

1.1. Age

☐ 34 or younger	☐ 35–44	☐ 45–54	☐ 55 or older

1.2. Gender

☐ Male	☐ Female

1.3. Qualifications

☐ Diploma	☐ Bachelor	☐ Postgraduate

1.4. Monthly Income (in USD)

☐ Less than 2,999	☐ 3,000–4,999	☐ More than 5,000

1.5. Nationality

☐ UAE	☐ Non-UAE

1.6. Experience in the current organization

☐ Less than 5 years	☐ 5–10 years	☐ 11–15 years	☐ More than 15 years

1.7. Which Sector or Ministry do you work in?

☐ Health	☐ Energy	☐ Information Security	☐ Agriculture

1.8. Do you think the R&D projects are important?

☐ Yes	☐ No

2: Critical Success Factors of R&D Projects

Please identify to what extent you agree or disagree with the following statements.

1	**2**	**3**	**4**	**5**
Strongly disagree	Disagree	Neutral	Agree	Strongly agree

A. Government analysis **To what extent do government policies and regulations affect the success of an R&D project?** **Comment: Government policies are currently in place, and there is strong support from the government for the conduct of R&D research.**					
A.1 R&D policies that guide the allocation of resources in R&D projects are set by the government.	1	2	3	4	5
A.2 The government may intervene in R&D projects that are not running smoothly.	1	2	3	4	5
A.3 There is a system that keeps stakeholders focused on the mission of the R&D project.	1	2	3	4	5
A.4 There is a review and evaluation system by the government on the progress of the project.	1	2	3	4	5
B. Economic analysis **To what extent does economic analysis affect the success of an R&D project?** **Comment: Most of the development projects that will nourish the economy are derived from R&D projects.**					
B.1 The economic impact of the R&D program is evaluated before the commencement of the project.	1	2	3	4	5

B.2 The R&D project products have a strong market.	1	2	3	4	5
B.3 Both human and non-human costs are identified before the project begins.	1	2	3	4	5
B.4 There is a review and evaluation system on the financial progress of the project.	1	2	3	4	5
C. Leadership **To what extent does leadership affect the success of an R&D project?** **Comment: The leadership of an organization supports and facilitates R&D projects, including financial and recruitment requirements.**					
C.1 R&D project leaders motivate other personnel to maximize their potential in service delivery.	1	2	3	4	5
C.2 Project leaders provide guidance and solutions for challenging issues and situations that might arise during the R&D project.	1	2	3	4	5
C.3 Project leaders help to generate ideas and support innovation.	1	2	3	4	5
C.4 Project leaders allow smooth communication and coordination to collect the information necessary for the project.	1	2	3	4	5
D. Disruptive technology **To what extent does disruptive technology affect the success of an R&D project? Comment: The continuous development of technology worldwide helps shape the approaches taken to R&D projects.**					

D.1 Disruptive technology offers problem-solving capabilities, as well as enhancing the capacity to develop new ideas and opportunities.	1	2	3	4	5
D.2 Disruptive technology leads to new commercial products.	1	2	3	4	5
D.3 Disruptive technology contributes to thinking outside the norms of product development.	1	2	3	4	5
D.4 Innovation from disruptive technology requires effective integration of knowledge and information about the R&D project.	1	2	3	4	5
E. Communications **To what extent do communications affect the success of an R&D project?** **Comment: It has been noted that participants value clear and effective communication throughout the project.**					
E.1 Effective communication boosts team morale and offers clarification of goals, tasks, and responsibilities.	1	2	3	4	5
E.2 The stages from budgeting through technical specification of the product are well communicated within the project team.	1	2	3	4	5
E.3 Project members and clients communicate effectively to identify the technological needs for the project.	1	2	3	4	5
E.4 Effective communication maintains the support and commitment of all R&D stakeholders.	1	2	3	4	5

F. Staff capability **To what extent does staff capability affect the success of an R&D project?** **Comment: Very little training is given to project teams; they are regarded as experts in the field, and therefore their capabilities are assessed during recruitment.**					
F.1 Project members are well assessed for their skills and knowledge for handling the project before it begins.	1	2	3	4	5
F2. Project members are provided with the training required before the project begins.	1	2	3	4	5
F3. The occupational and educational skills of R&D staff are highly reliable in developing the intellectual property of the project.	1	2	3	4	5
F.4 There is continuous performance evaluation for project team members throughout the project.	1	2	3	4	5
G. Organizational culture **To what extent does organizational culture affect the success of an R&D project?** **Comment: Because most organizations are multicultural, it is very important that organizations have a culture that supports all nationalities and empowers the people working on its projects.**					
G.1 The project team members have a common understanding of the values of the organization.	1	2	3	4	5

G.2 The organization fosters a culture that enhances commitment among employees and helps them to cope with stress and to come up with new ideas.	1	2	3	4	5
G.3 The cultural values and demographic factors of the project team affect the success of the project.	1	2	3	4	5
G.4 The organizational culture supports a learning environment.	1	2	3	4	5
H. Realistic schedules **To what extent does realistic scheduling affect the success of an R&D project?** **Comment: It is very important to ensure that the project is going to plan, because this is linked directly to the funding of the project.**					
H.1 A specified timeline for R&D is clearly identified, including a schedule that shows all stages from initiation to completion.	1	2	3	4	5
H.2 Project schedules are evaluated and adjusted continuously to ensure that they are realistic.	1	2	3	4	5
H.3 Project schedules are evaluated and agreed with all team members and stakeholders.	1	2	3	4	5
H.4 Each milestone in the project plan is evaluated continuously against the overall plan.	1	2	3	4	5

I. Project feasibility **To what extent does project feasibility affect the success of an R&D project?** **Comment: It is very important that the R&D projects are chosen according to the current situation and that future developments are taken into consideration.**					
I.1 There is a proper examination of whether a project is profitable or viable for an organization before conducting the project.	1	2	3	4	5
I.2 There is detailed and comprehensive planning that accounts for potential difficulties with the project before it starts.	1	2	3	4	5
I.3 There is a proper crisis management plan in place before the project starts.	1	2	3	4	5
I.4 The scope of the project is clearly identified before it starts.	1	2	3	4	5
J. Client involvement **To what extent does client involvement affect the success of an R&D project?** **Comment: Client decisions impact the completion of a project as well as the approval to obtain the necessary funding.**					
J.1 Project plans are clearly explained to clients and adjusted accordingly before the project starts.	1	2	3	4	5
J.2 There is continuous interaction between the clients and the project team throughout the project.	1	2	3	4	5
J.3 The challenges of the project are clearly communicated to the client, and alternative solutions are always presented.	1	2	3	4	5

J.4 The client conducts a comprehensive evaluation of the project team after each milestone is achieved and after the completion of the project.	1	2	3	4	5

3: R&D Project Success

The following statements explore the success of your R&D project. Please indicate the level of your agreement with each of the following statements.

1	2	3	4	5
Strongly disagree	Disagree	Neutral	Agree	Strongly agree

K. Timeline achieved **To what extent was the project schedule realistic?**					
K.1 The project timeline was defined on the basis of close cooperation with the project team and the stakeholders.	1	2	3	4	5
K.2 The project timeline was rarely reviewed or adjusted in the course of the project.	1	2	3	4	5
K.3 The milestones of the project were achieved according to the schedule for each milestone.	1	2	3	4	5
K.4 The final product of the project was reviewed and adjusted before the final submission to the client within the overall project timeline.	1	2	3	4	5
L. Objectives achieved **To what extent were the project objectives identified and achieved?**					
L.1 The goals and objectives of the project were in line with the general goals and objectives of the organization.	1	2	3	4	5
L.2 The goals and objectives of the project were made clear to the project team before the initiation of the project.	1	2	3	4	5
L.3 The client satisfaction with the final result was high.	1	2	3	4	5

L.4 There was clear audit activity throughout the project to ensure that the objectives were met.	1	2	3	4	5
M. Cost achieved **To what extent does the project feasibility study impact the success of the R&D project?**					
M.1 The project costs that were identified before the start of the project were equivalent to the costs of the project after completion.	1	2	3	4	5
M.2 There were continuous project budget update meetings throughout the project.	1	2	3	4	5
M.3 Cost performance reports were continuously prepared throughout the project.	1	2	3	4	5
M.4 A clear budget contingency plan was in place before the initiation of the project.	1	2	3	4	5

Thank you for your cooperation.

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