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The Relationship between Agile Project Management and Project Success Outcomes

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THE RELATIONSHIP BETWEEN AGILE PROJECT MANAGEMENT AND PROJECT SUCCESS OUTCOMES

by

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ABSTRACT

Agile project management (APM) has recently emerged as a new approach to managing complex projects. Some experts believe that APM will become the standard project management approach used in the 21st century. However, thus far, the role of agility in project management has not been widely investigated. In the recent past, the concept of agility has mainly been applied to software development projects. The literature on agility is still in its early stages, and further research needs to be conducted in new project management domains.

This study is intended to determine the impact of the adoption of APM on project success as perceived by project managers. This investigative approach can be applied to any project domain. In addition, the influencing effects of project complexity on the results of projects are analyzed. Through an analysis of the existing literature, critical success factors and success criteria are identified to develop a model that can be used to assess current APM practice.

The research questions are answered by means of an empirical study that collected data using an online survey that was distributed to project managers located across the United States. Confirmatory factor analysis and structural equation modeling are performed to gauge the validity of the proposed research model.

The study results show a significant positive relationship between APM and project success. Furthermore, a weak negative association is identified between project complexity and project success, suggesting a need for further research into and refinement of the project complexity construct. Finally, the results reveal an apparent need for additional education and certification in the field of project management, which are expected to lead to an increased use of agile approaches to project management in the future.

ACKNOWLEDGMENTS

After an intensive period of five years, today is the day: Writing this note of gratitude places the finishing touch on my dissertation. This has been a period of intensive learning for me, not only in the scientific arena but also on a personal level. Writing this dissertation has had a major impact on me, and I would like to reflect on the individuals who have supported and assisted me throughout this period.

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Finally, there are my parents, who supported me all the way from Germany. I would like to thank them for raising me and instilling in me the ambition and endurance necessary to succeed on such a long journey.

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LIST OF ACRONYMS AND ABBREVIATIONS

AMOS	Analysis of a moment structure (statistical software)
APM	Agile project management
APM-E	Association for Project Management - Europe
ARPA	Advanced Research Projects Agency
CCPM	Critical chain project management
CFA	Confirmatory factor analysis
CFI	Comparative fit index
CPM	Critical path method
CSF	Critical success factors
EFA	Exploratory factor analysis
EVA	Earned value analysis
GFI	Goodness-of-fit index
IPMA	International Project Management Association
IRB	Institutional Review Board
ISO	International Organization for Standardization
IT	Information technology
MI	Modification index
MIT	Massachusetts Institute of Technology
MRP	Material requirement planning
NASA	National Aeronautics and Space Administration
OSRD	Office of Scientific Research and Development

PERT	Program evaluation and review technique
PMBOK	Project Management Body of Knowledge
PM-2	Project management second order
PMI	Project Management Institute
PMO	Project management office
PRISMA	Preferred reporting items for systematic reviews and meta-analyses
R&D	Research and development
RMSEA	Root mean square error of approximation
SEM	Structural equation modeling
SIC	Standard industrial classification
SPSS	Statistical package for the social sciences (statistical software)
TLI	Tucker and Lewis index
TOC	Theory of constraints
UCF	University of Central Florida
WBS	Work breakdown structure

CHAPTER ONE: INTRODUCTION

1.1 Background

During the second half of the 20th century, the project management field attracted enormous interest. The concept of project management was initially developed by the defense industry in order to address national security concerns. From there, it rapidly branched out into other industries, such as construction, research and development (R&D), aerospace, and information technology. Later, it expanded into business areas such as insurance, finance, and other service industries. The goal of firms operating in these areas was to become more externally effective and more internally efficient (J. K. Pinto, 2002)

Research activities in the field of project management have significantly increased over the past decades. Today's complex and rapidly changing business environment has resulted in increasingly complex projects and an increased level of difficulty in project management. The initial focus of the "traditional" project management was on scheduling, resource allocation, budgeting, and project control; this shifted to the modern approach, which considers project management topics such as configuration management, critical chain scheduling, and risk management. In addition, the "soft" factors in project management, such as project managers' capabilities and teamwork in projects, are more frequently discussed in the contemporary literature.

Today, project managers are increasingly coming to consider performance to be the most important priority of project management (Shahin & Jamshidian, 2006). The main difficulties in project management are planning, project implementation, cost and time overruns, and quality non-achievement. In order to ensure that expected levels of performance are met, project managers need to develop a better understanding of the meaning of project success and the factors that contribute thereto. It is essential that project managers be able to identify critical success factors (CSF) and comprehend their potential effects. Doing so, however, is not straightforward, as, up until today, there has been only limited agreement among authors concerning critical factors and their individual influence on project success. The enormous complexity of today's projects makes it difficult to categorize and reduce the factors to be considered to a manageable number (Shahin & Jamshidian, 2006).

Over the past few decades, traditional project management increasingly demonstrated its limitations. The traditional approach, which focuses on scope, cost, and schedule control, is not suitable for today's dynamic, technology-driven environment, which is often characterized by rapid changes. In response to these new developments, agile project management (APM) was introduced. According to Jackson (2012), any project that faces uncertainty, complexity, volatility, and/or risk can benefit from agile practices and principles. While, in the past, APM was primarily applied in software development, it also has high potential to positively impact other project management domains. The literature on APM remains in its early stages, and further research should be conducted in areas other than software development. In order to fully utilize its potential, the concept of agility, and the practices associated with it, needs to be further developed in such a manner that it can be applied to projects in general.

1.2 Statement of the Problem

Over the past fifty years, an extensive amount of literature concerning project success and agile project management has been published. However, even today, agility is largely discussed in the context of software development. There exists a need to research the relationship between both agile project management and project success in order to make potential improvements to overall project outcomes in the contemporary business environment. Agile project management practices and their impact on the results of projects need to be further investigated. Furthermore, the discussion of APM needs to be expanded to consider types of projects other than those in the field of information technology (IT). An additional aspect of the contemporary business environment that should be considered is the increasing complexity and scale of projects, which makes the successful completion of these projects more challenging. Ultimately, the application of agile techniques needs to be further promoted and encouraged in domains where APM has proven to contribute to the success of a project.

1.3 Research Gap

Overall, there is a lack of comprehensive studies that analyze CSFs from the perspective of project management practitioners (Alias, Zawawi, Yusof, & Aris, 2014). Furthermore, APM has predominately been researched in the software and product development domains, leaving a gap in the literature concerning its impact in other project management domains. There is also a lack of understanding of how APM practices actually influence the outcome of a project. This research makes a significant contribution to the body of knowledge concerning APM and project success in consideration of project complexity. It does so by filling a number of gaps in the existing literature and attempting to determine both to what extent APM techniques are being utilized in various types of project and their impact on the success of such projects.

1.4 Research Objectives

The primary objective of this research is to determine the effects of APM on project success outcomes for a broad range of project types, taking into consideration the complexity of projects and the potential impact on their results. A secondary goal is the development of a model that assesses and evaluates existing APM practice during the project implementation phase by identifying the relationships between APM, project complexity (the independent variables), and project success (the dependent variable). Finally, the findings of this research may prove helpful in the evaluation of project managers and their relationships to APM.

Chapter Two, which follows, provides a comprehensive review of the literature concerning project management, project complexity, project success, CSFs, and APM. Subsequently, Chapter Three discusses this dissertation's research hypotheses, model, and methodology. In order to validate the hypotheses, a survey is conducted among project managers. Chapter Four presents the results of this study, which are based on statistical analysis. The results are further discussed in Chapter Five, in which conclusions are drawn and recommendations made for future research. The outcomes of this research emphasize the role played by APM in successful project implementation and support the opinion of many experts that APM is becoming the preferred 21st-century approach to project management (Stare, 2013).

CHAPTER TWO: LITERATURE REVIEW

The literature review was conducted in a systematic manner, following the guidelines set out in preferred reporting items for systematic reviews and meta-analyses (PRISMA) (Moher, Liberati, Tetzlaff, & Altman, 2009). A formal search strategy was adopted to identify a comprehensive list of scientific, peer-reviewed papers relevant to the research topic. The search space was defined through the development of a keyword search list, which was initiated based on a review of widely recognized and frequently cited articles. This list was comprised of over 25 keyword combinations, as shown in Table 1. An iterative and evolutionary review process was used to create subsequent keyword search lists until the majority of the search results were found to have been duplicated (Muhs, Karwowski, & Kern, 2018).

Table 1: Combinations of search term keywords

Agile attributes	Agile product development	Organizational agility
Agile characteristics	Agile project management	Project
Agility drivers	Agile project management methodologies	Project agility
Agile development	Agile software development	Project management
Agile enterprise	Agile workforce	Project complexity
Agile management	Agility	Project success
Agile manufacturing	Critical success factors	Project success criteria
Agile methodologies	Enterprise agility	Project success factors
Agile methods	Manufacturing agility	Workforce agility
Agile portfolio management	Measurement of agility	

A variety of relevant literature in the field of APM was reviewed, including textbooks, journal articles, conference proceedings, electronic articles, reports, and grey literature. The keyword combinations were searched for in popular industrial engineering and management-related database search tools such as EBSCOhost (Applied Science & Technology, Academic Search Premier, Business Source Premier, etc.), Compendex (Ei Engineering Village), IEEE Xplore, Web of Science, ProQuest (ABI/INFORM Complete: Dateline, Global, Trade & Industry; etc.), Google Scholar, ProQuest Dissertations & Theses, and Ulrichsweb Global Serials Directory. Based on reviews of the original search results, the keywords were repeatedly adjusted, and searches were again conducted using the same database tools. This search methodology resulted in over 1,000 identified search results, which were corrected slightly by the removal of duplicate articles. The scientific papers were further screened for research-relevant inclusion criteria such whether they were written in the English language, whether they had been peer reviewed, and whether they applied empirical and/or modeling methods when analyzing and comparing the relationships that may exist between agility, project management, and project results. Excluded were papers that upon review were either found to not be related to the research questions or revealed to include non-empirical opinions or viewpoints. Figure 1, which is based on the PRISMA flow diagram by Moher et al. (2009), depicts the paper selection process and number of studies selected at various stages.

This literature review chapter addresses various aspects of project management. It begins with an introduction to the concept of a project and project management, outlining the definitions thereof and explaining how project management evolved over the years. Furthermore, it explores the traditional project management approach and compares it to contemporary modern project management practices. It also reviews the literature on project complexity and its dimensions. Following this introduction, this chapter goes on to explore what project success means and how it is influenced by CSFs, the identification of which is another aspect of this literature review. The final part of this chapter focuses on agility and agile project management by reviewing the history, definitions, characteristics, and CSFs of these concepts, which consequently forms the basis for the subsequent chapters and the associated research conducted for this dissertation.

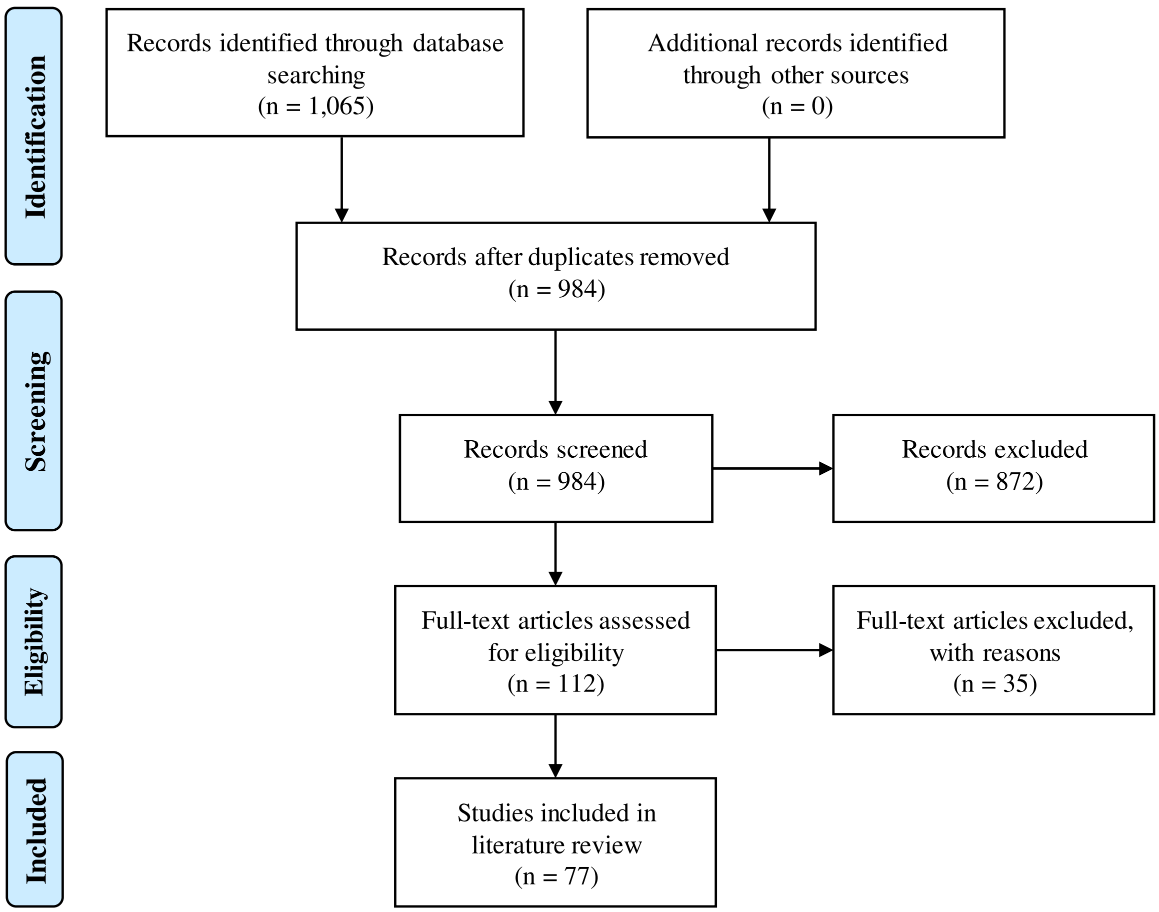

Figure 1: Process used to select studies for inclusion in the literature review

2.1 Project Management

2.1.1 Definition of Projects and Project Management

The point of departure of this research is distinguishing between project and project management and developing distinct definitions for both terms. A project has specific objectives, follows predetermined tasks and processes, and consumes resources. It must be completed within a specific timeframe and set of specifications and with a given set of resources. Nicholas and Steyn (2012) define a project and its characteristics as follows:

1. A project has well-defined goals and deliverables;
2. Every project is unique, which means that it is a once-off activity and is never repeated under the exact same conditions;
3. Projects are temporary activities with defined timelines and limited resources;
4. Projects are cross-functional and cross-organizational, as they require resources from different areas both within and even outside of an organization;
5. Projects carry risk and uncertainty in terms of their outcomes;
6. A project-implementing organization has something at stake, and a project's success has a direct impact on that organization's success; and
7. A project goes through the project life cycle. Tasks, team members, organizations, and other resources may change throughout the course of a project.

In contrast, project management can be defined as the process of controlling the achievement of a project's objectives utilizing existing organizational structures and resources. Project management seeks to manage a project by applying a set of tools and techniques without adversely disturbing the routine operations of the company in question (Munns & Bjeirmi, 1996). Its function is to define the requirements of a project, determine its work scope, allocate the required resources, plan, control, and monitor its execution, and make adjustments in response to possible deviations from the plan.

Considering the characteristics of a project, such as defined objectives, its temporary nature, and associated risks and uncertainty, the central purpose of project management becomes evident: the management of a project. In particular, this means managing tasks, resources, employees, and organizations to achieve a project's goal. For Nicholas and Steyn (2012), the characteristics of project management are primarily defined through the project manager's role, tasks, and responsibilities, which are as follows:

1. A single individual, the project manager, works independently of the rest of the organization and is fully responsible for the outcome of the project;
2. The project manager is the individual who coordinates all efforts to meet project objectives;
3. The project team can be comprised of team members from different functional areas or even from outside the organization;
4. The project manager is responsible for the integration of all team members;
5. The project manager is responsible for the project's staffing and negotiates directly with functional managers;
6. The project manager focuses on the project deliverables and requirements. Since the functional managers are responsible for the assignment of their human resources, conflicts may arise between the needs of project and functional managers;
7. All team members share the accountability and the decision-making for and the outcomes and rewards of the project; and
8. Since a project is temporary, the assigned resources will return to their respective originating organizations after the project has ended.

For development projects, it is possible to make another important distinction between projects and project management: While project management is considered a short-term undertaking that is engaged in until the delivery of the project for use, the project itself is a long-term undertaking, as its lifecycle extends far beyond the development and delivery stage (Munns & Bjeirmi, 1996).

2.1.2 History of Project Management

There is some controversy over the origins of project management in the literature. While some researchers identify the 1950s, when the United States began developing large-scale undertakings in the aerospace and defense industries (J.-S. Chou & Yang, 2012; Saynisch, 2010b), as the point in time in which this practice emerged, other researcher go further back in history and consider the Egyptian construction of the pyramids as representing the first project management practices (Nicholas & Steyn, 2012). However, there is a high level of consensus concerning the view that the systematic approach of project management and its tools and techniques were actually introduced fairly recently, approximately half a century ago.

Modern project management methodologies emerged in the late 1950s and were finally formalized in 2012 in the International Organization for Standardization (ISO) standard ISO/FDIS 21500:2012, Guidance on Project Management (Binder, Aillaud, & Schilli, 2014; Snyder, 1987). This ISO standard follows the traditional approach, which is characterized by detailed planning and control.

In his research, Kwak (2005) identifies four periods, as presented in Table 2, to better capture the history of modern project management. Each of the four periods is further discussed in the following paragraphs, which also provide supporting examples.

Table 2: The four periods of project management (Kwak, 2005)

Periods	Theme
Prior to 1958	Craft system to human relations administration
1958–1979	Application of management science
1980–1994	Production center: human resources
1995 to present	Creating a new environment

In the early 1900s, technological advances such as the automobile and telecommunications increased the mobility and speed of telecommunication. These acted as enablers for projects such as the Hoover Dam, which started construction in 1931 and was successfully completed under budget and ahead of schedule in 1936. Henry Gantt invented the Gantt Chart in this period, which is still used today for illustrating project schedules. Job specifications were used as the basis for the subsequently developed work breakdown structure (WBS). Another important project of this time was the Manhattan Project, which was initiated in 1942 with the objective of designing and building the first atomic bomb. The Office of Scientific Research and Development (OSRD) coordinated the project amongst several involved universities and other organizations, culminating in the successful testing of the bomb in 1945.

In the following decades, many technological advances were supported by project management activities. NASA, for example, conducted six missions to explore the Moon between 1969 and 1972. Project management practices such as the scheduling of missions with the program evaluation and review technique (PERT) and measuring project performance were conducted by the Apollo Program Office (Kwak, 2005). In the 1960s, the development of silicon chips and minicomputers contributed to the evolution of personal computers. The Internet project was initiated in 1962 through discussions of the concept of a “galactic network,” which was developed by J.C.R. Licklider of MIT. The project was scheduled and coordinated by the Advanced Research Projects Agency (ARPA), which developed the ARPANET, the forerunner of the Internet (Leiner et al., 2009). In 1971, Intel introduced a 4-bit microprocessor, which became the foundation of the development of the following processor series. In 1975, Bill Gates and Paul Allen founded Microsoft; several project management software companies were also founded in this decade, including Artemis (1977), Scitor Corporation (1979), and Oracle (1977). Important project management tools such as the critical path method (CPM)/PERT, and material requirement planning (MRP) were introduced between 1950 and 1979. CPM/PERT was first used for government sector projects involving large-scale computer systems that were operated by specialized programmers (Kwak, 2005).

During the 1980s and early 1990s, the focus increasingly shifted to people and their interactions with multitasking personal computers, which were more efficient in terms of managing and controlling complex project schedules than older mainframe computers. Project management software became widely available and made the use of project management techniques both more efficient and easier. In the same time period, local area networks and Ethernet technology started to emerge as the dominant network technologies (Leiner et al., 2009). Representative projects from this time period include the England-France Channel project (1989-1991) and the Space Shuttle Challenger project (1983-1986). The channel was the result of an international project that required a significant degree of project coordination between multiple contractors, such as engineering firms, financial institutions, and other involved organizations, from the two countries. The differences in language, units of measurement, and overall communication represented particular challenges for project teams of this time period.

The accident that occurred in the Space Shuttle Challenger project increased interest in risk management, quality management, and group dynamics in project management (Kwak, 2005).

In the mid-1990s, the expansion of the Internet facilitated new developments in project management practices. The number of users of the Internet increased as it began offering fast, reliable, and interactive browsing, online purchasing, and many other services. It allowed organizations to become more productive, efficient, and customer-oriented by providing a means of rapid and easy communication. The management and control of projects were significantly improved by the use of Internet technologies, which resulted in an increasing number of companies adopting and applying project management practices. Over the past decades, project management offices (PMOs) were strengthened by this development. Likely the most famous project from the end of the 20^{th} century is the Year 2000 (Y2K) project, which had the objective of preventing the malfunctioning of computers and systems as a result of the turn of the millennium. Several government agencies were involved in this project, and one of its challenges was coordinating and monitoring activities within the US government. Due to its strict requirements, the Y2K project featured many project management concerns, such as a sharp deadline and the increased complexity of coordinating between interdependent and interconnected organizations. The Y2K project became the most documented project in the history of project management due to the fact that millions of organizations across the world conducted similar projects with the same objectives (Kwak, 2005). Many of these organizations started to adopt project management practices, tools, and techniques and set up their own project offices. Project management software such as the Primavera project planner was used to handle complex and inter-related project tasks.

In recent years, it has largely been the following developments that have influenced and advanced project management practices (J. K. Pinto, 2002): (1) shorter product lifecycles require greater investments in research and development (R&D), (2) narrow product launch windows are required to keep up with increasing competition, (3) global markets provide new sales opportunities but also challenges due to increasing competition, and (4) increasingly complex and technical products come with new challenges for R&D to keep pace with technical advances and complexity.

The abovementioned developments have advanced project management in multiple areas, as presented in Table 3.

Table 3: Recent advances in project management (J. K. Pinto, 2002)

PM Area	Advances
Risk management	Developing more sophisticated methodologies to better assess risk up-front before the implementation of a project.
Scheduling	Critical chain project management (CCPM) is a new development in project scheduling; it offers a number of important advances over traditional scheduling techniques such as the program evaluation and review technique (PERT) and the critical path method (CPM). Golratt's application of the theory of constraints (TOC) improved the scheduling and managing of projects.
Structure	Project-oriented organizational structures such as matrix or project structures are becoming increasingly popular. Despite some challenges, they combine the benefits of increased efficiency with the ability to rapidly respond to market opportunities/changes. The increasing use of project management offices (PMO) as central administrative centers for project portfolio management is another positive development.

PM Area	Advances
Project team coordination	Two significant advances have been made in the area of project team development: (1) enhancements in cross-functional cooperation and (2) the application of the model of punctuated equilibrium as it pertains to intra-team dynamics. Per M. B. Pinto, Pinto, and Prescott (1993), there is sufficient evidence that cooperation positively affects both task performance and general positive feelings as a result of the accomplishment of a project.
Control	Earned value analysis (EVA) was introduced as an important new method for tracking project costs relative to performance. It enhances traditional project control by linking project development performance to date with the more traditional metrics of time and budget expended.
Impact of new technologies	Modern communication technologies enable the linking of individuals and organizations around the globe and the creation of virtual project teams, which are groups that may not physically interact but work in close collaboration through the use of the Internet and other technological advances.

With the recent advances in projects and project management, the role played by project managers has also been promoted. Up to this point, project managers suffered from a lack of training, political resistance from line managers, limited career opportunities and poor recognition, and a lack of processes and organizational setup. Management writers such as Tom Peters and executives such as Jack Welsh, however, became strong supporters of the project management role and have contributed to its positive reputation today (J. K. Pinto, 2002).

Over the past century, technological advances have not only influenced globalization, product lifecycles, and the overall business environment but have also affected thinking concerning project management. In the past, project management followed a rational and deterministic approach that emphasized the planning and control dimensions of project management. This traditional approach is still represented in the majority of the literature; examples include the PMBOK Guide (PMI, 2012) and the ISO standard for Guidance on Project

Management, which were both strongly influenced by these early project management theories. While the PMBOK recognized the need for emergent planning in 2004 (Collyer, Warren, Hemsley, & Stevens, 2010), the ISO standard is still based on the waterfall approach and lacks emergent and flexible approaches such as agile (Binder et al., 2014). The traditional management skills were developed in response to the requirements of the construction and defense industries to plan, control, and manage large and complex tangible projects. The focus was on the control and management of schedule, cost, and scope, which are considered the "hard" project success criteria (Alias et al., 2014). However, over recent years, this approach has been increasingly criticized for its inflexibility in terms of adjusting to meet the challenges posed by complexity and changing customer requirements. It has also been criticized for failing to deal with the emergent nature of front-end work, for treating all projects as if they were the same, and for not accounting for human issues, which are often the most significant factors to be considered in project management (Winter, Smith, Morris, & Cicmil, 2006). A need for new thinking arose, requiring organizations to shift from a functional to a matrix organization, and ultimately to a project organization. Project organizations are temporary, meaning that they are flexible in terms of adjusting to change. Today, project management can also be viewed as concerned with managing change, and project managers can be considered as change agents. This evolving perspective has added an additional focus to project management, the so-called "soft" aspects of relationship management (Bourne & Walker, 2004).

2.1.3 Traditional vs. Modern Project Management

There are many types of project management, some of which have been customized to meet the requirements of specific project domains. The literature distinguishes between two main types of project management:

- Traditional project management; and
- Modern project management.

Traditional project management is, for example, represented by the Project Management Institute's PMBOK Guide and most of the elements of the IPMA Competence Baseline, as well as the ISO 10006 standard. Per Saynisch (2010b), traditional project management is "based mainly on a mechanical, mono-causal, non-dynamic, linear structure and a discrete view of human nature and societies and their perceptions, knowledge, and actions." The PMBOK guide defines traditional project management as "a set of techniques and tools that can be applied to an activity that seeks an end product, outcomes or a service" (PMI, 2012). This approach has been used for many years and decades. It is characterized by a top-down approach in which all directions and tasks are established at the executive management level and are then floated down within the organization. Its leadership style is based on command, control, and hierarchy. The approach is very plan driven, as a plan is established at the very beginning of the project, with little flexibility to change it later. Planning is done centrally within an organization. Another characteristic is the vast amount of documentation and records that are produced using the traditional project management approach. This approach is also very structured, which makes it slow and resistant to change. Another limitation is that the lack of flexibility is a disadvantage in today's fast moving and complex project environment. Ownership of a project belongs only to its manager; the remaining team members follow the project manager's instructions and focus on their individual tasks, leaving very little opportunity for them to understand the "big picture" and take ownership of the project.

The traditional approach is based on a sequence of steps, as explained in the PMI (2012) PMBOK and depicted in Figure 2. The PMBOK guide divides the project management process into five process groups: initiating, planning, executing, monitoring and controlling, and closing. These groups are further broken down into 42 project management processes that fit into the following nine knowledge areas: integration management, scope management, time management, cost management, quality management, human resource management, communications management, risk management, and procurement management.

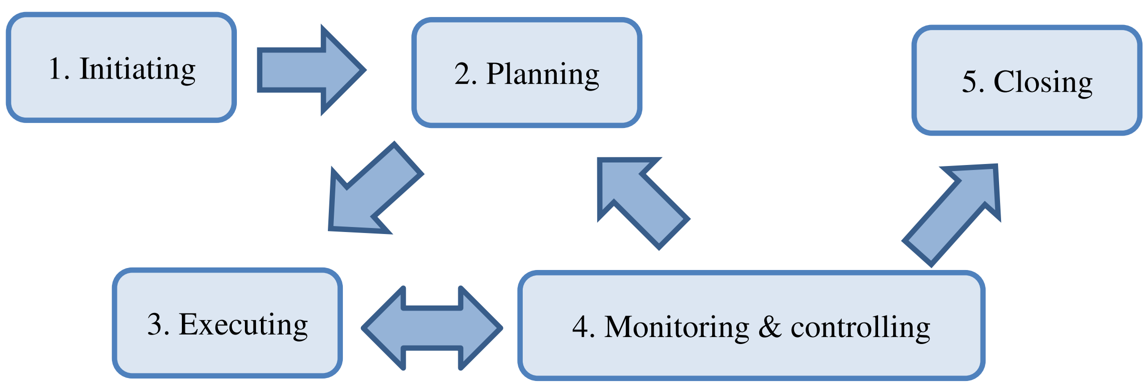

Figure 2: The five process groups of the PMBOK project management process

Traditional project management assumes that events are predictable and that all tools and techniques are well understood. While following the individual process steps, it is also assumed that completed phases will not be revisited. The strengths of this approach are its well-structured process and the importance of its requirements. In today's project environments, however, the limitations of this approach soon become clear, as projects rarely follow the preferred sequential flow, and customers typically have difficulties in defining all of their requirements at the beginning of a project (Hass, 2007).

Different industries use variants of the aforementioned process steps. In software development, this approach is often referred to as the waterfall model, which, as depicted in Figure 3, represents several tasks one after another in linear sequence.

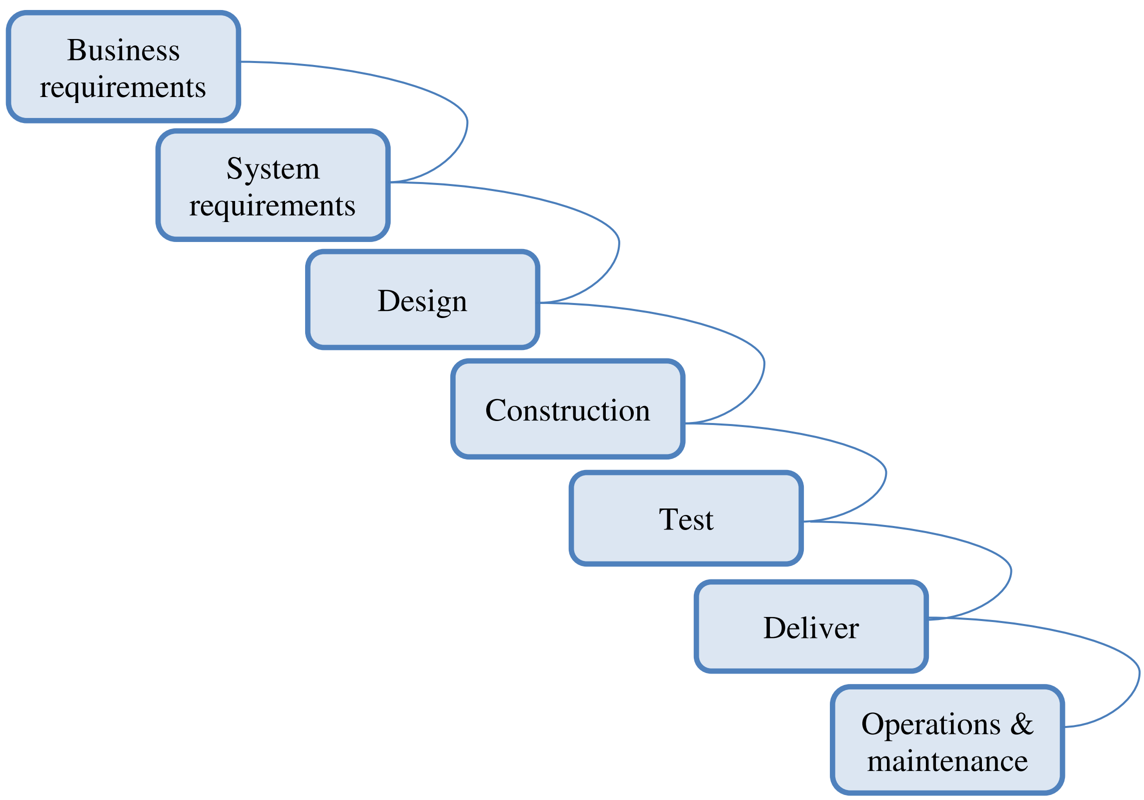

Figure 3: The waterfall project lifecycle model (Hass, 2007)

Many commonly used project management practices and tools are oriented towards large and slow-moving projects. These techniques are cumbersome to use and less effective in fast-paced and uncertain environments (Chin, 2004). Contemporary business processes are more complex, interconnected, and interrelated than those of the past. Alliances are formed between involved parties such as strategic suppliers, customers, stakeholders, competitors, political parties, governmental groups, and regulatory entities to master the challenges posed by unforeseen changes, global competition, shorter product lifecycles and the associated time-to-market pressure, rapidly advancing technologies, and increasing business complexity. Given these developments, the projects that are undertaken in this new business environment are also more complex, which results in increased complexity in project management. Modern project management approaches such as lean management and APM have emerged to assist organizations in adapting to the new business environment and improving their projects. However, the literature provides only a limited number of well-defined and effective approaches and systematic evaluations of their results (Conforto & Amaral, 2010). The majority of the existing solutions are intended to assist in the establishment of a more flexible approach that can be adapted in response to the contingencies of a project's environment in order to improve project performance (Conforto, Salum, Amaral, da Silva, & Magnanini de Almeida, 2014) . One of the modern project management approaches is APM, which is primarily used in the field of software development. However, research efforts are slowly beginning to determine whether APM can be adapted for other project types.

Agile project management is a highly iterative and incremental process wherein stakeholders and developers collaborate closely to understand the domain in question, determine requirements, and prioritize functionalities (Hass, 2007). The agile approach consists of many rapid iterative planning and development cycles, as depicted in Figure 4, allowing for constant evaluation of interim results and for adjustments to consequently be made if users and stakeholders desire them. As a result, a product will be continuously improved by its entire project team, including the stakeholders. This approach allows for immediate modifications of the product as previously unknown requirements are identified. Agile project management is discussed in greater detail in subsequent chapters of this work.

Another modern project management approach discussed in the literature is project management second order (PM-2). This is a fairly novel paradigm, and, over the next few decades, its originators anticipate that it will become the leading approach to meeting the challenges and requirements of the third millennium (Saynisch, 2010b). PM-2 is a universal approach for "mastering complexity in projects and project management" (Saynisch, 2010a).

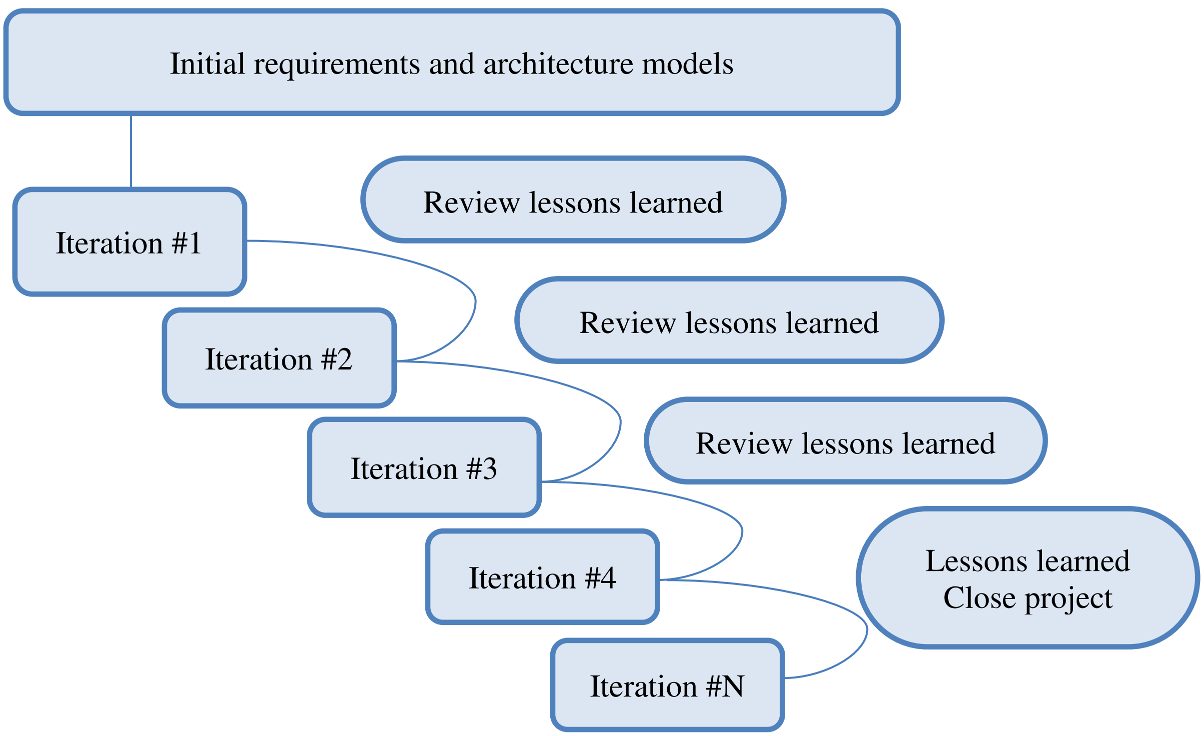

Figure 4: The agile project lifecycle model (Hass, 2007)

PM-2 is based on a behavior-oriented understanding of project management, taking "soft factors" such as human interaction and changes of attitude into account. PM-2 still considers traditional project management as being an important aspect of project management; however, this approach should be extended to consider dynamic, non-linear, and multi-causal structures and processes. In addition, it should reflect the principles of self-organization, networking, and evolution. PM-2 satisfies these requirements. In order to keep this work within its boundaries, the PM-2 approach is only mentioned here for the sake of completeness and is not further discussed in this research.

2.1.4 Project Complexity

Modern project management approaches have proven to be useful in the new economy, which is characterized by increasingly complex and uncertain project situations. Complex projects demand an exceptional level of project management, and the use of traditional systems alone is no longer considered appropriate given the complexity of today's projects. While the term "project complexity" is widely used, there is no clear definition thereof. To be able to cope with the challenges associated with project management, Williams (1999) considers it necessary to identify a definition of project complexity.

Baccarini (1996) defines project complexity as "consisting of many varied interrelated parts and [it] can be operationalized in terms of differentiation and interdependency." However, when referring to project complexity, it is important to also identify the type of complexity being dealt with. The two most common types of project complexity are organizational and technological complexity. Organizational complexity can be divided into vertical and horizontal structures. While vertical differentiation refers to the depth of the organizational hierarchical structure (e.g., number of levels), horizontal differentiation can be defined by the number of organizational units (e.g., the number of departments and/or groups) and the task structure (e.g., personal specialization or division of labor). Another attribute of organizational complexity is the degree of operational interdependencies, which refers to the interactions that occur between the organizational elements. Technological complexity can be differentiated with reference to the variety or diversity of task aspects, such as (1) number and diversity of inputs and/or outputs, (2) number of tasks required to produce the end product of a project, and (3) number of specialized parties (e.g., subcontractors) involved in a project (Baccarini, 1996). Technological complexity can encompass interdependencies between tasks, teams, inputs, and different technologies.

Considering the input of Baccarini (1996), Williams (1999) concludes that overall project complexity has two dimensions, each of which has two sub-dimensions, as depicted in Figure 5. The structural complexity and its sub-dimensions are the same as Baccarini's aspects; Williams, however, adds another element, uncertainty, to the concept of complexity. Uncertainty refers to the instability of the assumptions upon which the tasks are based. Uncertainty can be classified with reference to two parameters: how well-defined goals are and how well-defined the methods of achieving them are.

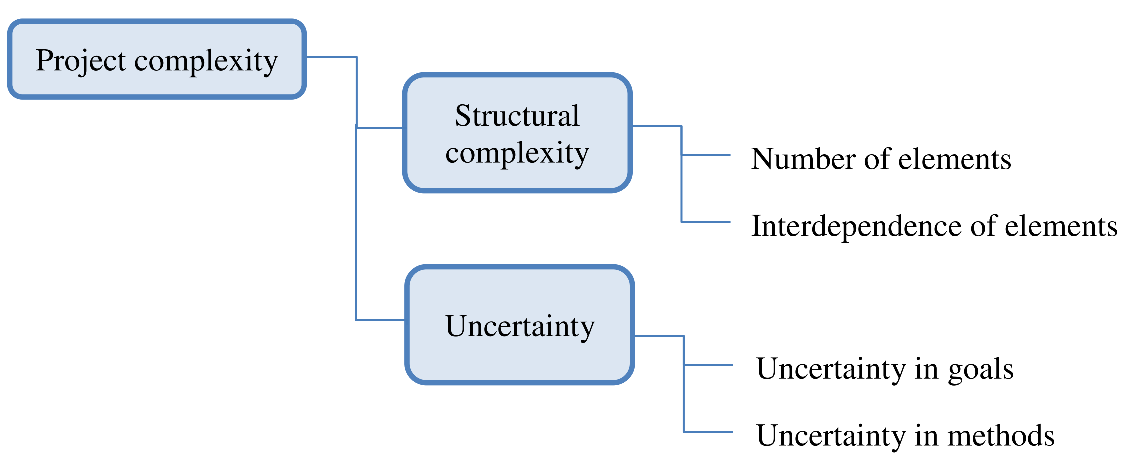

Figure 5: Project complexity model (Williams, 1999)

Williams (1999) identifies two significant causes of increasing (structural) project complexity: The first cause derives from the interrelation with product complexity. Advancements in product functionality, reductions in size, or closer intra-connectivity make a product, and consequently a project, more complex. The second cause arise from increased time constraints, the ability to deliver a project rapidly, and reduced time-to-market, all of which place more pressure on a project team and increases the complexity of a project.

As was previously stated, the meaning of the term “project complexity” is open to interpretation. Per Baccarini (1996), it can be interpreted to encompass anything that is characterized by difficulty. A white paper published by Mosaic Project Services defines four basic dimensions that affect the difficulty of managing projects (Mosaic-Project-Services, n.d.):

1. The size, measured in terms of value;
2. The degree of technical difficulty in creating the output resulting from the characteristics of project work and deliverables, measured in the time required to provide the deliverables;
3. The degree of uncertainty involved in a project;
4. The complexity of the relationships both within the project team and surrounding the project.

While all four factors impact the degree of difficulty associated with a project, a project manager can only influence the final two factors by reducing the degree of uncertainty and improving the relationships between stakeholders, including those between the members of the project team. The size and the degree of technical difficulty are predetermined and cannot be influenced by a project manager.

Although the size of a project impacts the degree of difficulty that will be encountered in achieving its objectives, this does not necessarily mean that large projects are complicated or complex. Over the last decade, the term "mega projects" has been further established in the literature; such projects are not necessarily "big" projects, but they are major, complex, and of high financial value. Due to their complexity (e.g., the politics involved and stakeholder engagement), they are typically broken down into a series of smaller projects.

The technical difficulty inherent in a project is a result of the combination of the work needed to accomplish its objectives and the characteristics of the output (i.e., the product, service, or result) being produced. Project duration and time pressure are common indictors of technical difficulty (Mosaic-Project-Services, n.d.).

There is always a degree of uncertainty associated with a project; however, what matters in project management is the understanding and handling of the uncertainties. An appropriate project delivery strategy, also called a project plan, will either attempt to minimize unnecessary uncertainty or go in the opposite direction and embrace uncertainty by searching for the opportunities that may accompany it.

Finally, the aspect of complexity also includes the effectiveness of the relationships within a project team, as well as those with other internal and external stakeholders. Factors such as team size, a team's geographical setup, and number of project sponsors can influence the complexity of a project.

2.2 Project Success

Project success is a controversial topic in the literature: Some authors follow the traditional approach, considering it a unidimensional construct that is concerned with meeting budget, time, and quality (Brown & Adams, 2000; Bryde, 2008; Fortune, White, Jugdev, & Walker, 2011; Müller & Turner, 2007), while others view it as a complex, multi-dimensional concept with many more attributes beyond only budget, time, and quality (Atkinson, 1999; Jugdev & Müller, 2005; Lim & Mohamed, 1999; Lipovetsky, Tishler, Dvir, & Shenhar, 1997; Mir & Pinnington, 2014; Shenhar, Dvir, Levy, & Maltz, 2001). There is evidence that many projects do not meet their objectives; therefore, there is a need to identify the factors that positively influence project success (Mir & Pinnington, 2014). J. K. Pinto and Slevin (1988b) summarize the state of the literature as follows: "There are few topics in the field of project management that are so frequently discussed and yet so rarely agreed upon as that of the notion of project success."

Project management and project success are not necessarily directly related. Their objectives are different, and experience has demonstrated that it is possible to achieve a successful project even though project management has failed and vice versa (Shahin & Jamshidian, 2006). Successful project management can contribute to the success of a project, but it will not prevent it from failing. The ability to selecting appropriate projects and screen potentially unsuccessful projects is essential in ensuring overall project success and the long-term success of an organization. However, the lack of a comprehensive list of project success factors and the fact that every project is unique make it difficult to determine upfront which projects will be successful. Shahin and Jamshidian (2006) even go so far as to state that it is impossible to generate a universal checklist of project success criteria that would be suitable for all projects. Due to their varying project sizes, degrees of complexity, and characteristics, success criteria will differ between projects.

As an example, Shenhar and Dvir (2007) define five dimensions of project success: efficiency, impact on clients, impact on staff, increased direct business, and preparation for the future. However, they also state that these five dimensions do not apply to all project types and that they can vary over time (both over the short and long term). In addition, they propose a sixth dimension, which involves sustainability-related topics. Finally, they develop a model called Diamond, which includes the following four dimensions: novelty, complexity, technology, and stage (Carvalho & Rabechini Jr, 2015; Shenhar & Dvir, 2007).

Schultz, Slevin, and Pinto (1987) conducted the first systematic classification of critical success factors in the field of project management. They identified two groups of factors that impact project performance, namely strategic and tactical factors. The “tactical” group includes factors such as client consulting, human resource selection, and the training of personnel, whereas factors such as project mission, top management support, and project scheduling are categorized as “strategic” factors. Research has also shown that the impact of success factors can vary depending on the stage of a project lifecycle (Alexandrova & Ivanova, 2012). In subsequent research, the original dimensions (time, cost, and quality) were extended by the addition of three further dimensions: (i) meeting the strategic goals of the client organization, (ii) achieving end-user satisfaction, and (iii) achieving satisfaction for other stakeholders (Baccarini, 1999; Shenhar et al., 2001). Ultimately, it is important that stakeholders be fully satisfied in order to achieve project success (Baker, Murphy, & Fisher, 2008); it is understood, however, that this depends on each stakeholder’s personal perception. Another approach is that offered by Harold Kerzner, who alters the original dimensions by including scope changes without workflow interruptions, without negative impacts on corporate culture, and with the customer fully accepting the results of a project (Kerzner, 2013).

2.3 Critical Success Factors

From a project management perspective, critical success factors (CSFs) are the characteristics, conditions, and/or variables that can have a significant impact on the success of a project when they are properly managed (Milosevic & Patanakul, 2005). The CSF approach has been researched over the last thirty years; however, there is still no consensus regarding the criteria that determine project success (Fortune & White, 2006).

Based on the literature, it can be concluded that there is a close link between a project's type and scope and its respective critical success factors. It is therefore important when conducting an empirical study on a specific type of project that the range of factors and approaches to measuring the CSFs be limited. One of the most widely quoted lists of project success factors is that of J. K. Pinto and Slevin (1988a). Their list, which is presented in Table 4, identifies success factors such as top management support, personnel, client consultation, client acceptance, and communication. However, per some critics, this list lacks the inclusion of the project manager and his or her leadership style and competence. Management literature considers effective leadership to be a success factor and has demonstrated that an adequate leadership style makes a positive contribution to overall project performance.

Table 4: Project success factors, after J. K. Pinto and Slevin (1988a)

Success Factor	Description
1. Project mission	Clearly defined goals and direction
2. Top management support	Resources, authority, and power required for implementation
3. Schedule and plans	Detailed implementation specifications
4. Client consultation	Communication with and consultation of all stakeholders
5. Personnel	Recruitment, selection, and training of competent personnel
6. Technical tasks	Access to the required technology and expertise
7. Client acceptance	Selling of the final product to the end users
8. Monitoring and feedback	Timely and comprehensive control
9. Communication	Timely provision of data to key players
10. Troubleshooting	Ability to handle unexpected problems

Further research over recent decades has not solely focused on the success factors but has also analyzed the relationship between project success, success criteria, and success factors. Based on their research, Alexandrova and Ivanova (2012) proposed a conceptual model of critical success factors and project success, which is depicted in Figure 6.

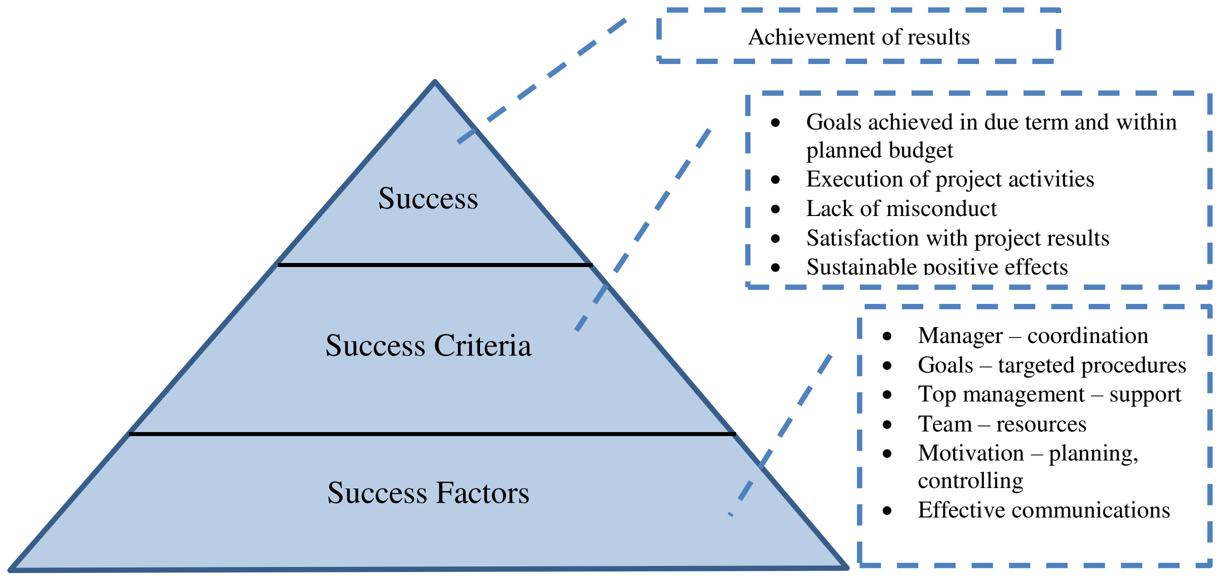

Figure 6: Conceptual model of CSFs and project success (Alexandrova & Ivanova, 2012)

The model depicts the relationships between success factors (e.g., top management support, motivated team, effective communication), success criteria (e.g., goals achieved in due terms and planned budget, satisfaction, sustainable positive effects), and project success (achievement of results). Müller and Jugdev (2012) place the success factors and success criteria in relation to dependent and independent variables as follows: "(1) Project success factors, which are the elements of a project which, when influenced, increase the likelihood of success; these are the independent variables that make success more likely. (2) Project success criteria, which are the measures used to judge on the success or failure of a project; these are the dependent variables that measure success." It is a project manager's responsibility to identify the relevant success criteria, to determine adequate success factors with reference to these criteria, and to choose an appropriate project management methodology in order to ultimately achieve project success. The success criteria determined by Alexandrova and Ivanova (2012) are largely focused on "hard" factors, such as schedule, budget, project execution, and customer satisfaction. The influencing success factors, on the other hand, are more human resource-related (“soft”), such as coordination by managers, top management support, team resources, motivation, and communication. The “soft” factors are very important to the success of a project, as it is people who execute projects, not processes or systems (Cooke-Davies, 2002).

Another framework that illustrates the relationships between the project performance variables, CSFs, and project success is that of Alias et al. (2014), as depicted in Figure 7. This model was based on the project success variables identified by Chan, Scott, and Chan (2004).

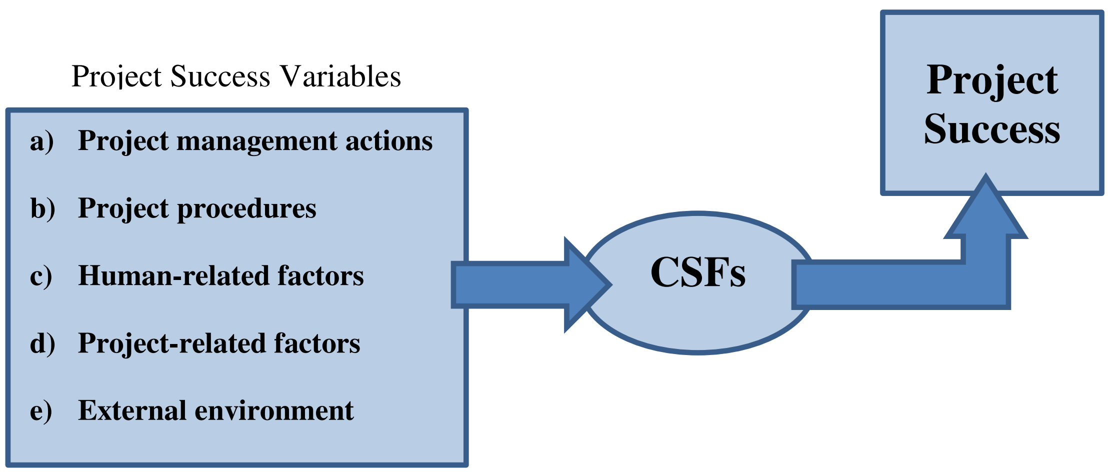

Figure 7: Conceptual framework of project success variables, CSFs, and project success (Alias et al., 2014)

Based on the results of the literature review, five project success variables can be identified (Alias et al., 2014):

- Project management actions focus on the communication system, planning efforts, the development of an appropriate organizational structure, the implementation of an effective safety and quality program, and the management and control of subcontractors’ work;

- Project procedures include procurement and tendering methods and strategies;
- Human-related factors involve the client's experience and expectations, the size of the client's organization, the client's emphasis in terms of low construction costs/high quality/rapid construction, and the client's ability to make decisions and to contribute to design and construction;
- Project-related factors focus on the type of project, its nature and complexity, and its size; and
- External issues include factors such as economic, social, and political issues and physical and technological advances.

The use of the variables of project success makes it easier for researchers to determine project-specific CSFs and ultimately determine their relation to project success, which is visualized in the conceptual framework. Although CSFs vary by project type, lifecycle phase, industry, nationality, individual, organization, etc., researchers have attempted to identify a manageable, universal set of critical success factors, as presented in Table 5. When noting the multitude of literature citations, it becomes evident that there is no consensus on the criteria for judging project success and the factors that influence project success (Alias et al., 2014). Again, however, the majority of the CSFs are in the "soft" categories, such as human resources, motivation, commitment, and communication.

Table 5: Critical success factors identified from the literature review (Alias et al., 2014)

Critical Success Factors	Reference
Support of senior management	(Fortune & White, 2006; Jha & Iyer, 2006; White & Fortune, 2002)
Skilled designers	(Chua, Kog, & Loh, 1999)
Skilled project managers	(Chan, Ho, & Tam, 2001; Jha & Iyer, 2006)
Troubleshooting	(Belout & Gauvreau, 2004)
Project team motivation	(Chua et al., 1999)
Commitment of all project participants	(Chan et al., 2001; Chua et al., 1999; Munns & Bjeirmi, 1996)
Strong/detailed planning effort in design and construction	(Chan et al., 2001; Munns & Bjeirmi, 1996)
Adequate communication channels	(Chan et al., 2001; Fortune & White, 2006)
Effective control, such as monitoring and updating plans	(Chan et al., 2001; Chua et al., 1999; Fortune & White, 2006)
Effective feedback	(Chan et al., 2001; Fortune & White, 2006)
Adequate financial budget	(Chan et al., 2001; Fortune & White, 2006)

According to J. K. Pinto and Slevin (1988a), project success is a complex and sometimes misleading construct, but it is nonetheless of crucial importance for effective project implementation. Using construction projects as an example, Table 6 presents the project performance indicators that determine project success (Alias et al., 2014). Besides the "iron triangle" of cost, time, and quality, the literature review identifies customer satisfaction as another important project performance indicator or success criterion.

Table 6: Project performance indicators (Alias et al., 2014)

Project Performance Indicators	Reference
Construction cost	(Cho, Hong, & Hyun, 2009; Enshassi, Mohamed, & Abushaban, 2009; Takim & Akintoye, 2002)
Construction time	(Cho et al., 2009; Enshassi et al., 2009; Takim & Akintoye, 2002)
Quality	(Enshassi et al., 2009)
Construction predictability, Time predictability, Defects predictability	(Takim & Akintoye, 2002)
Client satisfaction with the service	(Takim & Akintoye, 2002)
Client satisfaction with the product	(Enshassi et al., 2009; Takim & Akintoye, 2002)

Westerveld (2003) demonstrated that there are dependencies between success criteria, critical success factors, and project type. He argued that project success criteria could be divided into the following six groups: time; cost; quality; customer satisfaction; project personnel; and users, contracting partners, and stakeholders. In addition, he identifies five success factors, namely leadership and team, policy and strategy, stakeholder management, resources, and contracting. Finally, by analyzing different project types, he determined that success factors and criteria will vary depending by project type.

Cooke-Davies (2002) also attempts to provide a comprehensive answer to the question of which factors are critical to project success. He makes two distinctions in his research into critical project success factors: First, he distinguishes between project success, which is measured against the overall objectives of a project, and project management success, which is measured against the widespread and traditional measures of performance against cost, time, and quality. Second, he distinguishes between success criteria, which are used to judge the success or failure of a project or business, and success factors, which are those inputs to the management system that directly or indirectly lead to the success of a project or business. As shown in Table 7, he identifies 12 “real” success factors by answering the following three questions:

- Question 1. What factors are critical to project management success?
- Question 2. What factors are critical to success on an individual project?
- Question 3. What factors lead to consistently successful projects?

Although his focus is on risk management and mature change control processes, Cooke-Davies (2002) also emphasizes the importance of learning factors and the people who deliver projects.

Table 7: Factors critical to project success (Cooke-Davies, 2002)

Question	Success Factor
What factors are critical to project management success?	F1 - Adequacy of company-wide education on the concepts of risk management.
	F2 - Maturity of an organization’s processes for assigning ownership of risks.
	F3 - Adequacy with which a visible risk register is maintained.
	F4 - Adequacy of an up-to-date risk management plan.
	F5 - Adequacy of documentation of organizational responsibilities on the project.
	F6 - Keep project (or project stage duration) as far below three years as possible (one year is preferable).
	F7 - Allow changes to scope only through a mature scope-change control process.

Question	Success Factor
	F8 - Maintain the integrity of the performance measurement baseline.
Question 2. What factors are critical to the success of an individual project?	F9 - The existence of an effective benefits-delivery and management process that involves mutual cooperation between project management and line management functions.
Question 3. What factors lead to consistently successful projects?	F10 - Portfolio- and program management practices that carefully select projects that match the corporate strategy and business objectives.
	F11 - A set of project, program, and portfolio metrics that provides direct feedback on current project performance and anticipated future success, thus allowing project, portfolio, and corporate decisions to be aligned.
	F12 - An effective means of "learning from experience" that combines explicit with tacit knowledge in a manner that encourages employees to learn and to embed that learning into continuous improvement of project management processes and practices.

In conclusion, it can be stated that the CSF approach has been established and disseminated over the past few decades. Project success criteria vary from project to project. The majority of studies still largely focus on the traditional "iron triangle" criteria for measuring project success, which are cost, quality, and schedule. More recent studies, however, have concluded that other important criteria, such as scope and customer satisfaction, need to be considered. The project success factors that influence success criteria and project success vary widely. Based on the literature review, they can be clustered into main categories that are suitable for most project types. These clusters are management, processes, project factors, organization, human resources, and technical tasks.

2.4 Agile Project Management

2.4.1 History of Agility and Agile Project Management

The concept of "agility" was initially developed in the field of manufacturing in 1991 by a group of researchers working at the Iacocca Institute of Lehigh University (USA). They defined agility as "[a] manufacturing system with capabilities (hard and soft technologies, human resources, educated management, information) to meet the rapidly changing needs of the marketplace (speed, flexibility, customers, competitors, suppliers, infrastructure, responsiveness)" (Yusuf, Sarhadi, & Gunasekaran, 1999). Constantly and unpredictably changing business environments and customer expectations gave rise to the need for organizations to be flexible and able to rapidly adapt to changes in order to survive in a competitive environment. An effective approach to adapting and remaining competitive was found to be breaking down a large organization into smaller organizations, which was termed the "agile enterprise" (Routroy, Potdar, & Shankar, 2015). Kidd (1995) and Goldman, Nagel, and Preiss (1995) describe the capabilities of an agile enterprise as being able to rapidly respond to changes and to remain successful in an unpredictable environment that is characterized by ever-changing customer expectations.

Unlike traditional project management, which dates back to the 1950s and emerged from the defense and constructions industries, the concept of APM, which is similar to concurrent engineering, has its origins in the 1980s and was developed in the twenty-first century. However, in contrast to agile manufacturing and agile software development, APM has seldom been discussed in the literature. Until 2009, almost all projects that adopted an agile approach were in the field of IT. Consequently, the majority of the APM literature was focused on software development projects. In the last decade, only a limited number of projects in other areas have introduced agile practices (Stare, 2013).

In 2001, a group of software developers came together to discuss possible approaches to improving project results. They wished to overcome the limitations of traditional project management by developing the ability to respond more swiftly to changes in the environment and adapting a fast-learning approach. As a result of this meeting, the Manifesto of Agile Software Development was created, which states that the "highest priority is to satisfy the customer through early and continuous delivery of valuable software" (Hass, 2007). Methods were developed to improve project results by focusing on short-term outcomes and allowing for frequent, unpredictable changes. Team productivity was intended to be increased through the formation of agile teams with low hierarchies, joint decision-making, a brought knowledge base amongst team members, and excellent communication skills. Beyond its focus on project teams, the APM approach is further characterized by constant updating of the execution of a project, detailed planning cycles based on short-term results, and deep customer involvement (Stare, 2013). Today, the majority of innovative products are developed in uncertain and turbulent environments that are characterized by project complexity, unpredictable activities, and changes. In such environments, the limitations of the traditional approaches become clear, and the APM approach offers superior solutions and project results (Chin, 2004).

2.4.2 Definition of Agility

Agility is a relatively novel concept, and the understanding of its principles varies in the literature. A commonly accepted definition of agility does not exist; however, there are various views concerning it that are similar. There exists consent in the literature on flexibility and speed being the primary attributes of agility, a perspective that is supported by Gunasekaran (1999), Sharifi and Zhang (1999); Yusuf et al. (1999). Additional attributes of agility, such as the ability to effectively respond to change and uncertainty, high quality and highly customized products, and the ability to innovate new products and processes, are also considered to be extremely important in the literature (Sherehiy, Karwowski, & Layer, 2007). Goldman et al. (1995) define an agile organization as one that is capable of operating profitably in a competitive environment that is characterized by continually and unpredictably changing customer habits. Charles Darwin stated that "[i]t is not the strongest of the species that survives, nor the most intelligent that survives. It is the one that is the most adaptable to change." An agile organization can therefore adjust to unexpected changes rapidly and efficiently, which is also the definition offered by Kidd (1995). Subsequently, Dove (1994) determined four dimensions of the agility concept: cost, time, quality, and scope.

The agility supporters at the Iacocca Institute define agility in a manufacturing environment as "a manufacturing system with extraordinary capabilities to meet the rapid changing needs of the marketplace (speed, flexibility, customers, competitors, suppliers, infrastructure, and responsiveness)." Their definition continues, describing agility as "a system that shifts quickly (speed and responsiveness) among product models or product lines (flexibility), ideally in real time response to customer demand (customer needs and wants)" (Ganguly, Nilchiani, & Farr, 2009).

Yusuf et al. (1999) identify the competitive foundations of agility as follows: speed, flexibility, innovation, proactivity, quality, and profitability. In addition, the authors also consider the people factor. They state that it is important to have a knowledgeable workforce in order to provide customer-oriented products and services and react rapidly using flexible resources. Dove (1999) further elaborated upon the view that knowledge management and response ability are the two cornerstones of agility. In addition, Goldman et al. (1995) consider continuous workforce education and training as important to becoming agile. They proposed the following strategic dimensions of agility: (1) enriching the customer; (2) cooperating to enhance competitiveness; (3) organizing to master changes; and (4) leveraging the impact of people and information (Sherehiy et al., 2007).

Furthermore, not only adaptability and flexibility are important to an agile organization but also the adaptation of the features of an organic organization, such as limited levels of hierarchy, informal and changing lines of authority, open and informal communication, loose boundaries among functions and units, distributed decision-making, and fluid role definitions (Sherehiy et al., 2007). After conducting an intensive literature review, Ganguly et al. (2009) decided upon the following definition of agility: "an effective integration of response ability and knowledge management in order to rapidly, efficiently and accurately adapt to any unexpected (or unpredictable) change in both proactive and reactive business/customer needs and opportunities without compromising with the cost or the quality of the product/process."

2.4.3 Definition of Agile Project Management

The principles of APM are based on the values of agility and the Agile Manifesto. A strong emphasis is placed on people and the need to remain flexible and adaptable to changes in respect to uncertainty and complexity. Agile project management emphasizes an iterative and lean approach wherein only that which is needed (e.g., processes, tools, procedures, documentation, etc.) is used in a project. In addition, awareness of situations that may require different solutions or methodologies is an APM characteristic .

Conforto et al. (2014) define APM as "an approach based on a set of principles, whose goal is to render the process of project management simpler, more flexible and iterative in order to achieve better performance (cost, time, and quality), with less management effort and higher levels of innovation and added value for the customer." This is in line with Jim Highsmith's comments concerning the impact of APM over the past decade. He considers agile methods to be particularly beneficial for projects that feature uncertainty, varying requirements, and shorter delivery times. Furthermore, APM defines a different management style, one that is characterized by facilitation, collaboration, goal- and boundary-setting, and flexibility. Finally, the measurement of success in agile organizations tends to shift from the use of the traditional iron triangle of scope, schedule, and cost towards an agile triangle of value, quality, and constraints (Jackson, 2012).

2.4.4 Characteristics of Agile Project Management

Agile project management is based on the following four value principles, which were established by the authors of the Agile Manifesto (Agile-Alliance, 2001):

- To value individuals and interactions over processes and tools;
- To value working products over comprehensive documentation;
- To value customer collaboration over contract negotiation; and
- To value responding to change over following a plan.

Due to changing requirements, agile methodologies should be employed for projects that exhibit high variability in tasks, in the capabilities of the individuals involved, and in the technology being used (Kidd & Karwowski, 1994). In addition, for projects in which the value of the product or service to be delivered is very important to customers, the use of agile methodologies is also very appropriate (Nerur, Mahapatra, & Mangalaraj, 2005). Organizations that are flexible and conducive to innovation can more easily adapt and embrace agile methodologies than rigid organizations that are characterized by bureaucracy and formalization (Sherehiy et al., 2007). An organization should carefully evaluate its readiness to adopt agile methods before implementing them.

Augustine, Payne, Sencindiver, and Woodcock (2005) identify the following practices as essential for adaptive APM:

- The ability to manage and adapt to change;
- A view of organizations as fluid, adaptive systems that are composed of intelligent people;
- Recognition of the limits of external control in establishing order; and
- An overall humanistic problem-solving approach that
  - Considers all members to be skilled and valuable stakeholders in team management;
  - Relies on the collective ability of autonomous teams as the basic problem-solving mechanism; and
  - Minimizes up-front planning, stressing instead adaptability to changing conditions.

Following these principles helps managers to become adaptive leaders who can set directions, establish simple rules for systems, and encourage constant feedback, adaptation, and collaboration within project teams.

Further investigations into APM practices have identified that an agile approach is characterized by the following set of practices, which are largely based on the input of Fernandez and Fernandez (2008):

- Embraces and manages change instead of avoiding it;
- Makes incremental changes;
- Assumes simplicity and avoids complexity;
- Maximizes value;
- Considers intensive planning, design, and documentation as waste;
- Creates documentation based on value;
- Goes through iterations to break long projects down into shorter ones (enable and focus on the next effort);
- Employs empowered and motivated teams;
- Focuses on delivering working features to paying customers as soon as possible;
- Promotes active customer participation in the implementation process; and
- Delivers rapid feedback to all stakeholders.

2.4.5 Agile Project Management Dimensions

The reviewed literature indicates that the agile approach is more people- than process-oriented (Ceschi, Sillitti, Succi, & Panfilis, 2005). Human factors are an integral aspect of the APM framework; these factors include a highly knowledgeable and skilled project team, supportive top management, and deeply involved customers. Augustine et al. (2005) prescribe six practices for managing agile projects: the use of small, organic teams; appropriate guidance from agile managers; simple rules; free and open access to information; a light-touch management style; and adaptive leadership. The latter refers to leading an agile project team with just enough involvement to provide appropriate guidance, but not enough to lead to excessive rigidity, leaving a team with as much freedom as possible. This approach has been described as a balancing act on the edge of chaos. Beyond human factors, organizational form and culture are also part of the APM framework. In today's projects, it is important that an organization has a flexible and less hierarchical structure to adequately respond to the conditions of a complex and rapidly changing environment (Sherehiy & Karwowski, 2014). Another factor is the development process, which needs to support a short, iterative, test-driven development and emphasize adaptability (Nerur et al., 2005). Furthermore, the appropriate technology and tools must be available for the implementation of an agile approach.

Based on the literature reviewed, the dimensions of APM can be classified into five categories: organizational, people, process, technical, and project. Chow and Cao (2008) determined the following factors for each of these dimensions:

1. Organizational: management commitment, organizational environment, and team environment;
2. People: team capability and customer involvement;
3. Process: the project management process and the project definition process;
4. Technical: agile software techniques and delivery strategy; and
5. Project: project nature, type, and schedule.

In order to emphasize the previously mentioned importance of an appropriate management style, this study also considers a "management dimension" in the APM framework, which is further addressed in detail in subsequent chapters.

CHAPTER THREE: RESEARCH DESIGN AND METHODOLOGY

3.1 Introduction

In order to investigate the topics of interest in the field of APM, this study requires a robust methodological approach. The focus of this chapter is on the research design and methodology employed in this study. As depicted in Figure 8, the process of developing the methodology used in this work began in Chapter 2, which thoroughly reviews the existing literature on the topic under investigation.

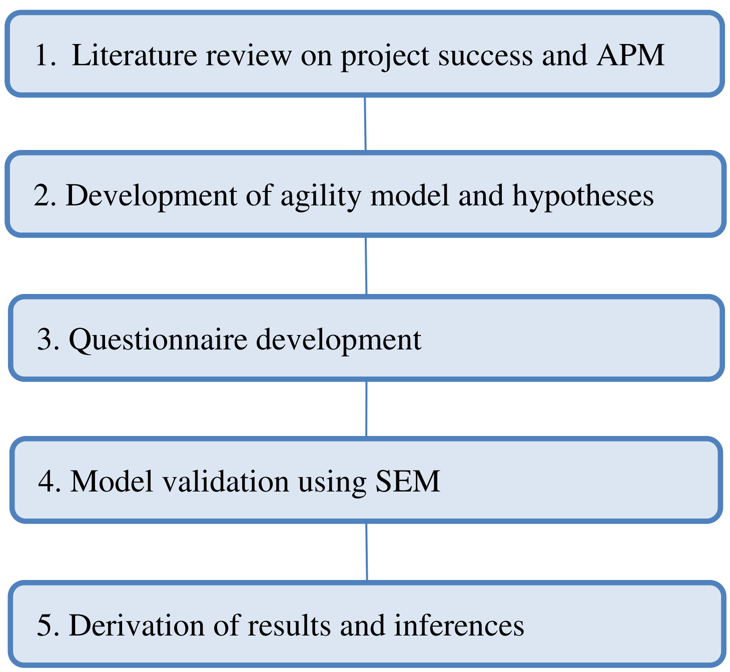

Figure 8: Methodology employed in this study

Based on the research objectives, a model that positions a set of independent and dependent variables into relation to each other is developed in the next step. These relationships are verbally expressed in the form of hypotheses. In a further step, a questionnaire is developed on the basis of the variables and validated survey questions used in other studies. The model is then validated using statistical analysis, in particular confirmatory factor analysis (CFA) and structural equation modeling (SEM). The findings are discussed in Chapter 4 of this study, while conclusions are drawn in Chapter 5.

3.2 Proposed Research Model, Research Questions, and Hypotheses

The focus of this research is on assessing the relationship between APM and the successful outcome of a project that is subject to project complexity. The basis of this research is the hypothesis that APM has a positive impact on the perceived outcome of a project. Project complexity, in contrast, is expected to negatively affect the results of a project. These relationships are conceptually visualized in Figure 9.

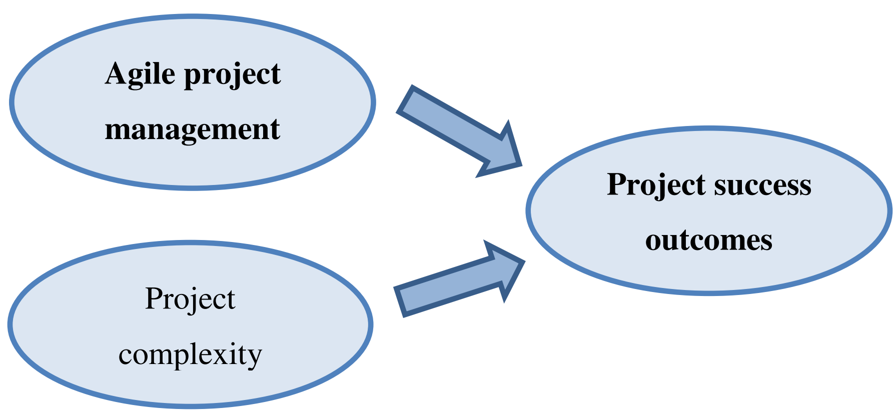

Figure 9: Conceptual research model

The main relationship to be tested is that between APM (the independent variable) and project success (the dependent variable). Agile project management is an unobserved hypothetical variable (latent) that consists of several observed variables (indicators). In the same manner, project success and project complexity are latent variables with several indicators. Based on the reviewed literature (Augustine et al., 2005; Boehm & Turner, 2005; Ceschi et al., 2005; Chow & Cao, 2008; Highsmith, 2002; Leon & Koch, 2004), agile success factors can be divided into five categories: organizational, people, process, technical, and project. An additional category, management, was added as a result of further research.

Leaning on the findings of Chow and Cao (2008), project success outcomes are categorized using the following success attributes: quality achievement (i.e., delivering a good working product), scope compliance (meeting all of the customer's requirements), timeliness (delivering on time), and cost target achievement (completing the project within budget).

Project complexity is comprised of the indicators project size, industry sector, project duration, whether customers are external or internal, number of team members, geographical team setup, and number of project sponsors. This categorization was based on the review of the relevant literature conducted in Chapter 2, in particular per Mosaic-Project-Services (n.d.).

Consequently, a model for evaluating the individual relationships between agile project management, project complexity, and project success outcomes is constructed. Figure 10 depicts the proposed model of the relationships between APM, project complexity, and project success. Each variable in the model is measured using a survey questionnaire, which was developed based on the validated questionnaires used in previous studies. Adjustments are made where necessary in order to address the specific interests of this research. Confirmatory factor analysis and SEM are used to analyze the relationships between the variables and allow for conclusions to be drawn.

Based on the objectives of this work, research questions are developed that the current model and associated survey questionnaire are expected to answer. The primary research questions are as follows:

- Q_1: What impact do APM practices have on the results of a project?
- Q_2: Does the complexity of a project influence its success outcomes?

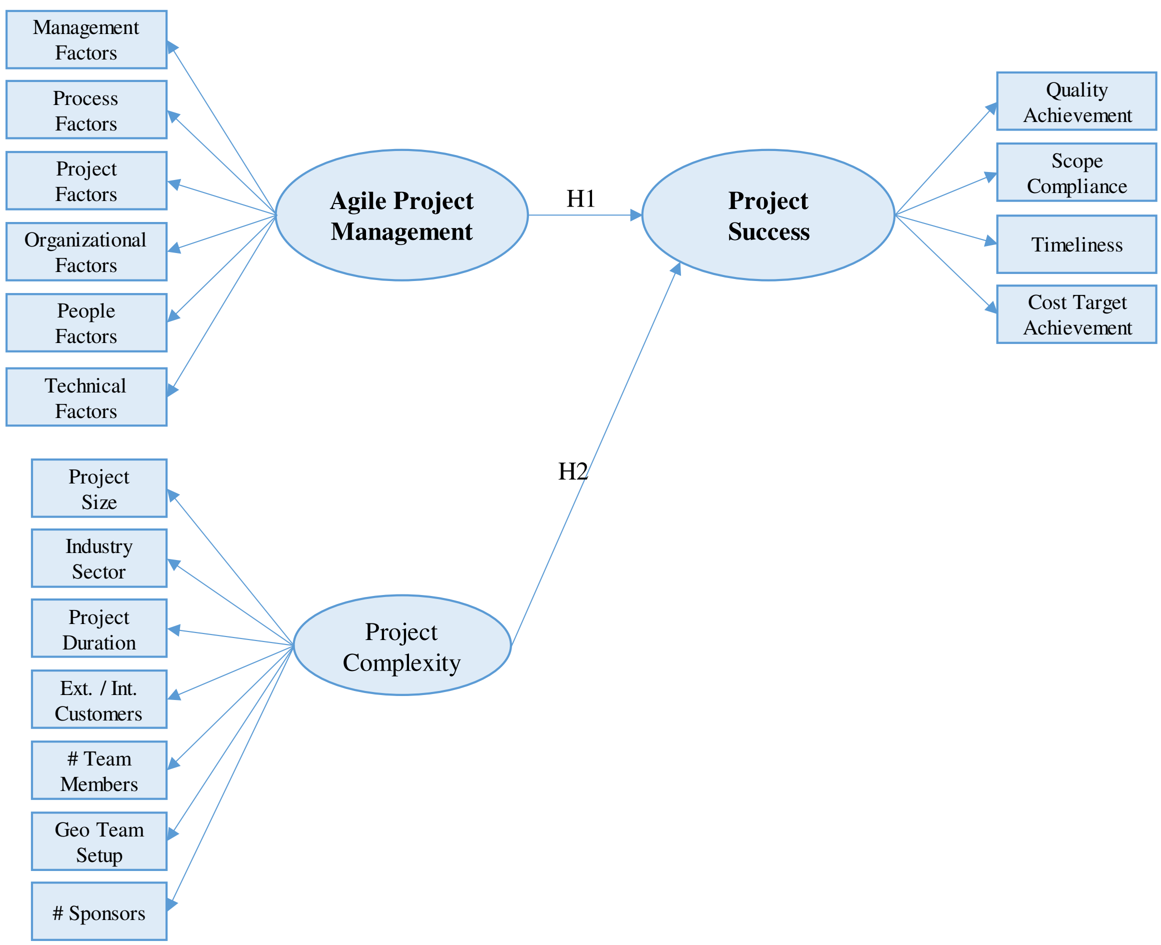

Figure 10: Proposed research model linking APM, project complexity, and project success

In addition, the secondary questions that are also expected to be answered are the following:

- Q_3: What agile project management factors are most important?
- Q_4: What project success dimensions have the largest impact on project results?
- Q_5: What project complexity dimensions are most significant?
- Q_6: How familiar are non-IT project managers with APM?
- Q_7: To what extent are APM techniques being utilized in non-IT projects?

While APM and project complexity are the independent variables in the model, project success is the dependent variable. Based on the constructed relationships in the model, the following hypotheses are proposed to test these relationships (see Figure 10):

- H1: Agile project management has a significant positive influence on project success; and
- H2: Project complexity has a significant negative impact on project success.

3.3 Survey Instrument

In the reviewed literature, surveys were commonly used as a tool for gathering data on model variables and providing the necessary inputs for statistical analyses. This study employs the web survey method, which was conducted using the QuestionPro, Inc. survey software (www.questionpro.com). The research questionnaire can be reviewed in Appendix A.

The survey instrument is a very convenient tool for both an interviewer and his or her respondents. Its advantages lie in its ability to reach a large population, relatively low costs, simple administration, convenient data gathering, and relative ease with which results can be analyzed through the use of advanced statistical tools. The disadvantages are the typically low response rates and the inability to encourage responders to provide accurate, honest answers.

Furthermore, surveys are inflexible in their design and cannot be changed throughout the process of data gathering.

The target population of this survey was project managers located in the United States of America with a minimum of one year's experience in project management and at least an undergraduate degree. The exact selection criteria were as follows:

- Minimum of one undergraduate degree (Question 2);
- Minimum of one year of work experience (Question 6);
- Minimum of one year of project management experience (Question 7);
- Minimum of one year of actively managing projects (Question 8);
- Currently in an active project manager function (Question 9); and
- Not currently working in or managing IT projects (Question 10).

A web survey with a 7-point Likert scale was distributed to the project managers; it also collected demographic information. The survey was divided into five sections: (1) demographic data, which included information such as work location, project management certifications, and years of project management experience; (2) project complexity aspects; (3) identification of APM factors; (4) perception of project success outcomes; and (5) additional comments and feedback in a free-form text area.

The degree of APM implemented in respondent's organizations was measured using a survey that included 40 statements concerning the six APM dimensions of management, process, project, organizational, people, and technical. The statements were addressed on a 7-point Likert scale ranging from 1 (strongly disagree), 2 (disagree), 3 (somewhat disagree), 4 (neither agree nor disagree), 5 (somewhat agree), 6 (agree), to 7 (strongly agree). Project outcomes were measured using the project success dimensions of quality achievement, scope compliance, timeliness, and cost target achievement. The survey section featured 14 statements, which were addressed using a 7-point Likert scale.

A pilot survey was conducted among 50 project managers to test the content validity, usability and readability of the questionnaire. Their feedback was incorporated into the survey before the final version was sent to the individual project managers.

3.4 Study Variables

The study variables investigated in this research are built around the three main constructs of agile project management, project complexity, and project success outcomes. They are based on the reviewed literature; in particular, APM and project success lean on the model from Chow and Cao (2008).

Agile project management is the exogenous latent variable; it is comprised of the following six dimensions (independent variables): (1) management factors, (2) process factors, (3) project factors, (4) organizational factors, (5) people factors, and (6) technical factors. The APM dimensions and their factors are listed in Table 8. The management factors' dimension consists of three statements that explore whether management provides strong support and "light-touch" engagement, meaning that management becomes involved only when truly necessary. Furthermore, another question is investigated whether management can adapt easily to changes.

Process factors include an agile-style project management process, which is an iterative process that involves breaking up long projects into smaller ones; it is also flexible and responsive to changes. The project definition process is a value-based process that features high-level planning, design, and documentation. The customer is highly committed and present throughout the process of implementing the project. Furthermore, continuous risk assessments are conducted throughout the process. The process factor variables account for fifteen statements in the questionnaire.

Table 8: Agile project management factors

Dimension	Factor
Management	• Strong executive management support • Light-touch management: engagement only if required • Adaptive management style

Process	• Agile-style project management process
	  ○ Iterative process that breaks up long projects
	  ○ Flexible process that accommodates change
	• Methodical project definition process
	  ○ Value-based process with high-level planning, design, and documentation
	• Strong customer commitment and presence
	• Continuous risk assessments

Project	• Variable scope, with emergent requirements • Dynamic and accelerated project schedules • Small project teams • Complex projects requiring unique project activities
Organizational	• Cooperative instead of hierarchical organizational culture • Organizational environment described by matrix organization • Free flow of information throughout the organization • Focus on strong communication • Necessary knowledge is widely available within the organization

Dimension	Factor
People	• Team members who demonstrate high levels of competence and expertise • Empowered and highly motivated team members • Good customer relationship based on commitment, knowledge, proximity, trust, and respect • Customers are deeply involved and fully committed • Self-organizing teams • Role interchangeability encouraged
Technical	• Simply designed products and services • Important features are in focus and are delivered first • Reduced amount of documentation

The variables of project factors were addressed with five statements about scope with emergent requirements, dynamic and accelerated schedules, and small project teams. Furthermore, the projects are fairly complex and involve unique activities.

Organizational factors include a cooperative organizational culture instead of the traditional hierarchical structure. The organizational environment is best described by a matrix structure, which allows a free flow of information throughout the organization and ensures that the necessary knowledge is widely available within the organization. Another focal point is strong communication. These characteristics were addressed with five survey statements.

People factors include team members with high levels of competence and expertise and who are empowered and highly motivated. A good customer relationship characterized by commitment, knowledge, proximity, trust, and respect is also important. Customers are deeply involved and fully committed. The project team is self-organizing, and roles are interchangeable, which is highly encouraged. Eight statements, covering the people factors of APM, were included.

Technical factors were addressed in four survey statements concerning the simple design of products and services. Only the important product or service features are in focus, and they are delivered first. The amount of documentation is significantly reduced when compared to traditional projects.

On the right side of the model are the project success dimensions. Project success is an endogenous latent variable that is comprised of the following dimensions: (1) quality achievement, (2) scope compliance, (3) timeliness, and (4) cost target achievement. The dimensions and factors of project success outcomes are listed in Table 9, below.

Table 9: Project success factors

Dimension	Factor
Quality achievement	• Delivering the expected quality in the product/service • Quality is of high importance within the organization • Following high quality standards • Zero error is a main goal • Quality assurance methods are used
Scope compliance	• Meeting all requirements and objectives • Delivering what was promised to be delivered
Timeliness	• Delivering on or ahead of schedule • Timeliness and meeting deadlines are important • Detailed scheduling is important
Cost target achievement	• Delivering within budget • Monitoring costs closely • Cost overruns are scrutinized in detail

The quality achievement dimension was investigated using five statements that addressed the delivery of products and services of the appropriate quality. Quality is of high importance in the organization, and high-quality standards are followed. Furthermore, the pursuit of zero errors is an important goal, and quality methods are used in the daily business.

The dimension of scope compliance is concerned with meeting the agreed upon requirements and objectives of the project. It is important to deliver that which was promised to the customer. The variables associated with scope compliance were addressed with two statements in the survey questionnaire.

The timeliness dimension was comprised of four survey statements that addressing the need to finish a project on or ahead of schedule. Timeliness and meeting deadlines, as well as detailed scheduling, are of importance to the project.

Finally, the cost target achievement dimension was comprised of the factors of delivering the project at or below the agreed upon budget, close cost monitoring, and detailed scrutiny of cost overruns to prevent future reoccurrences. The factors were addressed with three survey statements.

The second exogenous latent variable is project complexity. It was based on the four basic dimensions of project difficulty described in the white paper published by Mosaic-Project-Services (n.d.). Table 10 presents the four basic dimensions of project difficulty and the corresponding selected indicators of project complexity.

Project size is measured with reference to the average budget of a project, while technical difficulty is determined by considering the time required to accomplish project objectives (project duration). The degree of uncertainty is influenced by the industry sector, whether the respondent deals with internal or external customers, and the geographical team setup. All three of these indicators influence the level of uncertainty associated with a project. The relationship dimension of project difficulty was defined by the observed variables “number of team members" and "number of project sponsors," which can have different relationships and interests in a project.

Table 10: Indicators and dimensions of project difficulty (Mosaic-Project-Services, n.d.)

Dimension of Project Difficulty	Observed Variable (Indicator)
1. Size	Project size
2. Technical difficulty	Project duration
3. Uncertainty	Industry External vs. internal projects Geographical team setup
4. Relationships	Number of team members Number of sponsors

In summary, the exogenous latent variable "project complexity" is influenced by the following observed variables: (1) project size, (2) industry, (3) project duration, (4) external/internal customers, (5) number of team members, (6) geographical team setup, and (7) number of sponsors. The observed variables and their descriptions are listed in Table 11, below.

Of the three unobserved latent variables, namely agile project management, project complexity, and project success, and the seventeen observed variables, six are considered to measure APM (management factors, process factors, project factors, organizational factors, people factors, and technical factors), seven to measure project complexity (project size, industry sector, project duration, external vs. internal customers, number of team members, geographical team setup, and number of sponsors), and four to measure project success (quality achievement, scope compliance, timeliness, and cost target achievement).

Table 11: Factors of project complexity

Observed Variable (Indicator)	Description
Project size	• Size measured with reference to the available project budget
Industry	• Industry sector(s) the organization operates within
Project duration	• Typical project duration in months
External/Internal customers	• Interaction with external (outside the company) or internal (within the company) customers
Number of team members	• Typical project team size
Geographical team setup	• Location of project team members (global or local)
Number of sponsors	• Typical number of project sponsors

These seventeen observed variables function as indicators of their respective underlying latent factors. At this point, it should be mentioned that the observed variable "industry sector" was later removed as an indicator of project complexity and, after grouping (see Subchapter 3.7), replaced by the five independent observed variables industry primary sector, industry secondary sector, industry tertiary sector, industry quaternary sector, and other industry sectors (see Figure 11). This step was taken during the data analysis when it was determined that the gathered industry data would not support the expected relationship to project complexity. However, it was expected that the industry sector would still have a degree of influence on project success.

Associated with the remaining sixteen indicators are an error term (δ and ε) and, with the latent variable having been predicted (project success), a residual term (ξ). Error associated with the observed variables represents measurement error, which reflects on their adequacy in terms of measuring the related underlying factors (i.e., APM, project complexity, and project success).

The residual term represents error in the prediction of the endogenous factor (project success) from the exogenous factors (i.e., APM and project complexity).

Agile project management is expected to "cause" project success, and it is expected that APM is influenced by the six observed exogenous variables (see Table 12). Project complexity is expected to negatively influence project success. Project success is expressed in the observed endogenous variables of quality achievement, scope compliance, timeliness, and cost target achievement.

Table 12: Study variables

Variable Name	Variable Label	Variable Type	Variable Type
Management factors	Management factors	Observed	Exogenous
Process factors	Process factors	Observed	Exogenous
Project factors	Project factors	Observed	Exogenous
Organizational factors	Organizational factors	Observed	Exogenous
People factors	People factors	Observed	Exogenous
Technical factors	Technical factors	Observed	Exogenous
Project size	Project size	Observed	Exogenous
Project duration	Project duration	Observed	Exogenous
External vs. internal customers	Ext./int. customers	Observed	Exogenous
Number of team members	# team members	Observed	Exogenous
Geographical team setup	Geo team setup	Observed	Exogenous
Number of sponsors	# sponsors	Observed	Exogenous
Quality achievement	Quality achievement	Observed	Endogenous
Scope compliance	Scope compliance	Observed	Endogenous
Timeliness	Timeliness	Observed	Endogenous
Cost target achievement	Cost target achievement	Observed	Endogenous
Industry primary sector	Industry primary sector	Observed	Exogenous
Industry secondary sector	Industry secondary sector	Observed	Exogenous
Industry tertiary Sector	Industry tertiary sector	Observed	Exogenous
Industry quaternary sector	Industry quaternary sector	Observed	Exogenous
Industry other sector	Industry other sector	Observed	Exogenous

Variable Name	Variable Label	Variable Type	Variable Type
Agile project management	Agile project management	Unobserved (latent)	Exogenous
Project complexity	Project complexity	Unobserved (latent)	Exogenous
Project success	Project success	Unobserved (latent)	Endogenous

3.5 Procedures

Before the survey could be conducted, the approval of the survey company QuestionPro had to be secured. For this purpose, a cover letter that both explained the reason behind this study and its objectives and assured the confidentiality of the participants was written. Survey participation was anonymous and completely voluntary to ensure that honest responses were received. The survey questionnaire was distributed to QuestionPro and, after the company's approval was granted, the survey was announced to their panel members by means of an e-mail containing a link to the questionnaire.

3.5.1 Institutional Approval

In addition to securing the approval of the survey company, the survey was also reviewed and accepted by the Institutional Review Board (IRB) of the University of Central Florida (UCF) (see Appendix B). The IRB is a committee whose responsibility is to protect the rights and welfare of human research participants. Its approval ensures that a survey follows ethical principles and does not cause any harm to participants. The IRB focuses on the personal dignity and autonomy of the respondents involved and assesses the risks and benefits of a particular research undertaking to ensure that the anticipated benefits are greater than the anticipated risks. The first page of the survey addressed participant consent by explaining the purpose of the questionnaire and the fact that information was to be collected in an anonymous and voluntary manner. Only a limited amount of personal information was collected if it was required for the demographical variables needed for the data analysis.

3.5.2 Pilot Survey

The initial survey questionnaire was distributed to 50 project managers, who reviewed and answered it. They provided feedback regarding the usability and readability of the questionnaire, as well as suggestions for improvement. Furthermore, they identified inconsistencies in the possible responses, which indicated issues with the termination logic applied when required selection criteria were not met. As a result, the termination logic was adjusted to better align with the selection criteria. Fifty-four statements and 20 questions remained in the questionnaire that was finally distributed, a copy of which can be found in Appendix A.

3.5.3 Participants

The survey was conducted among project managers located in the United States with a minimum of one year of project management experience and an undergraduate degree or higher. These individuals were members of the survey panel and had the project management experience required to adequately respond to the survey questions and statements.

3.5.4 Procedure

The data was collected via a web survey that was distributed using survey software from QuestionPro to project managers who met the selection criteria. Their participation was voluntary, and their feedback was held confidentially and only used for the purpose of this study. The survey was conducted in an anonymous manner. After the survey was fully approved, the questionnaire was introduced to the project managers via an e-mail that contained a link to the web survey. The completed questionnaires were returned to QuestionPro and the author for review.

The questionnaire was distributed to a total number of 2,639 project managers in the United States. Complete responses were received from 397 participants, which resulted in a response rate of 15%. However, 45 questionnaire responses were removed due to either missing or unusable information. As a result, the number of usable samples was reduced to 352, which were then used for the data analysis.

3.6 Sample Size

The population investigated in the study consisted of project managers in the United States with a minimum of one year of project management experience and an undergraduate degree or higher. The population was targeted through an online survey tool provided by QuestionPro (www.questionpro.com) which provides access to a panel of project managers suitable for this type of survey study. The potential population is comprised of approximately 30,000 project managers.

Although there is a consensus in the literature regarding the importance of choosing an appropriate sample size for SEM, there is no single clearly defined and agreed upon rule concerning how to calculate the correct sample size. Bentler and Chou (1987) proposed a guideline that, for normally distributed data, a ratio as low as five cases per observed variable would be sufficient when the latent variables considered have multiple indicators. Other guidelines suggest that, in order to obtain appropriate results from significance tests, the ratio should be higher, at 10 to 20 participants per estimated parameter (Kline, 2010). Some authors are even of the opinion that meaningful tests can be conducted using a small sample size (Hoyle & Kenny, 1999; Marsh & Hau, 1999), but, usually, N = 100-150 is considered the minimum acceptable sample size for conducting SEM (Ding, Velicer, & Harlow, 1995). Per Muthén and Muthén (2002), a reasonable sample size is approximately N = 150 for a simulation studies with normally distributed indicator variables and no missing data. In order to reduce biases to an acceptable level, other researchers consider a larger sample size, for example, N = 200, as appropriate for SEM, (Boomsma & Hoogland, 2001; Kline, 2010). This size is also recommended by Weston and Gore Jr (2006), assuming that the researcher anticipates no problems with data (e.g., missing data or non-normal distributions).

Under these guidelines, the available sample of 352 fully completed surveys with no missing data and normal distribution is acceptable for testing the model. The sample size is on the higher side when considering the minimum of 100 to 150 and the conservative number of 10 participants per estimated parameter.

The model contains a total of 44 parameters to be estimated, which are indicated with asterisks in the fully mediated composite model depicted in Figure 11, below. These are comprised of directional effects and variances. The number of directional effects is 20, which consists of 13 relationships between latent variables and indicators (called factor loadings) and seven relationships between latent variables and other latent variables (called path coefficients). There are 24 variances estimated in the model for indicator errors associated with the 16 observed variables, variance in the single endogenous latent variable, the two exogenous latent variables, and the five independent variables.

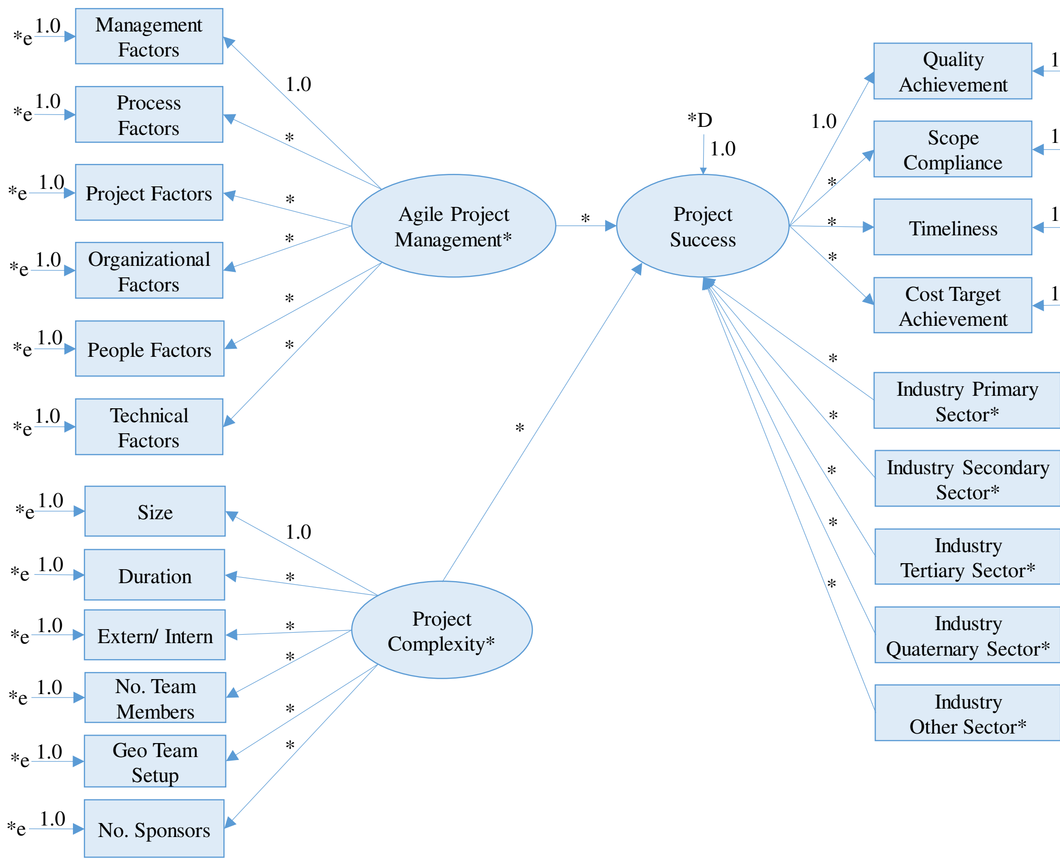

Figure 11: Fully mediated composite model

Note: Asterisks represent parameters to be estimated

3.7 Grouping

Since the model contains a large number of indicators and the sample size is limited, it was decided to group certain indicators into distinct constructs that seemed reasonable from a theoretical and conceptual perspective. For example, the three observed variables belonging to the management factor dimension were grouped together with the construct management factors. The same concept was applied to the remaining APM factors and the project success dimensions.

In addition, the demographical data obtained through the following questions were grouped:

- Question 6: How many years of work experience do you have?
- Question 7: How many years of project management experience do you have?
- Question 8: For how many years have you actively managed projects in your career?
- Question 12: Which sector(s) does your organization operate in?
- Question 17: What is the typical size of your project team?
- Question 18: Where are your project team members located?
- Question 19: How many project sponsors (external customers or financiers for internal projects) do your projects typically have?

The variables for questions 6, 7, and 8 were measured in number of years, ranging from zero to 50. A meaningful grouping was performed (see Chapter 4: Findings) to facilitate the interpretation of the results and to reduce complexity.

As shown in Table 13, the data obtained through question 12 were grouped into sectors of the economy, which are labeled as the primary, secondary, tertiary, quaternary, and other sectors. Per Kenessey (1987), this grouping is adequate, as these sectors are sufficiently distinct from each other to permit their separation and comparative analysis in the context of the US economy. The Standard Industrial Classification (SIC) manual was utilized when making connections between the four sectors of the economy and the original answer options in the survey questionnaire (*Standard Industrial Classification Manual*, 1987). The primary sector includes mining and agricultural business activities, while the secondary sector encompasses manufacturing and business activities that facilitate the production of tangible goods. The tertiary sector, also called the service sector, ranges from different types of service businesses to wholesale and retail trade businesses. The quaternary sector covers the knowledge-based section of the economy, which consists of intellectual industries such as finance, insurance, education, and government services. All remaining industries fall into the “other sector” category.

Table 13: Sector grouping per Kenessey (1987)

Sectors of the Economy	SIC Major Group	Questionnaire Sector Selection
Primary Sector Agriculture, forestry and fishing Mining	01, 02, 07, 08, 09 10, 11, 12, 13, 14	Mining (10, 12, 13, 14) or agriculture (01, 02, 07)
Secondary Sector Construction Manufacturing	15, 16, 17 20 through 39	Chemicals (28); consumer goods (20-39); food products (20); manufacturing (20-39); pharma/biotech/medical devices (38)
Tertiary Sector Transportation, electric, gas, sanitary services Wholesale trade Retail trade	40 through 49 50, 51 52 through 59	Energy/utilities (49); hi-tech/ telecom (48); Retail (52-59)
Quaternary Sector Finance, insurance, and real estate Services Public administration	60 through 67 70, 72, 73, 75, 76, 78 - 89 91 through 97	Financial services/banking (60-67); business services (73); hospital/healthcare/insurance (80); education/training (82); nonprofit (83); government (91)

In order to reduce complexity while maintaining the desired informational value, question 17 (“What is the typical size of your project team?”) was regrouped from six groups to the following four groups:

- Group 1: 1 (Yourself)
- Group 2: 1 to 5
- Group 3: 6 to 10
- Group 4: 11+

The answer choices in question 18 (“Where are your project team members located?”) were regrouped from seven into two categories, “local” and “global” team setup, as a meaningful conclusion based on the original categorization could not be drawn. A local team indicates team members in North America (the United States of America and Canada) only, whereas a global team can be located anywhere in the world.

For the same reason as for question 17, question 19 (“How many project sponsors do your projects typically have?”) was regrouped from seven to the following five groups:

- Group 1: None
- Group 2: One
- Group 3: Two
- Group 4: Three
- Group 5: Four+

3.8 Statistical Analysis

The statistical analysis in this research study was conducted by performing descriptive statistics, CFA, SEM, and testing of the hypotheses. The methods used are described in greater detail in the following sub-sections.

3.8.1 Descriptive Statistics and Data Analysis

A preliminary data analysis was conducted to review the data for outliers, missing data, normality, and reliability. Due to the termination logic and the rigid setup of the questionnaire, the number of outliers and the amount of missing data were expected to be very low. The majority of the responses were given on a 7-point Likert scale, which has a narrow range, meaning that it is unlikely that individual data will be discarded from it.

Most statistics used in SEM assume multivariate normality of the data distribution. Since testing for multivariate normality is impractical due to the necessity of screening an infinite number of linear combinations (Weston & Gore Jr, 2006), the distribution was tested for univariate normality by means of examination for skewness and kurtosis. Absolute skewness and kurtosis values between zero and 1.0 are considered to be very good indicators of normality. An approximate normal distribution is assumed with absolute skewness and kurtosis values between 1.0 and 2.0. The skewness determines whether the data are asymmetrically distributed: While a positive skew would indicate that many of the distribution scores are at the low end of the scale, a negative skew results when the majority of the scores are at the high end of the scale. Skewness indices with absolute values higher than 3.0 are considered extreme (C.-P. Chou & Bentler, 1995). Kurtosis indicates how peaked the distribution is: A positive kurtosis reflects a very peaked distribution with short, thick tails, representing only a few outliers. In comparison, a negative kurtosis indicates a flat distribution with short, thick tails, indicating many outliers (Weston & Gore Jr, 2006). Absolute kurtosis values of 10.0 and higher are considered problematic, and, once it exceeds 20.0, a peak is considered too extreme for a normal distribution (Kline, 2010).

The data were further analyzed for potential multicollinearity. Multicollinearity is a common problem when two variables have a high inter-correlation, meaning that they potentially measure the same variable and are thus essentially redundant. This is a problem for SEM when measures are too highly related for certain statistical operations. Per Kline (2010), a correlation of 0.85 or higher indicates a multicollinearity problem. One solution would be to remove one of the correlated variables; Spearman's correlation matrix was used to detect multicollinearity for the latent (unobserved) variables.

In addition, a frequency analysis was conducted for all measured variables, including demographic information, project complexity factors, APM factors, and project success factors.

3.8.2 Confirmatory Factor Analysis

Confirmatory factor analysis is considered an extension of factor analysis that determines whether a set of items or factors fit a common construct (Schumacker & Lomax, 2016). It tests the variation and covariation in a set of observed variables in terms of a set of theoretical, unobserved (latent) factors. Confirmatory factor analysis evaluates the construct validity of a proposed model and determines whether the constructs are measured correctly (Kline, 2010). Confirmatory factor analysis was conducted using the AMOS 24 software to validate the measurement model of each underlying latent construct.

The relationship between a latent variable and observed variable in the construct is represented by an arrow and its value (this is referred to as factor loading). The value can be interpreted in such a manner that the higher the factor loading, the more robust the relationship between the two variables. Table 14 illustrates factor loadings and corresponding interpretations suggested by Tabachnick and Fidell (2007).

Table 14: Factor loading scale (Tabachnick & Fidell, 2007)

Factor Loading	Interpretation	Variance accounted for
> 0.71	Excellent	50%
> 0.63	Very good	40%
> 0.55	Good	30%
> 0.45	Fair	20%
> 0.32	Poor	10%
<= 0.32	Not interpreted	<10%

Goodness of fit indices were used to determine how well the proposed model fits the set of observations. Rather than relying on a single statistic, it is recommended that goodness of fit be examined using multiple criteria (Bollen & Long, 1993; Mueller, 1999; Weston & Gore Jr, 2006). For this purpose, the indices shown in Table 15 were used, as recommended in the literature (Byrne, 2010; Meade, Johnson, & Braddy, 2008; Schermelleh-Engel, Moosbrugger, & Müller, 2003): maximum likelihood Chi-square ($\chi2$) statistic, the ratio of Chi-square to degrees of freedom, the root mean square error of approximation (RMSEA), the goodness-of-fit index (GFI), the comparative fit index (CFI), and the Tucker and Lewis index (TLI).

Table 15: Indices for model evaluation

Fit Measure	Good Fit	Acceptable Fit
χ^2	$0 \leq \chi^2 \leq 2df$	$2df < \chi^2 \leq 3df$
p value	$.05 < p \leq 1.00$	$.01 \leq p \leq .05$
χ^2 / df	$0 \leq \chi^2/df \leq 2$	$2 < \chi^2/df \leq 3$
RMSEA	$0 \leq$ RMSEA $\leq .05$	$.05 <$ RMSEA $\leq .08$
GFI	$.95 \leq$ GFI ≤ 1.00	$.90 \leq$ GFI $< .95$
CFI	$.95 \leq$ CFI ≤ 1.00	$.90 \leq$ CFI $< .95$
TLI*	$.95 \leq$ TLI ≤ 1.00	$.90 \leq$ TLI $< .95$

Note: * The "nonnormed" index can, on occasion, be greater than 1 or slightly below 0

The Chi-square statistic indicates the goodness of fit of a model to the data being investigated (Hu & Bentler, 1999). It tests the closeness of fit between a model and a perfect fit or a saturated model by determining the difference between the observed and the expected covariance matrices. The lower the Chi-square value, the better the fit of a model to the data. However, the Chi-square index is sensitive to a small sample size, potentially resulting in an inflated Chi-square statistic. The recommended ratio for representing an acceptable model fit between Chi-square and degrees of freedom is between two and three. A good model fit requires a Chi-square that is equal to or less than two times the degree of freedom and a p-value that is greater than 0.05 (Schermelleh-Engel et al., 2003).

The RMSEA accounts for model complexity and tests the extent to which a model fits reasonably (Harrington, 2009): the lower the value, the less manipulation of the fit exists. A RMSEA value of 0.00 indicates a perfect fit of a model to the data (Weston & Gore Jr, 2006). A value of 0.05 or lower is considered a good fit, values between 0.05 and 0.08 are considered adequate fits, and values of and above 0.10 are considered a poor fit to the data (Schermelleh-Engel et al., 2003).

An example of absolute fit indices is the GFI. Similarly to the R^2 formula that is used in regression to summarize the variance explained in a dependent variable, the GFI describes the variance accounted for in an entire model (Weston & Gore Jr, 2006). The GFI typically ranges between zero and one; as higher the GFI value as better is the model fitting to the data. Values of 0.95 and higher indicate a good fit, while values between 0.90 and 0.95 are still considered an acceptable fit (Schumacker & Lomax, 2016).

The CFI analyzes model fit by comparing the hypothesized model with a null model. It is considered reasonably robust due to its ability to adjust for the sample size issues that are inherent in the Chi-square test of model fit. A value above 0.95 is considered good, while values between 0.9 and 0.95 are acceptable (Hu & Bentler, 1999).

The TLI is also less sensitive to sample size. It is used to compare a single model or alternative model to a null model. Like the CFI and GFI, values above 0.95 are considered good fits, and values between 0.9 and 0.95 are acceptable. A value of less than 0.9 requires that the model in question be restructured (Hu & Bentler, 1999).

Another gauge of model-data fit is the modification index (MI), which is calculated for each non-estimated relationship. The MI is used to decide which parameter correlations should be added to a model. It is a measure of the predicted decrease in the Chi-square value that would result from relaxing a model's restrictions by freeing parameters that were fixed in the initial model. The MIs of good models should be close to one (Schermelleh-Engel et al., 2003). Values of approximately 4.0 ($p < 0.05$) and smaller do not require further model adjustment, as the improvement in model fit would be insignificant relative to the one degree of freedom obtained by estimating the additional parameter (Lu, Lai, & Cheng, 2007).

Reliability analysis was performed for the individual constructs using the Cronbach's alpha method. Cronbach's α is a measure of internal consistency, meaning that it is a direct function of the number of items and their magnitude of inter-correlation (Cronbach, 1951). According to Nunnally (1978), for emerging construct scales, the threshold for Cronbach's α is 0.5, while, for established scales, it is 0.7.

3.8.3 Structural Equation Modeling

Structural equation modeling is a statistical methodology that adopts a confirmatory approach such as hypothesis testing when analyzing a structural theory (Byrne, 2010). Two important aspects of SEM are that the causal processes are represented by structural equations and that these structural relations can be modeled pictorially. Furthermore, like multiple regression, factor analysis, and analysis of variance, SEM is a multivariate statistical technique. The purpose of SEM is to examine the plausibility of a hypothesized model based on collected data. While CFA focuses on the relationships between latent variables and their observed measures, SEM includes causal paths between the latent variables themselves (Harrington, 2009). In this study, SEM was performed using the AMOS 24 software. After the measurement models were validated, the factor score of each construct was assigned in the software tool. To test the relationship between the APM factors, project complexity factors, and the project success outcomes, a structural model was built based on the factor scope of each construct. Agile project management, project complexity, and industry sectors were the independent variables in the model. The only dependent variable in the study was successful project outcome.

CHAPTER FOUR: FINDINGS

This chapter commences with a discussion of descriptive statistics and examines the data distribution for missing data, outliers, and normality. In the next step, the data are analyzed for multicollinearity, which is followed by a frequency analysis of the measured variables. This chapter proceeds with the statistical analysis process by conducting both CFA and SEM to analyze the effects of APM and project complexity on project success outcomes. This chapter closes by testing the hypotheses, which represents the final step in the statistical analysis.

4.1 Descriptive Statistics and Data Analysis

4.1.1 Missing Data

In a first step, the data were "cleaned" of possible missing data and prepared for further path analysis. The survey was distributed to a total of 2,639 project managers in the United States who had a minimum of one year's worth of work experience. The survey had multiple termination points within the questionnaire to ensure that only respondents who fulfilled the following selection criteria complete the survey:

- Minimum of one undergraduate degree (Q2);
- Minimum of one year of work experience (Q6);
- Minimum of one year of project management experience (Q7);
- Minimum of one year of actively managing projects (Q8);
- Currently playing an active project manager role (Q9); and
- Not working in or managing IT projects (Q10).

If a respondent did not fulfill all the above criteria, the survey was terminated and the associated data were deleted. As a result, 397 project managers completed the survey. Despite the termination logic, out of the 397 completed surveys, four data sets were identified as missing data. At times, while answering the survey, if a respondent refreshed the page or used the browser's "back" button or any unwanted interruption in network access occurred while the data were being registered, the answers were likely to not be captured, resulting in missing data. The four data sets with missing data were deleted from the survey results. In addition, in an initial test run, 41 of 50 survey results were found to have inconsistent responses that did not meet the required selection criteria; this was due to the initial absence of termination logic. These results were deleted entirely, leaving 352 complete and fully valid data sets.

4.1.2 Outliers

The participants' scores were examined for any extreme or atypical data values, the so-called outliers. Since the data had already been thoroughly "cleaned" and the answer choices in the questionnaire setup were very limited, no outliers were expected. The data values were all found to be in their expected ranges (see Appendix D). For example, responses given on the 7-point Likert scale were all within a minimum of 1.0 and maximum of 7.0. Any value within this range was considered valuable for the data analysis and therefore not an outlier. Other questions, such as Q14 ("What is the average budget for a project at your organization?") or Q17 ("What is the typical size of your project team?") also provided values that were within their expected ranges. In conclusion, it was decided to keep all data values, as they were all within their narrow spectrums, and it would be imprudent to discard any of the valid responses.

4.1.3 Normality

In the following step, the distribution of each observed variable was examined for skewness and kurtosis to determine whether univariate normality exists (see Appendix D).

For APM factors, the skew is slightly negative, with absolute values between 0.5 and 1.0 indicating the normality of the data distribution. The kurtosis values range from positive 0.48 to 2.6, which are still within the range of an approximate normal distribution. The project complexity factors follow a normal distribution, with absolute skewness and kurtosis values ranging from 0.1 to 2.0. The same result applies for the project success factors, as their skew and kurtosis vary between absolute 0.4 and 1.3. In addition, the majority of the industry sector variables (secondary sector, tertiary sector, quaternary sector, and other sector) indicated an approximate normal distribution of the data, as their skewness and kurtosis absolute values ranged from 0.1 to 2.2. The skewness and kurtosis values for the primary sector variable were considered to be extreme, indicating that the data are potentially not normally distributed. The skewness had a value of 8.25, which is a score at the lower end of the scale, while the kurtosis value was 66.37, indicating a very peaked data distribution. These results suggest potential problems with normality, and if the existence of such problems is confirmed in further analysis, this variable should be removed.

4.1.4 Multicollinearity

The approach chosen to check for multicollinearity is screening bivariate correlations. Since the data are ordinal, Spearman's rho describes best the correlations between the indicators (Schumacker & Lomax, 2016). Bivariate correlations greater than 0.85 can indicate problems (Kline, 2010), while highly correlated observed variables could potentially be redundant. Thus, one solution could be to remove one of the two highly correlated variables. A Spearman's correlation matrix was developed for the indicators of the variables APM, project complexity, project success and the industry sectors using the SPSS 24 software (see Appendix E).

Agile project management had six indicators: management factors, process factors, project factors, organizational factors, people factors, and technical factors. All correlations showed a moderate to strong relationship between the indicators and were statistically significant at the 0.01 level. The highest correlation was 0.761, which was found between process factors and people factors; this, however, was still below the threshold of 0.85. Therefore, no multicollinearity problems were identified between the indicators of APM.

Project complexity was comprised of the observed variables project size, project duration, ext./int. customers, # team members, geo team setup, and # sponsors. Most correlations identified a low to moderate relationship between the variables and were statistically significant at the 0.05 level. The relationships between geo team setup and project size, as well as between geo team setup and ext./int. customers, were weak and not significant. However, no multicollinearity problems were identified between the project complexity indicators.

The project success factors were quality achievement, scope compliance, timeliness, and cost target achievement. All correlations showed moderate to strong relationships between the indicators and were statistically significant at the 0.01 level. The highest correlation was 0.694, which was found between quality achievement and scope compliance; however, this was still below the threshold of 0.85. Therefore, no multicollinearity problems were identified between the indicators of project success.

Finally, the industry sector variables primary sector, secondary sector, tertiary sector, quaternary sector, and other sector were analyzed for potential multicollinearity. The majority of the relationships were weak and not significant. Weak to moderate correlations with significance were identified between the quaternary sector and secondary/tertiary sectors, as well as between the other sector and the secondary/tertiary/quaternary sectors. The highest correlation was -0.505, which was still below the threshold of 0.85. Consequently, no multicollinearity issues were identified between the industry sector variables.

4.2 Frequency Analysis

The population investigated in this study consisted of project managers who are located in the United States of America. They were required to have at least one undergraduate degree and a minimum of one year's worth of experience in project management to be selected for this survey study. A total of 2,639 project managers participated in the web-based survey, of which 397 finished the survey entirely, corresponding to a response rate of 15%. Project managers who did not comply with the minimum selection criteria were identified by the answers that they provided to certain survey questions, which resulted in the termination of their surveys. This ensured that the 397 individuals who completed the survey met the minimum selection criteria. Of the 397 completed surveys, 45 had inadequate data and were excluded, resulting in 352 fully completed surveys with good data, which were used for analysis.

4.2.1 Demographic Information

Demographics refers to statistical data on the characteristics of a population. This subchapter explains the results obtained for questions 1 through 11, 13, and 20 (see Appendix C for more details).

The first demographic factor investigated was work location in the United States of America; it was found that the 352 project managers were spread out over all 50 of the nation's states. However, the vast majority of the respondents came from California (54 total, 15.34%) followed by Pennsylvania (26 total, 7.39%), Texas (25 total, 7.1%), and the state of New York (23 total, 6.53%).

The second demographic factor investigated was whether the respondents had an undergraduate degree. This question was also a termination point, as holding an undergraduate degree was a requirement to complete this survey. The 352 respondents had earned a total of 363 bachelor degrees. The majority of the project managers graduated with a bachelor's degree in business (62 total, 17.61%), followed by bachelor of arts (60 total, 17.05%), bachelor of science in business (37 total, 10.51%), and bachelor of engineering (14 total, 3.98%) degrees.

The next statement determined which of the respondents had obtained a graduate degree. The 352 respondents had amassed a total of 192 master degrees. Of the 352 respondents, 25 project managers had earned a master of accounting (25 total, 7.10%) degree, followed by master of business administration (22 total, 6.25%) and master of arts (13 total, 3.69%) degrees. A total of 172 project managers did not have a graduate degree, which represents 49% of the 352 respondents.

The fourth question inquired about the project management-related certifications that each project manager may have held. Surprisingly, more than 68% of the respondents (a total of 241 of 352 respondents) did not have any project management certifications. Of the remaining respondents, only 33 (9.38%) project managers had a Project Management Professional certification from the Project Management Institute (PMI), 16 (4.55%) were Certified Associates in Project Management by the PMI, and 16 (4.55%) held the Professional in Project Management certification.

The fifth question investigated how familiar the project managers were with APM. More than 50% of the project managers (total of 177) were unaware of the concept. Of 352 respondents, 55 project managers (15.62%) had recently learned about it and planned to implement it in the future. A further 49 respondents (13.92%) knew about it, but were not planning on using it. A total of 39 project managers (11.08%) had recently learned about APM and had just started adopting the agile methodology in their projects.

The sixth question inquired about how many years of work experience each respondent had. None of the 352 project managers had less than one year of work experience, which was expected given that this question was one of the termination criteria. The average (mean) work experience was 15.7 years, with a standard deviation of 10.02 years. A total of 157 project managers (44.6%) had one to 10 years of work experience (see Table 16). The second largest group was the group of 11 to 20 years of work experience, with a total of 115 project managers (32.67%). The smallest cluster was the group with 40 or more years of work experience, which included only six project managers.

The following question inquired about years of project management experience. As per one of the requirements for completing the survey, none of the respondents had less than one year of project management experience. The average (mean) project management experience was 8.1 years with a standard deviation of 6.12 years. The grouping of this variable showed that the majority of the project managers (193 of 352 respondents) had between one to five years of project management experience, which equates to almost 55% of all of the respondents. Those project managers who had six to 10 years of experience constituted the second largest group, at nearly 25% of all of the respondents (see Table 17). Very few project managers (4%) had more than 20 years of project management experience.

Table 16: Frequency analysis for Q6: years of work experience

Q6. How many years of work experience do you have?		
	n	**Percent (%)**
0 years	0	0.0
1 through 10 years	157	44.6
11 through 20 years	115	32.7
21 through 30 years	53	15.1
31 through 40 years	21	6.0
41 years and higher	6	1.7
Total	352	100.0

Table 17: Frequency analysis for Q7: years of project management experience

Q7. How many years of project management experience do you have?		
	n	**Percent (%)**
0 years	0	0.0
1 through 5 years	193	54.8
6 through 10 years	86	24.4
11 through 15 years	44	12.5
16 through 20 years	15	4.3
21 years and higher	14	4.0
Total	352	100.0

Question number eight investigated for how many years the respondents had actively managed projects in their careers. Each respondent was found to have managed projects for at least one year. The average (mean) number of years spent actively managing projects was 8.3 years, with a standard deviation of 6.35 years. The majority of the project managers (193 of 352) had managed projects for one to five years; this amounts to almost 55% of all of the respondents. Twenty-five percent of the project managers had between six to 10 years' experience of managing projects. These findings indicate that almost 80% of all of the project managers had managed projects for between one and 10 years (see Table 18).

Table 18: Frequency analysis for Q8: years spent actively managing projects

Q8. For how many years have you actively managed projects in your career?		
	n	**Percent (%)**
0 years	0	0.0
1 through 5 years	193	54.8
6 through 10 years	88	25.0
11 through 15 years	42	11.9
16 through 20 years	14	4.0
21 through 30 years	12	3.4
31 years and higher	3	0.9
Total	352	100.0

The question number nine concerned the specific project manager role that each survey respondent played. The majority of the participants (see Appendix C) were fulfilling the role of a project manager (~43%), followed by program managers (~18%), assistant project managers (~13%), and senior project managers (~11%).

Question number 10 established that none of the respondents were managing IT projects, as this was specifically excluded from this study investigation. The results of this question confirmed that none of the respondents were indeed working on IT projects.

The following question investigated the approximate amount of time spent on a project. The majority of the project managers (39.2%) spent between 25% and 50% of their time on projects. The next cluster followed closely (~32%), the members of which spent between 50% and 75% of their time on projects (see Table 19).

Table 19: Frequency analysis for Q11: time spent working on projects

Q11. Approximately how much of your time is spent working on projects?		
	n	**Percent (%)**
Less than 25%	31	8.81
25% to less than 50%	138	39.2
50% to less than 75%	114	32.39
75%+	69	19.6
Total	352	100.0

The 13th question concerned the number of employees who worked at the respondents' companies. The majority of the companies that the project managers worked for are of a smaller size (see Table 20), as 156 respondents worked in small companies with 1 to 500 employees (44.32%). Fifty-seven respondents worked in companies with 501 to 2,000 employees (16.19%), and 40 respondents in companies with 5,001 to 15,000 employees (11.36%). A fair percentage of the project managers worked in very large companies with over 100,000 employees (8.24%).

Table 20: Frequency analysis for Q13: number of company employees

Q13. How many total employees are there in your company?		
	n	**Percent (%)**
1 to 500	156	44.32
501 to 2,000	57	16.19
2,001 to 5,000	40	11.36
5,001 to 15,000	27	7.67
15,001 to 25,000	18	5.11
25,001 to 50,000	13	3.69
50,001 to 100,000	12	3.41
Over 100,000	29	8.24
Total	352	100.0

4.2.2 Project Complexity

The following described control variables provided demographic information concerning the latent variable of project complexity. Information on seven demographic factors was collected from industry sector, project size, project duration, external vs. internal customers, number of team members, geographical team setup, and number of project sponsors.

The first control variable was industry sector, which had 16 initial answer options in the questionnaire. Multiple selections were allowed, as a company can potentially operate in several industry sectors. The answer options were grouped in the five main categories of primary sector, secondary sector, tertiary sector, quaternary sector, and other, as described in Chapter 3.7 Grouping. This made it possible to perform a simplified model analysis without loss of information critical to this study. To avoid the double-counting of results, the "select cases" functionality in the SPSS software was used to group data and simultaneously filter results that would not have been existed had the respondent selected from among the grouped answering options. As shown in Table 21, the majority of companies operated in the quaternary sector (41.3%), followed by the secondary (28.7%) and tertiary sectors (15.6%). Only five companies operated in the primary sector (1.3%).

Table 21: Frequency analysis for Q12: industry sectors

Q12. Which sector(s) is your organization operating in?		
	n	**Percent (%)**
Primary sector	5	1.28
Secondary sector	112	28.72
Tertiary sector	61	15.64
Quaternary sector	161	41.28
Other	51	13.08
Total	390	100.0

The second control variable was project size, which measured average project budget. The majority of the project managers (33.2%) had managed projects with budgets between 100,000 and 1 million US dollars, followed by the approximately 30% who had managed budgets of less than 100,000 US dollars. Almost 19% of the project managers had handled project budgets of between 1 and 10 million US dollars, followed by the 12% who had managed budgets of between 10 to 100 million US dollar. From here, the number of projects gradually decreased with increasing project budget (see Table 22).

The third control variable, which was named “external vs. internal customers,” identified whether the respondents’ projects dealt with internal, external, or both, internal and external customers. The majority of projects (60%) had both internal and external customers (see Table 23).

Table 22: Frequency analysis for Q14: project budget

Q14. What is the average budget for a project at your organization?		
	n	**Percent (%)**
Less than $100,000	106	30.1
$100,000 – less than $1M	117	33.2
$1M – less than $10M	66	18.8
$10M – less than $100M	42	11.9
$100M – less than $1B	15	4.3
$1B and higher	6	1.7
Total	352	100.0

Table 23: Frequency analysis for Q15: external vs. internal customers

Q15. Are your projects dealing with external customers (outside your company) or internal customers (within your company)?		
	n	**Percent (%)**
External only	83	23.58
Internal only	57	16.19
Both, External and Internal	212	60.23
Total	352	100.0

The following question addressed the control variable of project duration. As shown in Table 24, the majority of projects (33.5%) had a duration of one to less than six months, followed by six to less than 12 months (26.4% of all projects), and one year to less than two years (~15.6% of all projects).

Table 24: Frequency analysis for Q16: project duration

Q16. What is the typical duration of a project in your organization?		
	n	**Percent (%)**
Less than one month	39	11.08
One month to less than six months	118	33.52
Six months to less than 12 months	93	26.42
One year to less than two years	55	15.62
Two years to less than five years	38	10.8
Five years to less than 10 years	7	1.99
10 years and longer	2	0.57
Total	352	100.0

Another control variable was the size of project teams. As described in Chapter 3.7 Grouping, this variable was regrouped from six to four groups (see Table 25). The majority of projects (41.5%) had team sizes of two to five team members, followed by the group with six to 10 team members (29.3%).

Table 25: Frequency analysis for Q17: project team size

Q17. What is the typical size of your project team?		
	n	**Percent (%)**
One (yourself)	9	2.6
Two to five	146	41.5
Six to 10	103	29.3
Eleven and higher	94	26.7
Total	352	100.0

The following control variable determined the geographical setups of the project managers' teams. The questionnaire provided the following response choices: North America

(USA and Canada), Central and South America (Mexico and south of Mexico), Europe, Asia, Australia, Africa, and the rest of the globe. Since the respondents were project managers located in the United States, that is where also most of their team members (79.5%) were located (see Table 26). Only a few project managers had international teams with team members in Europe (6.9%), Asia (5.3%), or Central/South America (4%).

Table 26: Frequency analysis for Q18: geographical team setup

Q18. Where are your project team members located?		
	n	**Percent (%)**
North America (USA and Canada)	299	79.52
Central and South America (Mexico and south of Mexico)	15	3.99
Europe	26	6.91
Asia	20	5.32
Australia	5	1.33
Africa	3	0.8
Rest of the Globe	8	2.13
Total	376	100.0

As explained in Chapter 3.7 Grouping, the original team setup categories were regrouped into two variables, namely local and global geographical team setups. The frequency analysis (see Table 27) revealed that the majority of the projects had local teams (84.9%), and only a handful were operating with global teams (15.1%).

Table 27: Frequency analysis for Q18: geographical team setup

Geographical team setup		
	n	**Percent (%)**
Local	299	84.9
Global	53	15.1
Total	352	100.0

The last control variable was the number of project sponsors. As described in Chapter 3.7 Grouping, this variable was regrouped from seven to five groups (see Table 28). The majority of respondents had not any sponsor (28.7%) for their projects, followed by the groups of one (23.6%) and two project sponsors (22.7%). About 15% of project managers had three sponsors for the projects and the remaining 10% of respondents had four or more project sponsors. Considering the presented results, there appeared to be a difference in interpretation of what a project sponsor is, as it was expected that every project had to have at least one sponsor funding the project. Some project manager may not consider their external customer as a project sponsor and refer the sponsor terminology to internal projects only. However, this discrepancy in interpretation is not expected to change the degree of influence on project success.

Table 28: Frequency analysis for Q19: number of project sponsors

Q19. How many project sponsors (external customers or financiers for internal projects) do your projects typically have?		
	n	**Percent (%)**
None	101	28.69
One	83	23.58
Two	80	22.73
Three	53	15.06
Four and higher	35	9.94
Total	352	100.0

4.2.3 Agile Project Management

This subchapter presents the results of the frequency analysis conducted for the exogenous variables (the independent variables or predictors) of APM, which are management factors, process factors, project factors, organizational factors, people factors, and technical factors. A frequency analysis was performed to determine the mean and standard deviations over the range of a 7-point Likert scale, on which (1) indicated strongly disagree, (2) disagree, (3) somewhat disagree, (4) neither agree nor disagree, (5) somewhat agree, (6) agree, and (7) strongly agree.

The indicators of predictor variable management factors had their averages close to five, which means "somewhat agree," and their standard deviations were approximately 1.4 and 1.5 (see Table 29). For variable Q21 ("Our executive management strongly supports our projects"), the respondents were close to agreeing to this statement (mean = 5.47).

The indicators of predictor variable process factors had averages ranging from 4.37 to 5.48, so they fell near the "somewhat agree" area. In consideration of responses to Q25, with a mean of 5.48, the respondents were close to agreeing that change is considered inevitable in the project managers' organizations. With regard to Q30, the respondents somewhat agreed (mean = 4.37) that they minimized the effort invested during the initial planning phase of project execution. Their standard deviations ranged from 1.216 to 1.674 (see Table 30).

Table 29: Frequency analysis for management factors

Exogenous Variables (Management Factors)	Mean	Std. Deviation
Q21. Our executive management strongly supports our projects.	5.47	1.394
Q22. Our managers lead with a light touch and engage only if required.	4.77	1.492
Q23. Our managers have an adaptive leadership style.	5.01	1.511

Table 30: Frequency analysis for process factors

Exogenous Variables (Process Factors)	Mean	Std. Deviation
Q24. We follow an iterative process when executing our projects.	4.90	1.216
Q25. Change is considered inevitable in our organization.	5.48	1.404
Q26. There is no beginning and no ends to changes, resulting in continuous improvement to the system.	5.08	1.399
Q27. Our processes are flexible enough to support frequent changes in project requirements.	5.12	1.349
Q28. We have a mature process in place to control scope changes.	5.10	1.269
Q29. Our projects follow value-based processes with high-level planning, design, and documentation.	5.27	1.397
Q30. We minimize the efforts invested in the initial planning phase of the execution of a project.	4.37	1.442
Q31. We conduct daily face-to-face meetings.	4.59	1.674
Q32. We assess risks continuously throughout the course of a project and make adjustments to the plan as needed.	5.34	1.306
Q33. Our project goals are quantified.	5.32	1.306
Q34. Our project goals are widely communicated within our organization.	5.19	1.482
Q35. Our project outcomes are measured.	5.37	1.319

Exogenous Variables (Process Factors)	Mean	Std. Deviation
Q36. Our project outcomes are widely communicated within our organization.	5.17	1.493
Q37. Instead of a process-centric approach, we have a goal-driven, people-centric approach to project management.	5.01	1.423
Q38. We are able to adequately resolve unexpected problems.	5.29	1.347

The indicators of predictor variable project factors had averages ranging from 4.53 to 5.16, meaning that they fell in the "somewhat agree" area. There was some agreement that the projects are handled by small project teams and that project schedules can be rapidly adjusted. The standard deviations for responses to these questions ranged from 1.388 to 1.517 (see Table 31).

Table 31: Frequency analysis for project factors

Exogenous Variables (Project Factors)	Mean	Std. Deviation
Q39. The scope of our projects varies with frequently changing customer requirements.	5.16	1.388
Q40. Our projects have dynamic schedules that can be adjusted quickly.	4.94	1.444
Q41. We are constantly compressing the project schedule.	4.53	1.432
Q42. Our projects consist of small project teams.	5.00	1.421
Q43. Project activities are never the same between different projects in our organization.	4.57	1.517

The indicators of predictor variable organizational factors had averages ranging from 5.22 to 5.91, so they fell within the "somewhat agree" and "agree" areas. Overall, there was agreement (mean = 5.91) that cooperation is an important aspect of the project managers' organizational cultures. There was some agreement that information flows freely between project team members (Q46). The standard deviations of these variables ranged from 1.388 to 1.517 (see Table 32).

Table 32: Frequency analysis for organizational factors

Exogenous Variables (Organizational Factors)	Mean	Std. Deviation
Q44. Cooperation is an important aspect of our organizational culture.	5.91	1.278
Q45. Our organizational environment is described by a project organization that fosters interactions among the team members with a minimum amount of disruptions, overlaps and conflicts.	5.23	1.327
Q46. Information flows freely between team members of our organization.	5.22	1.517
Q47. Our organization is focused on an effective communication.	5.37	1.442
Q48. Necessary knowledge is accessible to all team members.	5.47	1.444

The indicators of predictor variable people factors had means ranging from 4.59 to 5.77, meaning that they fell in the "somewhat agree" and "agree" areas. There was nearly agreement that the relationship with customers is based on commitment, knowledge, proximity, trust, and respect (Q52, mean = 5.77). The freedom to reorganize teams had an average of 4.59, which is between "neither agree nor disagree" and "somewhat agree." The standard deviations ranged from 1.215 to 1.627 (see Table 33).

Table 33: Frequency analysis for people factors

Exogenous Variables (People Factors)	Mean	Std. Deviation
Q49. All my team members have the required technical knowledge and expertise.	5.22	1.387
Q50. I believe that our team members feel empowered to make decisions.	5.17	1.419
Q51. Our team members are highly motivated.	5.39	1.396
Q52. Our relationship with customers is based on commitment, knowledge, proximity, trust, and respect.	5.77	1.215
Q53. Our customers are deeply involved in the execution of the project.	4.88	1.547
Q54. Our customers are very responsive on questions or queries related to the project.	5.16	1.308
Q55. In my company our teams have the freedom to reorganize themselves.	4.59	1.588
Q56. Role interchangeability is encouraged in our company.	4.62	1.627

The indicators of predictor variable technical factors had means ranging from 4.24 to 5.29, meaning that they fell in the "neither agree nor disagree" and "somewhat agree" areas. There was some degree of agreement that the amount of documentation used is high (Q59, mean = 5.29). The respondents were indifferent (mean = 4.24) when it came to the question of whether some of the documentation provided to customers is unnecessary (Q60), and their standard deviations ranged from 1.241 to 1.670 (see Table 34).

Table 34: Frequency analysis for technical factors

Exogenous Variables (Technical Factors)	Mean	Std. Deviation
Q57. The design of products/services is characterized by simplicity.	4.49	1.487
Q58. We are delivering most important design features of our products/services first.	5.18	1.241
Q59. The amount of documentation we use is high.	5.29	1.470
Q60. Some of the documentation we provide to our customers is unnecessary.	4.24	1.670

4.2.4 Project Success

This subchapter discusses the results of the frequency analysis that was conducted for the endogenous variables (the dependent variables or criteria) of project success, which are quality achievement, scope compliance, timeliness, and cost target achievement. As was the case in the previous subchapter, a frequency analysis was performed to determine the mean and standard deviation over the range of a 7-point Likert scale, on which (1) indicated strongly disagree, (2) disagree, (3) somewhat disagree, (4) neither agree nor disagree, (5) somewhat agree, (6) agree, and (7) strongly agree.

The observed variables of the quality achievement dimension had their means between 5.56 and 5.97, which means that they were close to “agree.” On average, the respondents agreed that quality is of high importance in their organizations, which have high quality standards. Most of the respondents were of the opinion that their projects deliver their required quality of products and/or services. The associated standard deviations varied between 1.196 and 1.445 (see Table 35).

Table 35: Frequency analysis for quality achievement factors

Exogenous Variables (Quality Achievement Factors)	Mean	Std. Deviation
Q61. The projects I am involved in deliver the product and/or service in the required quality.	5.76	1.196
Q62. Quality is of high importance in our organization.	5.97	1.234
Q63. Our organization follows high quality standards.	5.89	1.310
Q64. Zero errors is one of our main goals.	5.56	1.445
Q65. Our company utilizes proven quality methods/procedures in the day-to-day business activities.	5.56	1.295

The two observed variables of the dimension of scope compliance had averages of 5.41 and 5.83, which means that they fell between "somewhat agree" and "agree." The respondents somewhat agreed that the contractual requirements and objectives of their projects are always met (Q66). They also agreed that they deliver the promised scope to their customers (Q67). The standard deviations of the variables were 1.276 and 1.161 (see Table 36).

Table 36: Frequency analysis for scope compliance factors

Exogenous Variables (Scope Compliance Factors)	Mean	Std. Deviation
Q66. Contractual requirements and objectives are always met for my projects.	5.41	1.276
Q67. I am delivering to my customers what I promised to deliver.	5.83	1.161

The four observed variables of the timeliness dimension had averages between 5.40 and 6.05, which means that they fell between "somewhat agree" and "agree." The respondents somewhat agreed that they finish their projects on or ahead of schedule (Q68). They further agreed that it is essential to deliver project deliverables on time (Q70). Their standard deviations varied between 1.098 and 1.225 (see Table 37).

Table 37: Frequency analysis for timeliness factors

Exogenous Variables (Timeliness Factors)	Mean	Std. Deviation
Q68. I am finishing my projects on or ahead of schedule.	5.40	1.225
Q69. Timeliness and meeting deadlines is important on my projects.	5.88	1.158
Q70. It is essential to deliver project deliverables on time.	6.05	1.098
Q71. Detailed scheduling is an important part on my projects.	5.80	1.176

The three observed variables of the cost target achievement dimension had averages between 5.32 and 5.67, which means that they fell between “somewhat agree” and “agree.” On average, the respondents somewhat agreed that their projects are completed at or under budget (Q72). They largely agreed that the costs of their projects are closely monitored (Q73). Their standard deviations varied between 1.225 and 1.294 (see Table 38).

Table 38: Frequency analysis for cost target achievement factors

Exogenous Variables (Cost Target Achievement Factors)	Mean	Std. Deviation
Q72. My projects are completed at or under budget.	5.32	1.225
Q73. Costs are closely monitored.	5.67	1.290
Q74. Unplanned costs are scrutinized in detail to prevent future reoccurrence.	5.42	1.294

4.3 Confirmatory Factor Analysis

A CFA was conducted using maximum likelihood estimation to verify the validity and reliability of the measurement models of APM, project complexity, and project success. Confirmatory factor analysis enables the evaluation of how well the observed (measured) variables combine to identify the underlying hypothesized constructs. In other words, it shows to what degree the observed variable is related to its latent variable.

In this chapter, in addition to data collection, the individual measurement models were tested by following the typical six SEM steps: model specification, identification, estimation, evaluation, and modification (Hoyle, 1995; Kline, 2010; Schumacker & Lomax, 2016). These steps were performed using the AMOS 24 software.

The first step of CFA specifies the initial measurement model for each latent variable by determining its relationship to the respective observed variables (the indicators). The factor loadings represent how well each observed variable is related to its latent variable.

The next step verified whether the model was properly identified using maximum likelihood estimation. This determined whether each parameter in a model could be estimated from the covariance matrix.

Following the identification of the model, the measurement models were tested and goodness-of-fit statistics were evaluated to determine whether the specified model represents the sample data sufficiently. The fitness of each measurement model was evaluated by analyzing the following statistics: Chi-square ($\chi 2$) statistic, the ratio of Chi-square to degrees of freedom, root mean square error of approximation (RMSEA), goodness-of-fit index (GFI), comparative fit index (CFI), and Tucker and Lewis index (TLI).

The final step evaluated the necessity of modifying the model to improve the overall fit. Each factor loading in the latent construct had to have a critical ratio of $\pm$ 1.96 or higher to be statistically significant. Non-significant indicators were eliminated. Furthermore, modification indices (MI) were determined as predicted decrease in the Chi-square value that results from relaxing model restrictions by freeing parameters that were previously fixed. The MI values of approximately 4.0 ($p < 0.05$) and smaller did not require any further model adjustment. Finally, Cronbach's alpha was calculated for each measurement model to ensure an adequate level of model reliability. An α value of 0.70 or above is considered as the criterion for demonstrating strong internal consistency in established scales (Nunnally, 1978).

4.3.1 Confirmatory Factor Analysis of APM

Agile project management is considered a latent exogenous variable in this model. The initial model used to measure APM consisted of six indicators: management factors, process factors, project factors, organizational factors, people factors, and technical factors. The initial measurement model and its standardized estimates output (factor loadings) are depicted in Figure 12. The model was determined to be overidentified, as the degree of freedom was 9, which is greater than zero (21 observations minus the 12 parameters to be estimated). The Chi-square value of 87.004 is above the acceptable limit of three times the degree of freedom (3df), and this is significant, as the probability level is less than 0.05. Therefore, there is a significant difference between the model and the saturated model.

Furthermore, the GFI and CFI were above the acceptable fit limit of 0.90, but the TLI was slightly lower, at 0.897. It was determined that the model fit needs to be improved. In addition, the RMSEA value of 0.157 was significantly higher than the acceptable limit of 0.08, which also indicates that the model does not fit the data very well.

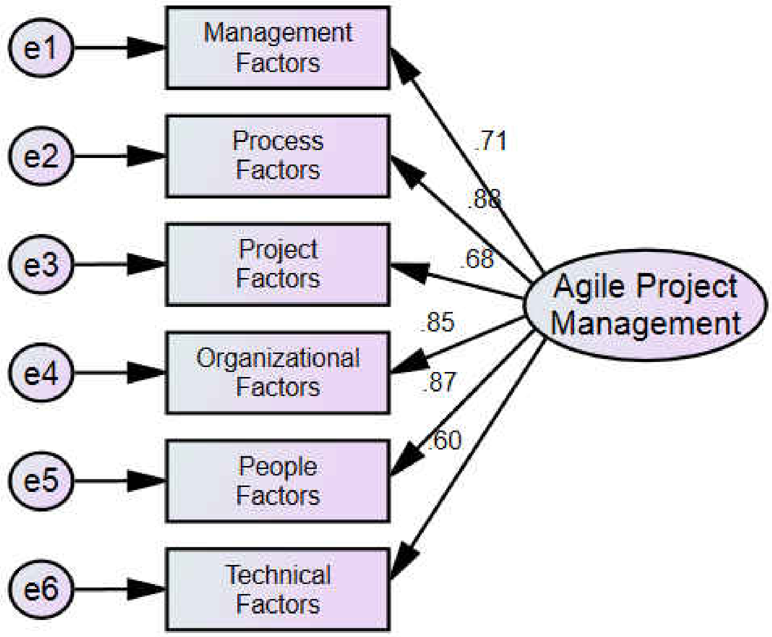

Figure 12: Initial APM measurement model

The indicators organizational factors, process factors, and people factors have a strong relationship with the latent variable of APM, which can be seen in their relatively high factor loadings. The indicators project factors, management factors, and technical factors were found to have a moderate correlation with the latent variable (see Table 39). All indicators are significant at the 0.05 significance level, as their critical values are greater than 1.96. Therefore, all indicators are maintained in the next revision of the measurement model.

In order to improve the model's fit, MIs were evaluated, with the intention of freeing up parameters and decreasing the Chi-square value of the revised model. For covariances with modification indices above 10, the corresponding error terms were correlated in the revised and improved measurement model.

Table 39: Parameter estimates for the APM measurement model

Indicator	Standardized parameter or factor loading	Unstandardized factor loading	Standard error (SE)	Critical value/ significance*
Project Factors	0.679	0.725	0.060	12.099*
Organizational Factors	0.847	1.150	0.076	15.054*
Management Factors	0.711	1.000		
Process Factors	0.879	0.989	0.063	15.761*
People Factors	0.868	1.063	0.070	15.260*
Technical Factors	0.601	0.650	0.061	10.677*

Note: * Statistical significance at the 0.05 or lower level.

The improved APM measurement model was comprised of the same indicators as the initial measurement model. Based on the modification indices from the previous model, the error terms e6 – e3, e5 – e4, e6 – e4, and e4 – e3 were correlated (see Figure 13).

The revised model is overidentified with a degree of freedom of 5, which is still greater than zero (21 observations minus the 16 parameters to be estimated). The Chi-square value was significantly lowered to 9.164, which indicates a good model fit, as the $\chi 2$ / df ratio is lower than 2.0 and the probability level (=0.103) is higher than 0.05, indicating no statistical significance. Therefore, there was no significant difference between the revised and the saturated models.

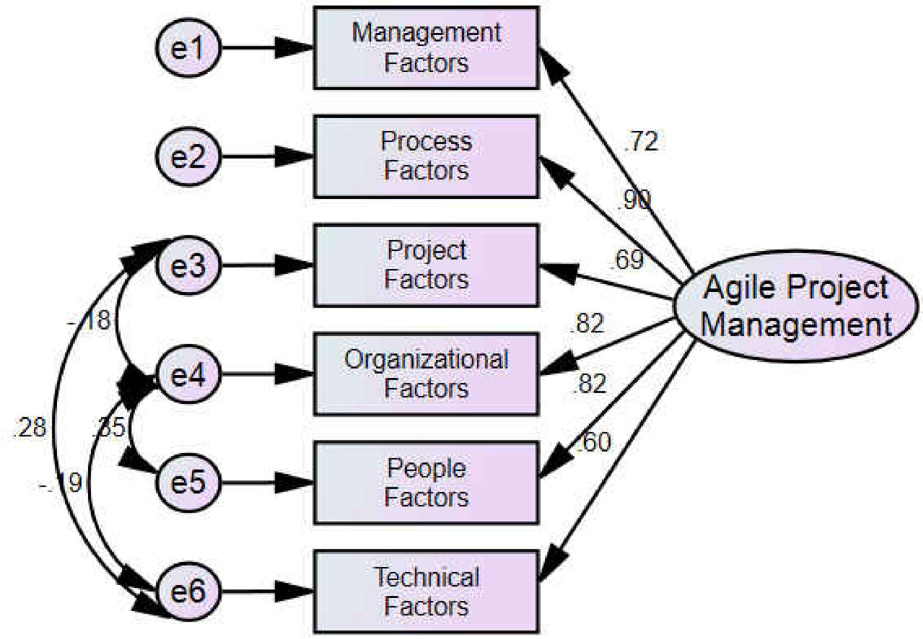

Figure 13: Revised APM measurement model

Furthermore, the goodness-of-fit indices GFI, CFI, and TLI are not only greater than 0.9 but are also very close to 1.0, indicating a good model fit. In addition, the RMSEA was lowered to 0.049, which is also within the good fit range. Table 40 presents the goodness-of-fit indices for both the initial and the revised APM measurement models.

The factor loadings of the indicators organizational factors, process factors, and people factors maintained strong relationships with the latent variable APM, which can be seen in their relatively high values. The indicators project factors, management factors, and technical factors also have robust relationships, with only slightly lower factor loadings than the first group (see Table 41).

Table 40: Goodness-of-fit indices for APM

Index	Fit Criteria		Initial Model	Revised Model
	Good Fit	Acceptable Fit		
χ^2	$0 \le \chi^2 \le 2df$	$2df < \chi^2 \le 3df$	87.004	9.164
p value	$.05 < p \le 1.00$	$.01 \le p \le .05$	<0.001	0.103
χ^2 / df	$0 \le \chi^2/df \le 2$	$2 < \chi^2/df \le 3$	9.667	1.833
RMSEA	0 ≤ RMSEA ≤ .05	.05 < RMSEA ≤ .08	0.157	0.049
GFI	.95 ≤ GFI ≤ 1.00	.90 ≤ GFI < .95	0.920	0.992
CFI	.95 ≤ CFI ≤ 1.00	.90 ≤ CFI < .95	0.938	0.997
TLI*	.95 ≤ TLI ≤ 1.00	.90 ≤ TLI < .95	0.897	0.990

Note: * The "nonnormed" index, on occasion, can be larger than 1 or slightly below 0.

Table 41: Parameter estimates for the revised APM measurement model

Indicator	Standardized parameter or factor loading	Unstandardized factor loading	Standard error (SE)	Critical value/ significance*
Project factors	0.694	0.735	0.060	12.228*
Organizational factors	0.824	1.111	0.077	14.392*
Management factors	0.717	1.000		
Process factors	0.905	1.010	0.063	16.019*
People factors	0.820	0.996	0.069	14.466*
Technical factors	0.605	0.649	0.061	10.605*

Note: * Statistical significance at the 0.05 or lower level.

All indicators are significant at the 0.05 significance level, as their critical values are greater than 1.96. Therefore, all indicators are maintained in the measurement model.

In summary, the revised model demonstrates a substantial improvement in terms of model fit. Its Chi-square statistic is lower than two times the degree of freedom, indicating good model fit. In addition, the revised model had GFI, CFI, TLI, and RMSEA values in ranges that indicate a well-fitting model. The internal consistency of the APM construct was evaluated by measuring its Cronbach's alpha. The Cronbach's alpha was found to be 0.894, which is above the recommended level of 0.70; this indicates that the measurement model is reliable.

4.3.2 Confirmatory Factor Analysis of Project Complexity

The initial measurement model for the latent construct project complexity was comprised of the following indicators: project size, project duration, external vs. internal customers (ext./int. customers), number of team members (# team members), geographical team setup (geo team setup), and number of sponsors (# sponsors). The initial measurement model and its standardized estimates output (factor loadings) are depicted in Figure 14.

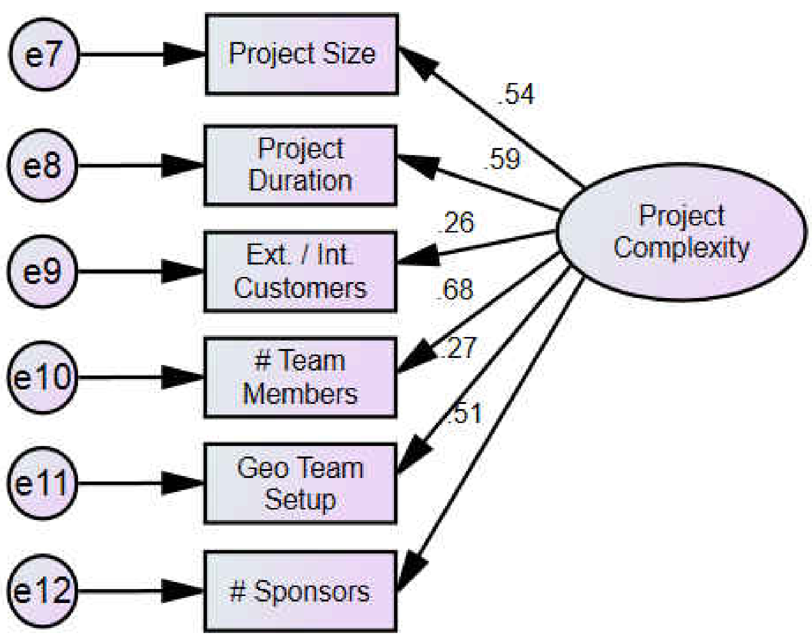

Figure 14: Initial measurement model for project complexity

Similarly to the APM measurement model, the project complexity model was overidentified, as the degree of freedom was 9, which is greater than zero (21 observations minus the 12 parameters to be estimated). The Chi-square value of 13.547 indicates a good model fit, as it is less than two times the degree of freedom (2df); it is not significant, as the probability level is greater than 0.05. Therefore, there were no significant differences between the revised and the saturated models.

Furthermore, the values of the goodness-of-fit indices GFI, CFI, and TLI are greater than 0.95, again supporting a good model fit. The RMSEA value of 0.038 also indicates a good model fit, as it is lower than 0.05. The indicators project duration, project size, number of team members, and number of sponsors have robust relationships with the latent variable project complexity, which are reflected in their moderate factor loadings. The indicators ext./int. customers, and geographical team setup have weak relationships with project complexity. However, it was decided to keep them, as they are considered significant to this research. In addition, by running a revised model without these indicators, it was verified that they do not affect the fit of the model.

Table 42: Parameter estimates for project complexity measurement model

Indicator	Standardized parameter or factor loading	Unstandardized factor loading	Standard error (SE)	Critical value/ significance*
Project duration	0.587	1.120	0.156	7.195*
Ext./int. customers	0.260	0.326	0.087	3.762*
Project size	0.542	1.000		
# team members	0.684	0.884	0.127	6.974*
Geo team setup	0.271	0.145	0.038	3.860*
# sponsors	0.508	0.997	0.165	6.042*

Note: * Statistical significance at the 0.05 or lower level.

All indicators are significant at the 0.05 significance level, as their critical values are greater than 1.96. Therefore, all indicators are maintained in the next revision of the measurement model.

Furthermore, the modification indices were evaluated to potentially improve the model's fit by freeing up parameters and decreasing the Chi-square value of the revised model. Only one covariance with a modification index of 4.902 was identified, which suggests correlation between the error terms e8 and e7. A correlation between project budget (project size) and project duration is realistic, as a positive relationship between the two would be expected.

The improved project complexity measurement model consisted of the same indicators as the initial measurement model. Based on the modification index of the previous model, the error terms e8 – e7 were correlated (see Figure 15).

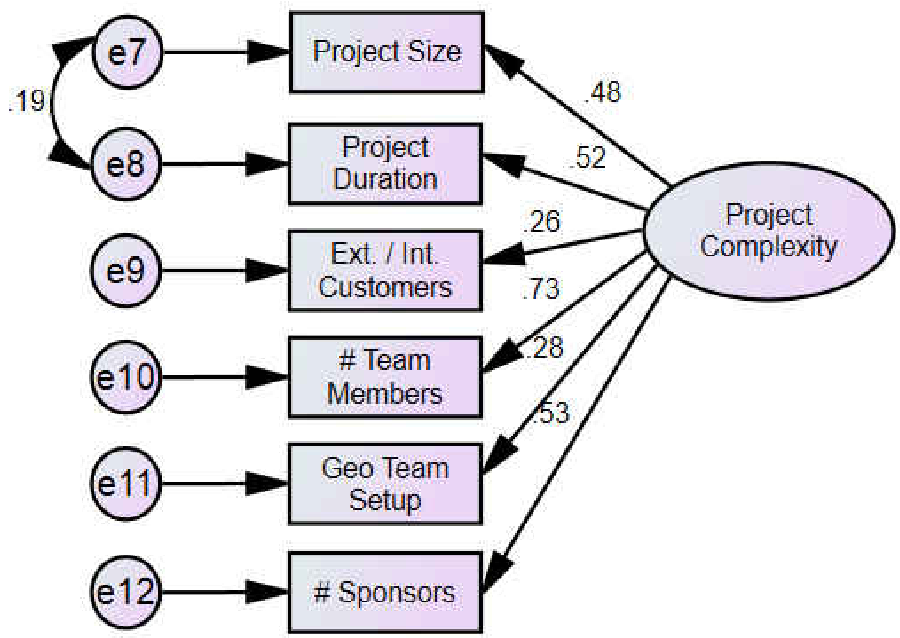

Figure 15: Revised project complexity measurement model

The revised model is overidentified with a degree of freedom of 8, which is still greater than zero (21 observations minus 13 parameters to be estimated). The Chi-square value was significantly lowered to 6.031, which indicates a good model fit, as the $\chi2$ / df ratio is lower than 2.0 and the probability level (=0.644) is higher than 0.05, indicating no statistical significance. Therefore, there were no significant differences between the revised and the saturated models.

Furthermore, the values of the goodness-of-fit indices GFI, CFI, and TLI are now very close to 1.0, supporting a good model fit. In addition, the RMSEA was lowered to nearly zero, which indicates that the model fits very well. Table 43 compares the goodness-of-fit indices of the initial and the revised project complexity measurement models.

Table 43: Goodness-of-fit indices for project complexity

Index	Fit Criteria		Initial Model	Revised Model
	Good Fit	Acceptable Fit		
χ^2	$0 \leq \chi^2 \leq 2df$	$2df < \chi^2 \leq 3df$	13.547	6.031
p value	$.05 < p \leq 1.00$	$.01 \leq p \leq .05$	0.139	0.644
χ^2 / *df*	$0 \leq \chi^2/df \leq 2$	$2 < \chi^2/df \leq 3$	1.505	0.754
RMSEA	$0 \leq$ RMSEA $\leq .05$	$.05 <$ RMSEA $\leq .08$	0.038	0.000
GFI	$.95 \leq$ GFI ≤ 1.00	$.90 \leq$ GFI $< .95$	0.987	0.994
CFI	$.95 \leq$ CFI ≤ 1.00	$.90 \leq$ CFI $< .95$	0.980	1.000
TLI*	$.95 \leq$ TLI ≤ 1.00	$.90 \leq$ TLI $< .95$	0.966	1.016

Note: * The “nonnormed” index, on occasion, can be larger than 1 or slightly below 0

There were no significant changes in the factor loadings of the six indicators. The effects of project duration, project size, number of team members, and number of sponsors remained robust, and the effects of ext./int. customers and geographical team setup remained on the weaker side (see Table 44).

Table 44: Parameter estimates for the revised project complexity measurement model

Indicator	Standardized parameter or factor loading	Unstandardized factor loading	Standard error (SE)	Critical value/ significance*
Project duration	0.521	1.134	0.172	6.604*
Ext./int. customers	0.262	0.375	0.103	3.636*
Project size	0.475	1.000		
# team members	0.727	1.070	0.172	6.210*
Geo team setup	0.280	0.171	0.045	3.801*
# sponsors	0.527	1.180	0.209	5.660*

Note: * Statistical significance at the 0.05 or lower level.

All indicators are significant at the 0.05 significance level, as their critical values are greater than 1.96. Therefore, all indicators are maintained in the measurement model.

In summary, the revised model shows a small degree of improvement in terms of model fit. Its Chi-square statistic was lower than two times the degree of freedom, indicating a good model fit. In addition, the revised model had GFI, CFI, TLI, and RMSEA values in ranges that indicated a well-fitting model. The Cronbach's alpha of the project complexity construct was 0.632, which is slightly lower than the recommended level of 0.70. However, the lower level of reliability was still adequate for the purposes of this research (Nunnally, 1978).

4.3.2 Confirmatory Factor Analysis of Project Success

The initial measurement model for the endogenous latent variable project success had the following indicators: quality achievement, scope compliance, timeliness, and cost target achievement. The initial measurement model and its standardized estimates output (factor loadings) are depicted in Figure 16.

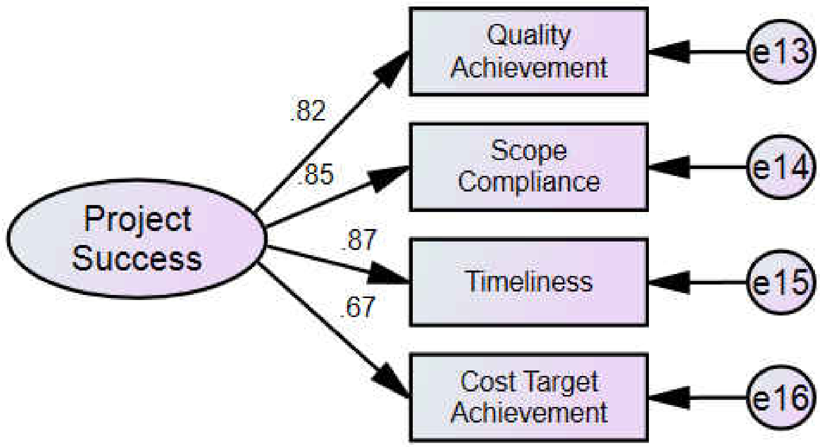

Figure 16: Initial project success measurement model

The initial model of project success was overidentified with a degree of freedom of 2, which is greater than zero (10 observations minus the 8 parameters to be estimated). The Chi-square value of 6.168 indicates a weak model fit, as it is greater than three times the degree of freedom (3df); it is significant, as the probability level is less than 0.05. Therefore, there was a significant difference between the revised and the saturated models.

The values of the goodness-of-fit indices GFI, CFI, and TLI are greater than 0.95, indicating a good model fit. However, the RMSEA value of 0.077 indicated only an acceptable degree of model fit, as it is lower than 0.08.

The indicators quality achievement, scope compliance, and timeliness have strong relationships with the latent variable project success, which can be seen in their relatively high factor loadings. The indicator cost target achievement has a moderate correlation with the latent variable (see Table 45).

Table 45: Parameter estimates for the project success measurement model

Indicator	Standardized parameter or factor loading	Unstandardized factor loading	Standard error (SE)	Critical value/ significance*
Timeliness	0.874	0.967	0.054	17.935*
Scope compliance	0.846	1.080	0.060	17.920*
Cost target achievement	0.670	0.791	0.061	13.036*
Quality achievement	0.815	1.000		

Note: * Statistical significance at the 0.05 or lower level.

All indicators are significant at the 0.05 significance level, as their critical values are greater than 1.96. Therefore, all indicators are maintained in the next revision of the measurement model.

Furthermore, the modification indices were evaluated in order to potentially improve the model's fit by freeing up parameters and decrease the Chi-square value of the revised model. Only one covariance with a modification index of 4.159 was identified, which suggested correlation between the error terms e15 and e16. A correlation between timeliness and cost target achievement is realistic, as a positive relationship between the two would be expected. A similar relationship was previously identified in the project complexity construct between project size (project budget) and project duration.

The improved project success measurement model was comprised of the same indicators as the initial measurement model. Based on the modification index of the previous model, the error terms e15 – e16 were correlated (see Figure 17)

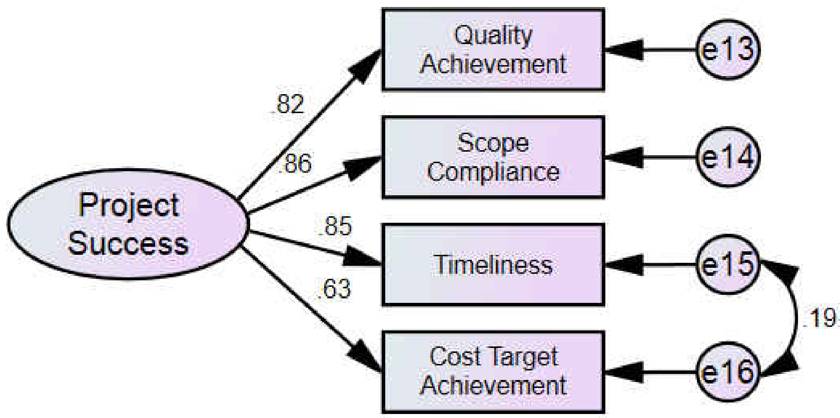

Figure 17: Revised project success measurement model

The revised model is overidentified with a degree of freedom of 1, which is still greater than zero (10 observations minus the 9 parameters to be estimated). The Chi-square value was lowered significantly to 0.011, which indicates a good model fit, as the $\chi 2$ / df ratio is lower than 2.0, and the probability level (=0.916) is higher than 0.05, indicating no statistical significance. Therefore, there were no significant differences between the revised and the saturated models.

Furthermore, the values of the goodness-of-fit indices GFI, CFI, and TLI are now equal to 1.0 or higher, which support a very good model fit. In addition, the RMSEA value was lowered to nearly zero, which means the model fits very well. Table 46 compares the goodness-of-fit indices of the initial and the revised project success measurement models.

Table 46: Goodness-of-fit indices for project success

Index	Fit Criteria Good Fit	 Acceptable Fit	Initial Model	Revised Model
χ^2	$0 \leq \chi^2 \leq 2df$	$2df < \chi^2 \leq 3df$	6.168	0.011
p value	$.05 < p \leq 1.00$	$.01 \leq p \leq .05$	0.046	0.916
χ^2 / df	$0 \leq \chi^2/df \leq 2$	$2 < \chi^2/df \leq 3$	3.084	0.011
RMSEA	0 ≤ RMSEA ≤ .05	.05 < RMSEA ≤ .08	0.077	0.000
GFI	.95 ≤ GFI ≤ 1.00	.90 ≤ GFI < .95	0.991	1.000
CFI	.95 ≤ CFI ≤ 1.00	.90 ≤ CFI < .95	0.994	1.000
TLI*	.95 ≤ TLI ≤ 1.00	.90 ≤ TLI < .95	0.983	1.008

Note: * The "nonnormed" index, on occasion, can be larger than 1 or slightly below 0

There were no significant changes in the factor loadings of the four indicators. The relationships of timeliness, scope compliance, and quality achievement remained robust, while the relationship of cost target achievement remained on the moderate side (see Table 47).

Table 47: Parameter estimates for project success revised measurement model

Indicator	Standardized parameter or factor loading	Unstandardized factor loading	Standard error (SE)	Critical value/ significance*
Timeliness	0.853	0.933	0.053	17.579*
Scope compliance	0.860	1.085	0.061	17.856*
Cost target achievement	0.635	0.741	0.062	11.940*
Quality achievement	0.825	1.000		

Note: * Statistical significance at the 0.05 or lower level.

All indicators are significant at the 0.05 significance level, as their critical values are greater than 1.96. Therefore, all indicators are maintained in the measurement model.

In summary, the revised model showed a substantial improvement in model fit. Its Chi-square statistic was significantly lower than two times the degree of freedom, indicating a very good model fit. In addition, the revised model had GFI, CFI, TLI, and RMSEA values in ranges that indicated a very well-fitting model. The Cronbach's alpha for the project success construct was 0.876, which is higher than the recommended level of 0.70, indicating that the measurement model is reliable.

4.4 Structural Equation Modeling

After validating the individual measurement models, a structural equation model was developed to test the research hypotheses. The full model consists of one exogenous latent variable (APM), one exogenous latent control variable (project complexity), one endogenous latent variable (project success), and five exogenous observed variables (industry sectors). The full hypothesized structural equation model of this research study is depicted in Figure 18. Support for the assumed relationships was obtained from the prior research presented in the literature review chapter.

The proposed structural equation model has 231 observation points and 50 unknown parameters, resulting in 181 degrees of freedom. Hence, as required, the model is overidentified. The Chi-square value of 752.899 indicates an unacceptable model fit, as the Chi-square ratio and degree of freedom (χ^2 / df) are greater than 3. Furthermore, it is significant as the probability level is less than 0.05. Therefore, there was a significant difference between the revised and saturated models.

The values of the goodness-of-fit indices GFI, CFI, and TLI are lower than 0.90, resulting in an unacceptable model fit. Furthermore, the RMSEA value of 0.095 supports this verdict, as it is greater than 0.08.

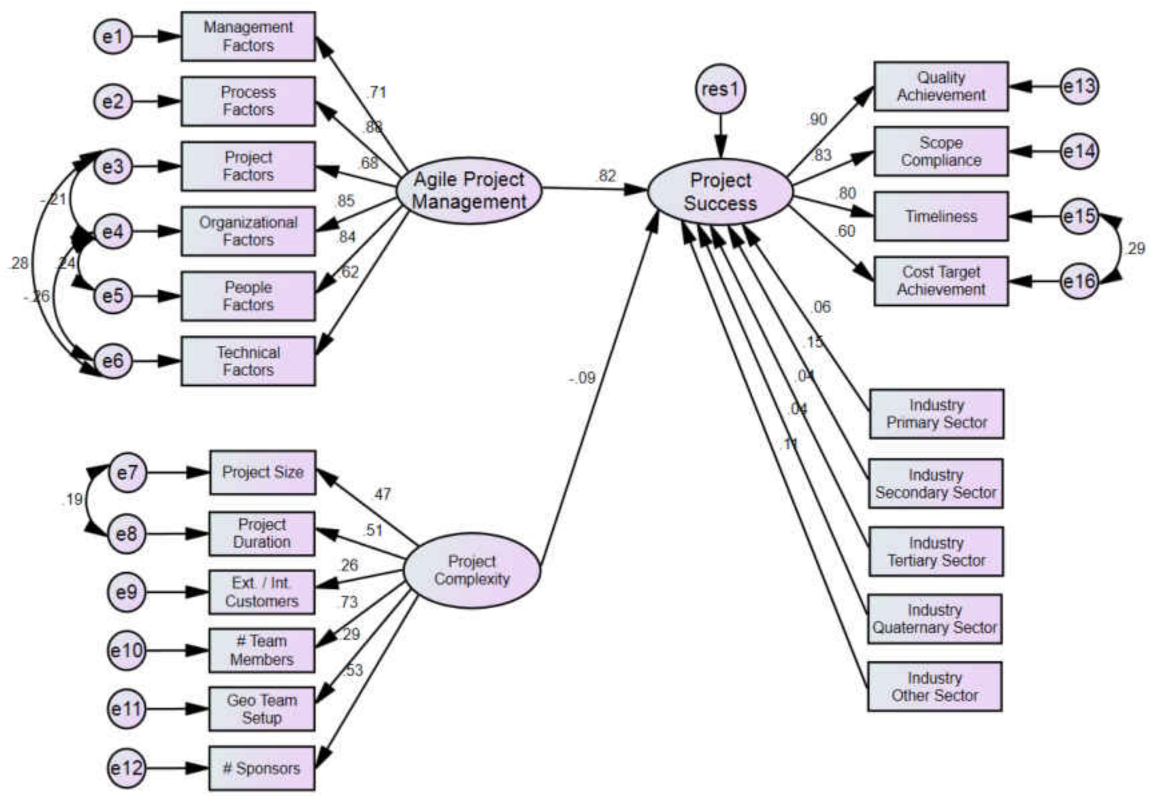

Figure 18: Initial hypothesized structural equation model

The path coefficients of the five industry sector variables are very low (less than 0.15), indicating a very weak relationship with the latent endogenous variable project success. In addition, three out of the five are not significant at the 0.05 significance level, as their critical values are lower than 1.96. Consequently, it was decided to remove the five industry sector variables in the next model revision, as their influence on project success was minimal and ultimately not significant to this research (see Table 48).

Table 48: Parameter estimates for initial structural model

	Standardized parameter or factor loading	Unstandardized factor loading	Standard error (SE)	Critical value/ significance*
Project success ← APM	0.825	0.938	0.072	13.011*
Project success ← Project complexity	-0.091	-0.150	0.076	-1.969*
Project success ← Industry primary sector	0.062	0.504	0.295	1.708
Project success ← Industry secondary sector	0.146	0.303	0.120	2.522*
Project success ← Industry tertiary sector	0.042	0.108	0.118	0.917
Project success ← Industry quaternary sector	0.044	0.085	0.123	0.687
Project success ← Industry other sector	0.115	0.314	0.147	2.145*
Project factors ← APM	0.679	0.727	0.061	12.017*
Organizational factors ← APM	0.852	1.159	0.078	14.837*
Management factors ← APM	0.710	1.000		
Process factors ← APM	0.883	0.996	0.063	15.875*
People factors ← APM	0.844	1.036	0.070	14.832*
Technical factors ← APM	0.622	0.674	0.062	10.926*
Project duration ← Project complexity	0.515	1.122	0.170	6.584*
Ext./int. customers ← Project complexity	0.258	0.370	0.103	3.599*
Project size ← Project complexity	0.474	1.000		
# team members ← Project complexity	0.727	1.073	0.171	6.278*
Geo team setup ← Project complexity	0.288	0.176	0.045	3.882*
# sponsors ← Project complexity	0.530	1.188	0.209	5.680*
Timeliness ← Project success	0.805	0.807	0.045	17.790*
Scope compliance ← Project success	0.825	0.956	0.052	18.330*
Cost target achievement ← Project success	0.602	0.642	0.054	11.827*
Quality achievement ← Project success	0.898	1.000		

Note: * Statistical significance at the 0.05 or lower level.

In addition, the modification indices were evaluated to potentially improve the model's fit by freeing up parameters and decreasing the Chi-square value of the revised model. Covariances with modification indices above 4.0 were reviewed and considered for correlation in the revised and improved model. The following correlations of error terms were made in the revised model: e14 – e15, e13 – e14, e2 – e1, e3 – e2, e6 – e1, and e14 – e16 (see Figure 19). Furthermore, an association was made between APM and project complexity, as suggested by the covariances. This correlation was verified and determined to be reasonable. There are APM factors, e.g., questions #31, 40, 41, 42, 47, 53, 55, and 57, that are associated with project complexity factors (see Appendix A).

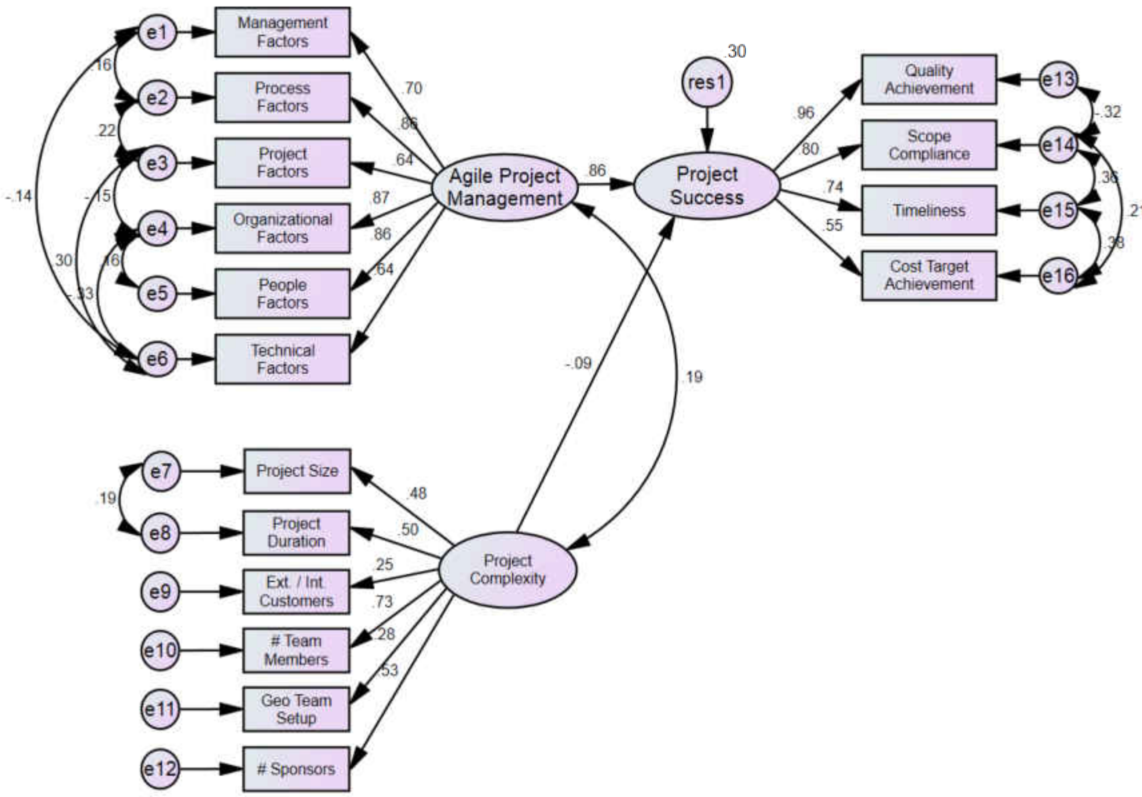

Figure 19: Revised hypothesized structural equation model

The revised model contains the independent latent variable APM, the independent latent control variable project complexity, and the dependent latent variable project success. The five industry sector variables were removed, as their path coefficients were very low and their impact on project success was consequently too weak. Beyond adding the aforementioned error term correlation, an association between APM and project complexity was also made.

The revised model is overidentified with a degree of freedom of 89, which is still greater than zero (136 observations minus 47 parameters to be estimated). The Chi-square value was lowered significantly to 153.443. The Chi-square to degree of freedom ratio ($\chi 2$ / df) was reduced below 2.0 when compared to the previous model, suggesting a good model fit. The p-value is close to zero, which means that it is lower than 0.05, indicating statistical significance. This suggests that there is still a significant difference between the revised and the saturated models. However, the literature notes that the Chi-square, as a non-parametric statistic, is very sensitive to sample size and therefore should not be relied upon for acceptance or rejection (Schermelleh-Engel et al., 2003; Vandenberg, 2006). For large sample sizes (usually, those greater than 200 are already considered large), the p-value will tend to be very small and deem the model difference to be significant. Therefore, it is recommended that the p-value be ignored when reporting the fit of the measurement model and that multiple fit indices, such as GFI, CFI, and RMSEA, be used to provide a more holistic view of goodness-of-fit.

Furthermore, the values of the goodness-of-fit indices CFI and TLI are above 0.95, indicating a good model fit. The GFI value is only slightly lower than 0.95, which supports an acceptable model fit. The RMSEA value was reduced to 0.045, which also indicates a good model fit. Table 49 compares the goodness-of-fit indices of the initial and the revised structural models. No significant changes in factors loadings were noted (± 0.05) between the initial and the revised model (see Appendix F). The factor loadings of APM and project success remained robust, and those associated with project complexity remained on the moderate to weaker side (see Table 50).

Table 49: Goodness-of-fit indices for initial and revised structural models

Index	Fit Criteria		Initial Model	Revised Model
	Good Fit	Acceptable Fit		
χ^2	$0 \leq \chi^2 \leq 2df$	$2df < \chi^2 \leq 3df$	752.899	153.443
p value	$.05 < p \leq 1.00$	$.01 \leq p \leq .05$	< 0.001	< 0.001
χ^2 / *df*	$0 \leq \chi^2/df \leq 2$	$2 < \chi^2/df \leq 3$	4.160	1.724
RMSEA	0 ≤ RMSEA ≤ .05	.05 < RMSEA ≤ .08	0.095	0.045
GFI	.95 ≤ GFI ≤ 1.00	.90 ≤ GFI < .95	0.877	0.948
CFI	.95 ≤ CFI ≤ 1.00	.90 ≤ CFI < .95	0.815	0.976
TLI*	.95 ≤ TLI ≤ 1.00	.90 ≤ TLI < .95	0.785	0.967

Note: * The “nonnormed” index, on occasion, can be larger than 1 or slightly below 0

Table 50: Parameter estimates for revised structural model

	Standardized parameter or factor loading	Unstandardized factor loading	Standard error (SE)	Critical value/ significance*
Project success ← APM	0.856	1.047	0.076	13.749*
Project success ← Project complexity	-0.088	-0.150	0.076	-1.972*
Project factors ← APM	0.638	0.696	0.064	10.915*
Organizational factors ← APM	0.869	1.204	0.084	14.364*
Management factors ← APM	0.696	1.000		
Process factors ← APM	0.856	0.984	0.062	15.986*
People factors ← APM	0.857	1.072	0.075	14.270*
Technical factors ← APM	0.637	0.704	0.068	10.409*
Project duration ← Project complexity	0.500	1.069	0.163	6.575*
Ext./int. customers ← Project complexity	0.254	0.357	0.100	3.589*
Project size ← Project complexity	0.484	1.000		
# team members ← Project complexity	0.732	1.058	0.166	6.372*
Geo team setup ← Project complexity	0.278	0.167	0.044	3.824*
# sponsors ← Project Complexity	0.534	1.174	0.202	5.810*
Timeliness ← Project success	0.735	0.693	0.044	15.613*
Scope compliance ← Project success	0.800	0.870	0.052	16.762*
Cost target achievement ← Project success	0.549	0.552	0.051	10.780*
Quality achievement ← Project success	0.957	1.000		

Note: * Statistical significance at the 0.05 or lower level.

All indicators are significant at the 0.05 significance level, as their critical values are greater than 1.96. Therefore, all indicators are maintained in the structural model. The path coefficient between APM and project success was high (0.86), indicating a strong positive relationship between the two latent variables. This indicates the importance of APM as a main predictor of improved project success. The path coefficient between project complexity and project success remained very low (-0.09), meaning that the relationship between the two is very weak. It is also negative, as an increase in project complexity would likely result in reduced project success. This relationship is comprehensible and reasonable, which was the deciding factor for keeping it in the revised model.

Together, APM and project complexity account for 91.1% of the variance in project success. The degree of explained variance (R^2) was determined by squaring the disturbance error associated with project success (0.299) and subtracting the value from 1 ($R^2 = 1\text{-}D^2 = 1\text{-}\ 0.299^2$).

In summary, the revised structural model showed a substantial improvement in model fit. Its Chi-square statistic was lower than two times the degree of freedom, indicating a good model fit. In addition, the revised model had GFI, CFI, TLI, and RMSEA values in ranges that indicated a very well-fitting model. The Cronbach's alpha for the revised structural model was 0.841, which is higher than the recommended level of 0.70, indicating a reliable model.

4.5 Hypothesis Testing

As the final step of structural equation modeling, the two hypotheses, H1 and H2, as depicted in Figure 11, were tested. The final revised model of APM, project complexity, and project success (see Figure 19) was used to test the following hypotheses:

- H1: Agile project management has a significant positive influence on project success; and
- H2: Project complexity has a significant negative impact on project success.

The first hypothesis (H1) was supported by the model, as APM was found to have a significant positive impact on project success. This is supported by the relatively high path coefficient and the low p-value ($\beta = 0.856$, $p < 0.001$). As was predicted, APM positively influences the likelihood of the overall success of a project.

The second hypothesis (H2) was also supported: Project complexity was found to have a significant negative direct effect on project success, indicated by its p-value of less than 0.05 ($\beta = -0.088$, $p = .049$). The low negative path coefficient expresses the weak negative association between the two variables of project complexity and project success. The negative relationship indicated that the higher the complexity of a project, the lower the likelihood of achieving project success.

CHAPTER FIVE: DISCUSSION AND CONCLUSION

The primary purpose of this study was to analyze the effects of APM on project success for non-IT projects. The complexity of both projects and industry sectors were taken into consideration when attempting to determine their potential influence on the results of a project. Therefore, a model for assessing current APM practices by validating the assumed relationships was developed. Furthermore, it was used to determine the importance of individual APM factors and the project success and project complexity dimensions. This research was also intended to assist in the evaluation of project managers and their relationship to APM. Finally, it attempted to answer the question concerning the extent to which APM techniques are employed in non-IT projects. This chapter discusses the results of this research and draws conclusions from them; in addition, it explains the contributions of this work, identifies its limitations, outlines its implications, and provides suggestions for future research.

5.1 Discussion

The survey instrument was used to collect descriptive data and data relevant to the modeled relationships by interviewing project managers located in the United States of America. The exact target group consisted of project managers located in the United States who met the following criteria: they had to hold at least one undergraduate degree, have a minimum of one year of work experience, a minimum of one year of project management experience, a minimum of one year of actively managing projects, be currently employed in an active project management role, and have no involvement in IT projects.

The influence of APM on project success was analyzed in the first hypothesis. The results thereof indicated that APM has significant positive effects on the success of projects: The more agile the management of a project, the greater the success of that project. This is consistent with the study results of Conforto et al. (2014) and Stare (2014), who found that the implementation of APM had favorable effects on project results.

The second hypothesis evaluated the impact of project complexity on the success of a project. It was determined that project complexity has a significant negative effect on project success, which means that the results of projects are negatively affected by increasing complexity. The association between project complexity and project success was very weak, as indicated by a low path coefficient. It is believed that this was caused by the project complexity model itself, indicating that there is room for further refinement and improvement in order to more accurately capture the true complexity of a project setup. However, the results are consistent with the findings of Baccarini (1996) and Mosaic-Project-Services (n.d.), who also confirmed that project complexity has a significant negative influence on project results.

The industry variable was initially part of the project complexity construct, but it was subsequently segregated and incorporated into the model as a set of independent variables with a potential association with project success. The following five industry sector variables were identified in the initial structural equation model: industry primary sector, industry secondary sector, industry tertiary sector, industry quaternary sector, and other industry sectors. After the first model run, it was determined that all of the path coefficients of all five industry sector variables were very low (less than 0.15), and three out of five z scores (at $p = .05$) were lower than 1.96, indicating that the parameters were not significant. Due to the very weak relationships to the latent endogenous variable of project success it was decided to remove the industry sector variables from this study. The literature is not conclusive about the role of these variables in this regard: Some researchers have found that industries have significant effects on project risk and consequently on the success of a project (Carvalho, Patah, & de Souza Bido, 2015; Raz, Shenhar, & Dvir, 2002; Zwikael & Ahn, 2011). Other studies, however, have concluded that the industry sector does not seem to be statistically significant (Carvalho & Rabechini Jr, 2015; Pennypacker & Grant, 2003). Consequently, further research needs to be conducted to determine the true impact of industry sectors on project success. The original ungrouped data of this study could be further analyzed for this purpose.

The number of critical success factors identified in the study conducted by Chow and Cao (2008) was relatively small compared to the number of research hypotheses (of 48, only 10 were supported). Factors such as an appropriate delivery strategy, a high-caliber team, an effective APM process, and intense customer involvement were identified as critical to certain success dimensions. Insufficient evidence was found concerning the impact of other factors, such as strong executive support and strong sponsor commitment, on project success. In this study, however, all six critical success factors (management, process, project, organizational, people, and technical factors) showed a significant association with APM, which in turn had a significant positive relation to project success. Process factors, organizational factors, and people factors had the strongest relations to APM and were therefore found to be most important. The other factors of management, project, and technical factors were also found to have very good relationships with APM. Since these variables used grouped data, additional data analysis could be conducted using the original ungrouped data in order to further define the critical success factors.

The factors of project size, project duration, ext. vs. int. customers, # team members, geo team setup, and # sponsors were all found to be significantly related to project complexity. The number of team members was found to be the most important factor of project complexity, with a path coefficient of 0.73. The other factors of project size, project duration, and number of sponsors were also found to have strong relationships with project complexity. External vs. internal customers and geographical team setup, however, had relatively weak associations with project complexity. Considering the lack of a proven set of project complexity factors in the literature, the presented results are superior to those that were originally expected. However, due to some of the weak associations and the weak relationship between project complexity and project success, additional studies are recommended in order to further establish the validity of a project complexity construct.

The project success dimensions of quality achievement, scope compliance, timeliness, and cost target achievement all had significant positive effects on project success. Quality achievement had by far the greatest impact ($\beta = 0.96$) on project results, followed by scope compliance ($\beta = 0.80$) and timeliness ($\beta = 0.74$). Chow and Cao (2008) found similar results and identified quality as being most important relative to the other dimensions. Cost target achievement was also found to be moderately associated with project success.

The descriptive data revealed that only 32% of the respondents were certified in project management. A similar observation was made by Müller and Turner (2007), who concluded in their study that, although a project management certification alone does not guarantee effective project management, excellent project results plus certification are a very strong indicator of a high-performing project manager. Of all of the certified project managers, only 15% were unaware of APM, whereas 67% of non-certified project managers were unfamiliar with APM (see Appendix D). This indicates that certified project managers are, in general, very familiar with APM; however, more than 50% of all project managers (certified and non-certified) are not aware of the concept. This study further revealed that 65% of the APM-knowledgeable certified project managers were either already using APM or were planning to do so in the future. Therefore, the acceptance of APM among this group of certified project managers was found to be relatively strong. Overall, approximately 14% of the respondents (both certified and non-certified project managers) reported that they were using APM techniques in their projects. This confirms the need for further education and certification in the project management domain in order to increase the usage of APM.

On average, the respondents had approximately eight years of project management experience. Of the certified project managers, more than 60% were below the eight-year PM experience average, while 32% were above this level. This provides an indication that the desire to acquire PM certifications is relatively high among the less experienced project managers when compared to their more experienced counterparts.

The results of question #7 (years of project management experience) and question #8 (years spent actively managing projects) were very similar. Their averages were very close to eight years, with 55% of project managers in the one- to five-year range and 25% of project managers in the six- to 10-year range. This confirms that the respondents not only have PM experience but also utilize their knowledge in project management when actively executing projects. This was also reflected in the responses to question #9 (current PM function). The majority of the respondents were working as project managers and senior project managers (~54%), followed by program managers (~18%), and assistant project managers (~13%).

Finally, of all project managers who were familiar with APM, 34% somewhat agreed, 22% agreed, and 9% strongly agreed that their project management approaches were indeed agile. In other words, this means that approximately one third of these project managers were in agreement and that one third partially agreed that their project management approach followed agile principles. This also indicates that APM is quite frequently utilized wherever a manager is aware of its theory and methodology. As has been stated by Mafakheri, Nasiri, and Mousavi (2008), following its genesis in software development (Qumer & Henderson-Sellers, 2008) and manufacturing (Sherehiy et al., 2007), APM and its guidelines have been widely adopted for a variety of projects over recent years.

5.2 Conclusion

Agile project management has begun to fill in the gaps created by the new business environment, leading to improved project outcomes. This approach provides sufficient flexibility to allow for an iterative planning process with constantly changing requirements and close customer involvement during the execution of a project. The increasing complexity of contemporary business projects is a challenge that teams must overcome to ensure the success of their projects. The original project success dimensions of time, cost, and quality have been extended by a scope dimension to collectively reflect stakeholder satisfaction. However, the project success factors that have been identified as influencing project success vary widely in the literature. They are consequently frequently clustered in six main categories that are applicable to most projects. These clusters, also referred to as the APM dimensions, are management, process, project, organizational, people, and technical factors. This set of categories reflects the focal points of today's business environment and is general enough to be applied to most project types.

This study utilized the SEM approach to develop a model that examines the relationships between APM, project complexity, and project success. Compared to the majority of previous APM studies, the proposed model was built to be independent of project type and specifically excludes IT related projects. The results indicate that APM practices have a significant positive impact on project success outcomes. This means that increasing the agility of project management leads to better project results. Another factor that impacts project outcome is the complexity of a project. Here, the relationship is significant but negative: An increase in project complexity makes it more difficult to achieve the desired project outcome. The results also indicated that the association between project complexity and project success is very weak, hinting that further refinement of the model may be necessary. However, the constructs APM and project complexity were found to explain 91.1% of the variance in project success. The concept of industry sectors could not be validated due to a lack of statistical significance. It is assumed that important detail was missed as a result of the grouping of associated data. It is therefore recommended that the industry data be modeled and analyzed in greater detail in future research.

Furthermore, all six proposed critical success factors proved to be important for APM. Process factors, organizational factors, and people factors had the strongest relationships to APM and were therefore found to be most important. Mature and flexible processes, knowledgeable and motivated employees, and an interactive organizational setup are key aspects of APM. The proposed project complexity factors were found to be significant, but they did not all have equally strong associations with project complexity. The most important factor was identified as being the number of team members: As more people become involved in a project, the greater the effort required to coordinate activities, communicate effectively, and maintain a motivated and committed project team. The four proposed project success dimensions were found to have a significant positive relation with project success. Quality achievement showed the highest association with project success, placing this quality aspect ahead of other factors. This indicates the importance of quality to stakeholders.

Finally, the results revealed that more than 50% of the project managers were unaware of APM, and only 32% of the respondents had a certification in project management. However, the majority of certified project managers were knowledgeable regarding the APM methodology. The acceptance of APM among the certified project managers proved to be high; therefore, this study revealed an apparent need for further education and certification in the field of project management, which are expected to further increase the usage of APM. It was also determined that, once the principles and methodology of APM are understood, project managers are likely to utilize APM practices more frequently.

5.3 Implications

The developed model offers a basis for predicting project success and therefore allows for potential improvements to be made to overall project outcomes in today's dynamic business environment. Furthermore, the model represents a valuable contribution to better understanding the potential impacts of the adoption of APM on the results of projects. Critical success factors and project success criteria were determined for general use, irrespective of project type. This research considered real-life complexity factors such as project size, number of team members, and geographical team setup. Furthermore, this study makes a significant contribution to the body of knowledge concerning APM by expanding the domain beyond the field of IT. Finally, the results of this research may prove useful to project managers and their organizations when expanding their knowledge of APM and attempting to determine the potential benefits it offers for their projects and organizations.

5.4 Research Limitations

While this study provides insight into the relationships between APM, project complexity, and project success, it is subject to a number of limitations. The presented model was based on a certain literature selection and personal experience, which is expected to come close to, but may not entirely reflect, the truth and reality. The data collection was done using a survey questionnaire, which was distributed to practicing project managers located in the United States. Although projects face many of the same issues worldwide, geographic location may represent a potential limitation. The study results reflect the participants voluntarily provided personal perceptions and opinions, which are subjective and do not necessarily reflect reality. Their perceptions of APM and project success may differ from their actual project management experiences. It was also assumed that the sample taken was representative of the overall population. Furthermore, the project managers, when answering the questionnaire, may have been biased in terms of what they thought were the "right" answers and therefore may have potentially not shared their real opinions. Finally, considering the large size of the APM community, the sample size was somewhat small; a larger sample size could allow for a more robust and accurate statistical analysis.

5.5 Future Research

The present study examined the effect of APM and project complexity on project success outcomes. It determined that a strong positive relationship exists between APM and project success. However, the association between project complexity and project success was found to be weak, which is a questionable finding, as previous research has confirmed the existence of an influence on project results caused by the level of difficulty of a project (Baccarini, 1996;

Shenhar et al., 2001; Williams, 1999). Further investigation is therefore required to strengthen the theory outlined in this work and to further refine the project complexity model.

Future research should continue to investigate the impact of industry sectors on project success. This study was not able to clearly identify the existence of a relationship between these variables, which was most likely caused by the data grouping. Therefore, the existing data could be reused without prior grouping to determine if more meaningful results could be achieved in this regard.

A similar investigation could be conducted for the APM construct. The critical success factors (management, process, project, organizational, people, and technical factors) had very good and even stronger relationships with APM; however, since these variables were grouped, additional data analysis could be conducted with the original ungrouped data to further define the APM model and its critical success factors.

Finally, the best-fitting model created should be further refined and validated by repeating this investigation with the inclusion of a confirmed project complexity model. Future research could undertake model validation by replicating the present study using multiple sample analysis, performing cross-validation, or bootstrapping the parameter estimates to determine the degree of bias. Other interesting insights could be attained in future studies by involving project managers located outside of the United States of America.

APPENDIX A: SURVEY INSTRUMENT

Confidential Research Questionnaire – Agile Project Management

This research is conducted as part of a doctoral study. Its main purpose is to investigate the relationship between Agile Project Management and project success outcomes perceived by project managers. You are invited to participate in this web survey consisting of 74 questions/statements related to different dimensions of project management and project success outcomes. All data and measurements obtained from this study are completely anonymous, only the researcher will have access to view and analyze the collected data. It is anticipated that the survey will take approximately 30 minutes to complete. Your participation is completely voluntary. You will incur no material benefit, penalty, or risk whether you agree or decline to participate. You must be 18 years of age or older to take part in this research study.

Your opinion is very important. Please be as frank and honest with your answers as possible.

If you have any questions, concerns, or complaints about this survey or if you wish to withdraw your participation after submission of the survey, please contact Thomas Bergmann (thombergmann@knights.ucf.edu).

Thank you very much for your time and support. By clicking on the "Next" button below, you are granting consent to the collection and reporting of the data provided in accordance with above conditions.

Research at the University of Central Florida involving human participants is carried out under the oversight of the Institutional Review Board (UCF IRB). This research has been reviewed and approved by the IRB. For information about the rights of people who take part in research, please contact: Institutional Review Board, University of Central Florida, Office of Research & Commercialization, 12201 Research Parkway, Suite 501, Orlando, FL 32826-3246 or by telephone at (407) 823-2901.

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About You

1. Where do you currently work in the United States?
- Alabama
- Alaska
- Arizona
- Arkansas
- ...
- Other

2. Please select your undergraduate degree(s). (Hold down Ctrl key to select multiple)
- *Insert list of "Structure of the U.S. Education System: Bachelor's Degrees" from International Affairs Office, U.S. Department of Education, Feb. 2008*
- Other
- None

3. Please select your graduate degree(s). (Hold down Ctrl key to select multiple)
- *Insert list of "Structure of the U.S. Education System: Master's Degrees" from International Affairs Office, U.S. Department of Education, Feb. 2008*
- Other
- None

4. Do you hold any of the listed project management related certification(s)? (Select all that apply)
- PMI Agile Certified Practitioner (PMI-ACP)
- Project Management Professional by PMI (PMP)
- Program Management Professional by PMI (PgMP)
- Portfolio Management Professional by PMI (PfMP)
- Certified Associate in Project Management by PMI (CAPM)
- PMI Professional in Business Analysis (PMI-PBA)
- PMI Risk Management Professional (PMI-RMP)
- PMI Scheduling Professional (PMI-SP)
- Certified Scrum Master (CSM)
- Master Project Manager (MPM)

- Certified Project Manager (CPM, IAPPM)
- CompTIA Project+
- PRINCE2 Practitioner
- Professional in Project Management (PPM)
- Certified Project Director (CPD)
- Other
- None

5. How familiar are you with Agile Project Management?

- I am an expert user of agile methodology.
- I recently learned about it and just started using agile methodology in my projects.
- I recently learned about it and plan to implement it in future projects.
- I know about it, but do not plan on using it.
- Our company just started implementing it.
- I do not know it.

6. How many years of work experience do you have?

- *Insert Drop-down to 51+ years*
- None

7. How many years of project management experience do you have?

- *Insert Drop-down to 51+ years*
- None

8. How many years have you actively managed projects in your career?

- *Insert Drop-down to 51+ years*
- None

9. Are you currently fulfilling any of the listed project manager functions?

- Assistant Project Manager
- Project Manager
- Senior Project Manager

- Program Manager
- Program / Project Director
- Head of Projects
- Other project manager role
- None

10. Are you working in or managing IT projects?

- Yes
- No

11. Approximately how much of your time is spent working on projects?

- Less than 25%
- 25% – less than 50%
- 50% – less than 75%
- 75%+

About Your Organization

12. Which sector(s) is your organization operating in? (Select all that apply)

- Business services
- Chemicals
- Consumer goods
- Education/Training
- Energy/Utilities
- Financial services/Banking
- Food products
- Government
- Hi-tech/Telecom
- Hospital/Health care/Insurance
- Manufacturing
- Mining or agriculture
- Nonprofit
- Pharma/Biotech/Medical devices
- Retail
- Other Sector

13. How many total employees are there in your company?

- 1 - 500
- 501 - 2,000
- 2,001 - 5,000
- 5001 - 15,000
- 15,001 - 25,000
- 25,001 - 50,000
- 50,001 - 100,000
- Over 100,000

About Projects in Your Organization

14. What is the average budget for a project at your organization?

- Less than $100,000.00
- $100,001 – less than $1M
- $1M – less than $10M
- $10M – less than $100M
- $100M – less than $1B
- $1B+

15. Are your projects dealing with external customers (outside your company) or internal customers (within your company)?

- External only
- Internal only
- Both, External and Internal

16. What is the typical duration of a project in your organization?

- Less than 1 month
- 1 month to less than 6 months
- 6 months to less than 12 months
- 1 year to less than 2 years
- 2 years to less than 5 years
- 5 years to less than 10 years
- 10 years+

17. What is the typical size of your project team?

- 1 (Yourself)
- 2 to 5
- 6 to 10
- 11 to 20
- 21 to 50
- 51+

18. Where are your project team members located at? (Select all that apply)

- North America (USA and Canada)
- Central and South America (Mexico and South of Mexico)
- Europe
- Asia
- Australia
- Africa
- Rest of the Globe

19. How many project sponsors (external customers or financiers for internal projects) do your projects typically have?

- None
- One
- Two
- Three
- Four
- Five
- Six +

20. I would describe our project management as being agile.

- Strongly disagree
- Disagree
- Somewhat disagree
- Neither agree or disagree
- Somewhat agree
- Agree
- Strongly disagree

Agile Project Management Factors

Statement	Strongly Disagree	Disagree	Somewhat disagree	Neither agree or disagree	Somewhat agree	Agree	Strongly Agree
Management Factors							
21. Our executive management strongly supports our projects.	1	2	3	4	5	6	7
22. Our managers lead with a light-touch and engage only if required.	1	2	3	4	5	6	7
23. Our managers have an adaptive leadership style.	1	2	3	4	5	6	7
Process Factors							
24. We are following an iterative process when executing our projects.	1	2	3	4	5	6	7
25. Change is considered inevitable in our organization.	1	2	3	4	5	6	7
26. There is no end and no start to changes, resulting in continuous improvement to the system.	1	2	3	4	5	6	7
27. Our processes are flexible enough to support frequent changes in project requirements.	1	2	3	4	5	6	7
28. We have a mature process in place to control scope changes.	1	2	3	4	5	6	7
29. Our projects follow value-based processes with high-level planning, design, and documentation.	1	2	3	4	5	6	7

Statement	Strongly Disagree	Disagree	Somewhat disagree	Neither agree or disagree	Somewhat agree	Agree	Strongly Agree
30. We are minimizing the efforts in the initial planning phase of the project execution.	1	2	3	4	5	6	7
31. We are conducting daily face-to-face meetings.	1	2	3	4	5	6	7
32. We assess risks continuously throughout the project and make adjustments to the plan as needed.	1	2	3	4	5	6	7
33. Our project goals are quantified.	1	2	3	4	5	6	7
34. Our project goals are widely communicated within our organization.	1	2	3	4	5	6	7
35. Our project outcomes are measured.	1	2	3	4	5	6	7
36. Our project outcomes are widely communicated within our organization.	1	2	3	4	5	6	7
37. Instead of process-centric we have a goal-driven, people-centric approach to project management.	1	2	3	4	5	6	7
38. We are able to resolve unexpected problems adequately.	1	2	3	4	5	6	7
Project Factors							
39. The scope of our projects varies with frequently changing customer requirements.	1	2	3	4	5	6	7
40. Our projects have dynamic schedules that can be adjusted quickly.	1	2	3	4	5	6	7

Statement	Strongly Disagree	Disagree	Somewhat disagree	Neither agree or disagree	Somewhat agree	Agree	Strongly Agree
41. We are constantly compressing the project schedule.	1	2	3	4	5	6	7
42. Our projects consist of small project teams.	1	2	3	4	5	6	7
43. Project activities are never the same between different projects in our organization.	1	2	3	4	5	6	7
Organizational Factors							
44. Cooperation is an important aspect of our organizational culture.	1	2	3	4	5	6	7
45. Our organizational environment is described by a project organization that fosters interactions among the team members with a minimum amount of disruptions, overlaps and conflicts.	1	2	3	4	5	6	7
46. Information flows freely between team members of our organization.	1	2	3	4	5	6	7
47. Our organization is focused on an effective communication.	1	2	3	4	5	6	7
48. Necessary knowledge is accessible to all team members.	1	2	3	4	5	6	7
People Factors							
49. All my team members have the required technical knowledge and expertise.	1	2	3	4	5	6	7

Statement	Strongly Disagree	Disagree	Somewhat disagree	Neither agree or disagree	Somewhat agree	Agree	Strongly Agree
50. I believe that our team members feel empowered to make decisions.	1	2	3	4	5	6	7
51. Our team members are highly motivated.	1	2	3	4	5	6	7
52. Our relationship with customers is based on commitment, knowledge, proximity, trust, and respect.	1	2	3	4	5	6	7
53. Our customers are deeply involved in the execution of the project.	1	2	3	4	5	6	7
54. Our customers are very responsive on questions or queries related to the project.	1	2	3	4	5	6	7
55. In my company our teams have the freedom to reorganize themselves.	1	2	3	4	5	6	7
56. Role interchangeability is encouraged in our company.	1	2	3	4	5	6	7
Technical Factors							
57. The design of our products/services is characterized by simplicity.	1	2	3	4	5	6	7
58. We are delivering most important design features of our products/services first.	1	2	3	4	5	6	7
59. The amount of documentation we use is high.	1	2	3	4	5	6	7
60. Some of the documentation we provide to our customers is unnecessary.	1	2	3	4	5	6	7

Project Success Dimensions

Statement	Strongly Disagree	Disagree	Somewhat disagree	Neither agree or disagree	Somewhat agree	Agree	Strongly Agree
Quality Dimension							
61. The projects I am involved in deliver the product and/or service in the required quality.	1	2	3	4	5	6	7
62. Quality is of high importance in our organization.	1	2	3	4	5	6	7
63. Our organization follows high quality standards.	1	2	3	4	5	6	7
64. Zero errors is one of our main goals.	1	2	3	4	5	6	7
65. Our company utilizes proven quality methods/procedures in the day-to-day business activities.	1	2	3	4	5	6	7
Scope Dimension							
66. Contractual requirements and objectives are always met for my projects.	1	2	3	4	5	6	7
67. I am delivering to my customers what I promised to deliver.	1	2	3	4	5	6	7
Time Dimension							
68. I am finishing my projects on or ahead of schedule.	1	2	3	4	5	6	7
69. Timeliness and meeting deadlines is important on my projects.	1	2	3	4	5	6	7

Statement	Strongly Disagree	Disagree	Somewhat disagree	Neither agree or disagree	Somewhat agree	Agree	Strongly Agree
70. It is essential to deliver project deliverables on time.	1	2	3	4	5	6	7
71. Detailed scheduling is an important part on my projects.	1	2	3	4	5	6	7
Cost Dimension							
72. My projects are completed at or under budget.	1	2	3	4	5	6	7
73. Costs are closely monitored.	1	2	3	4	5	6	7
74. Unplanned costs are scrutinized in detail to prevent future reoccurrence.	1	2	3	4	5	6	7

		Comments/Suggestions:

Thank you for your support!

APPENDIX B: IRB APPROVAL LETTER

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

Approval of Exempt Human Research

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

To: **Thomas Bergmann**

Date: **May 10, 2017**

Dear Researcher:

On 05/10/2017, the IRB approved the following activity as human participant research that is exempt from regulation:

Type of Review:	Exempt Determination
Project Title:	The Relationship between Agile Project Management and Project Success Outcomes
Investigator:	Thomas Bergmann
IRB Number:	SBE-17-13043
Funding Agency:	
Grant Title:	
Research ID:	N/A

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

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

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

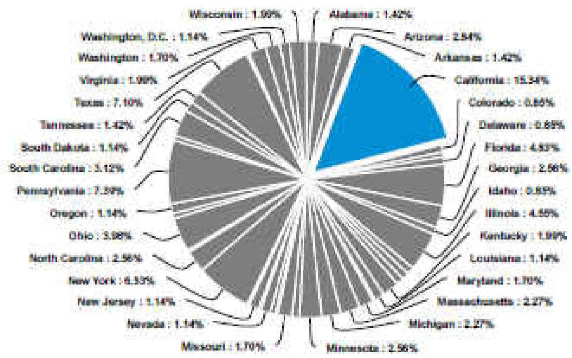
Renea Carver

Signature applied by Renea C Carver on 05/10/2017 09:08:01 AM EDT

IRB Coordinator

APPENDIX C: EXTRACTS OF SURVEY REPORT

1. Where do you currently work in the United States?

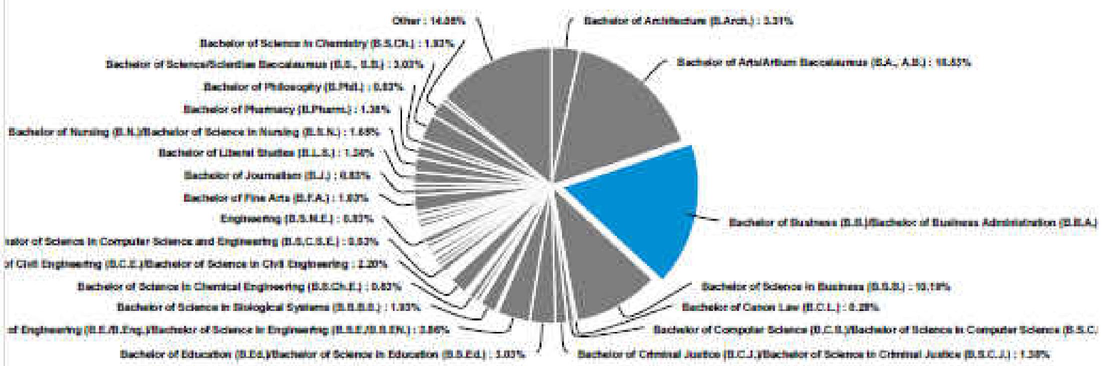


Answer	Count	Percent	20% 40% 60% 80% 100%
Alabama	5	1.42%	
Alaska	0	0%	
Arizona	10	2.84%	
Arkansas	5	1.42%	
California	54	15.34%	
Colorado	3	0.85%	
Connecticut	2	0.57%	
Delaware	3	0.85%	
Florida	17	4.83%	
Georgia	9	2.56%	
Hawaii	0	0%	
Idaho	3	0.85%	
Illinois	16	4.55%	
Indiana	3	0.85%	
Iowa	3	0.85%	
Kansas	3	0.85%	
Kentucky	7	1.99%	
Louisiana	4	1.14%	
Maine	1	0.28%	
Maryland	6	1.7%	
Massachusetts	8	2.27%	
Michigan	8	2.27%	
Minnesota	9	2.56%	
Mississippi	3	0.85%	
Missouri	6	1.7%	
Montana	1	0.28%	
Nebraska	2	0.57%	
Nevada	4	1.14%	
New Hampshire	1	0.28%	
New Jersey	4	1.14%	

New Mexico	1	0.28%	
New York	23	6.53%	
North Carolina	9	2.56%	
North Dakota	1	0.28%	
Ohio	14	3.98%	
Oklahoma	2	0.57%	
Oregon	4	1.14%	
Pennsylvania	26	7.39%	
Rhode Island	2	0.57%	
South Carolina	11	3.12%	
South Dakota	4	1.14%	
Tennessee	5	1.42%	
Texas	25	7.1%	
Utah	1	0.28%	
Vermont	0	0%	
Virginia	7	1.99%	
Washington	6	1.7%	
Washington, D.C.	4	1.14%	
West Virginia	0	0%	
Wisconsin	7	1.99%	
Wyoming	0	0%	
Other	0	0%	
Total	352	100 %	

1. Where do you currently work in the United States? - Text Data for Other

2. Please select your undergraduate degree(s). (Hold down Ctrl key to select multiple)



Answer	Count	Percent	20% 40% 60% 80% 100%
Bachelor of Architecture (B.Arch.)	12	3.41%	
Bachelor of Arts/Artium Baccalaureus (B.A., A.B.)	58	16.53%	
Bachelor of Business (B.B.)/Bachelor of Business Administration (B.B.A.)	62	17.61%	
Bachelor of Science in Business (B.S.B.)	37	10.51%	
Bachelor of Canon Law (B.C.L.)	1	0.28%	
Bachelor of Computer Science (B.C.S.)/Bachelor of Science in Computer Science (B.S.C.S.)	3	0.85%	
Bachelor of Criminal Justice (B.C.J.)/Bachelor of Science in Criminal Justice (B.S.C.J.)	5	1.42%	
Bachelor of Divinity (B.D.)	0	0%	
Bachelor of Education (B.Ed.)/Bachelor of Science in Education (B.S.Ed.)	11	3.12%	

Bachelor of Wireless Engineering (B.W.E.)	0	0%
Bachelor of Engineering (B.E./B.Eng.)/Bachelor of Science in Engineering (B.S.E./B.S.EN.)	14	3.89%
Bachelor of Science in Aerospace Engineering (B.S.A.E.)	0	0%
Bachelor of Science in Agricultural Engineering (B.S.A.E.)	1	0.28%
Bachelor of Science in Biological Systems (B.S.B.S.)	7	1.94%
Bachelor of Science in Biosystems and Agricultural Engineering (B.S.B.A.E.)	1	0.28%
Bachelor of Science in Biological Engineering (B.S.B.E.)	0	0%
Bachelor of Biomedical Engineering (B.B.m.E.)/Bachelor of Science in Biomedical	2	0.56%
Engineering (B.S.B.E./B.S.B.M.E.)	0	0%
Bachelor of Science in Chemical Engineering (B.S.Ch.E.)	3	0.83%
Bachelor of Science in Chemical and Biomolecular Engineering (B.S.Ch.B.E.)	1	0.28%
Bachelor of Science in Chemical and Materials Engineering (B.S.C.M.E.)	1	0.28%
Bachelor of Civil Engineering (B.C.E.)/Bachelor of Science in Civil Engineering	8	2.2%
(B.S.C.E.)	1	0.28%
Bachelor of Science in Civil and Infrastructure Engineering (B.S.-C.I.E.)	1	0.28%
Bachelor of Computer Engineering (B.Comp.E.)/Bachelor of Science in Computer	1	0.28%
Engineering (B.S.C.E./B.S.Co.E/B.S.Cp.E./B.S.Cmp.E./B.S.C.P.)	1	0.28%
Bachelor of Science in Computer Science and Engineering (B.S.C.S.E.)	3	0.83%
Bachelor of Science in Electrical and Computer Engineering (B.S.E.C.E.)	0	0%
Bachelor of Electrical Engineering (B.E.E.)/Bachelor of Science in Electrical	0	0%
Engineering (B.S.E.E.)	2	0.56%
Bachelor of Science in Engineering Management (B.S.E.Mgt.)	2	0.56%
Bachelor of Science in Environmental Engineering (B.S.En.E./B.S.Env.E.)	1	0.28%
Bachelor of Fiber Engineering (B.F.E.)	0	0%
Bachelor of Science in Industrial Engineering (B.S.I.E.)	2	0.56%
Bachelor of Science in Manufacturing Engineering (B.S.Mfg.E.)	1	0.28%
Bachelor of Science in Manufacturing Systems Engineering (B.S.M.S.E.)	1	0.28%
Bachelor of Science in Materials Science and Engineering (B.S.M.S.E.)	0	0%
Bachelor of Science in Materials Engineering (B.S.MA.E.)	0	0%
Bachelor of Mechanical Engineering (B.M.E.)/Bachelor of Science in Mechanical	2	0.56%
Engineering (B.S.M.E.)	3	0.83%
Bachelor of Science in Metallurgical Engineering (B.S.Mt.E.)	1	0.28%
Bachelor of Science in Mining Engineering (B.S.M.E.)	0	0%
Bachelor of Science in Systems (B.S.-SYST.)	0	0%
Bachelor of Software Engineering (B.S.W.E.)/Bachelor of Science in Software	0	0%
Engineering (B.S.S.E.)	0	0%
Bachelor of Systems Engineering (B.S.E.)/Bachelor of Science in Systems	1	0.28%
Engineering (B.S.S.E.)	1	0.28%
Bachelor of Engineering Technology (B.E.T.)/Bachelor of Science in Engineering Technology	1	0.28%
(B.S.E.T.)	0	0%
Bachelor of Science in Civil Engineering Technology	0	0%

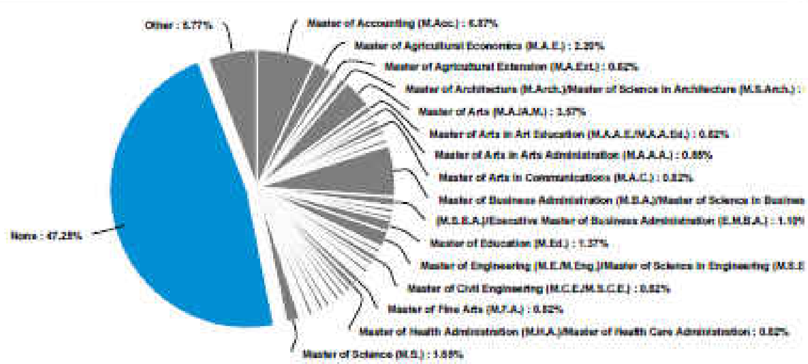
(B.S.C.E.T./B.S.Ch.E.T.)		
Bachelor of Science in Computer Engineering Technology (B.S.C.E.T.)	0	0%
Bachelor of Science in Construction Engineering Technology (B.S.Con.E.T.)	2	0.55%
Bachelor of Science in Drafting Design Technology (B.S.D.D.T.)	2	0.55%
Bachelor of Science in Electrical/Electronics Technology (B.S.E.T.)	1	0.28%
Bachelor of Science in Electrical Engineering Technology (B.S.E.E.T.)	2	0.55%
Bachelor of Science in Electro-Mechanical Engineering Technology (B.S.E.M.E.T.)	0	0%
Bachelor of Science in Mechanical Engineering Technology (B.S.M.E.T.)	0	0%
Bachelor of Fine Arts (B.F.A.)	7	1.93%
Bachelor of Forestry (B.F.)	0	0%
Bachelor of Science in Forest Research (B.S.For.Res.)	0	0%
Bachelor of Hebrew Letters (B.H.L.)	0	0%
Bachelor of Journalism (B.J.)	3	0.83%
Bachelor of Laws (LL.B.)	2	0.55%
Bachelor of Liberal Studies (B.L.S.)	5	1.38%
Bachelor of Literature (B.Lit.)	0	0%
Bachelor of Marine Science (B.M.S.)	0	0%
Bachelor of Music (B.M.)	0	0%
Bachelor of Nursing (B.N.)/Bachelor of Science in Nursing (B.S.N.)	6	1.65%
Bachelor of Pharmacy (B.Pharm.)	5	1.38%
Bachelor of Philosophy (B.Phil.)	3	0.83%
Bachelor of Religious Education (B.R.E.)	0	0%
Bachelor of Science/Scientiae Baccalaureus (B.S., S.B.)	11	3.03%
Bachelor of Science in Chemistry (B.S.Ch.)	7	1.93%
Bachelor of Technology (B.T./B.Tech.)	2	0.55%
None	0	0%
Other	51	14.05%
Total	363	100 %

2. Please select your undergraduate degree(s). (Hold down Ctrl key to select multiple) - Text Data for Other

10/09/2017	28188974	associates degree
10/09/2017	28188779	BA psychology
10/03/2017	28138817	associates
09/26/2017	27715666	Associates degree
09/26/2017	27714309	hospitality
09/26/2017	27705483	Associated
09/26/2017	27704780	associate degree
09/26/2017	27700901	Communication
09/26/2017	27700377	BS culinary arts
09/26/2017	27699078	Bachelor of Science in Psychology
09/18/2017	27361595	1
09/18/2017	27360948	BS Legal Studies
09/14/2017	27277091	Bachelors in Science Management
09/14/2017	27270245	Lic /
09/14/2017	27265078	Bachelor of Science in Management Studies
09/13/2017	27242597	hs diploma
09/13/2017	27241300	Business Managment
09/13/2017	27240078	BS Environmental Sciences

09/13/2017	27235942	Drug and alcohol counseling
09/13/2017	27235461	Psychology
09/13/2017	27233094	mechanical engineer
09/13/2017	27232401	EDU
09/13/2017	27232031	associates degrees
09/13/2017	27229978	Robotic
09/13/2017	27229761	B.S. HDFS
09/13/2017	27229048	BSW
09/13/2017	27227106	Traffic Management
09/11/2017	27110901	B.S. Biology
09/11/2017	27110243	Environmental health
09/11/2017	27109430	Health science
09/11/2017	27108494	Master Degree
09/11/2017	27107437	Tech degree
09/11/2017	27106038	Bachelor of Arts, Political Science
09/11/2017	27104703	BS Sociology
09/11/2017	27102538	associates
09/11/2017	27101710	Bachelors of science in psychology
09/11/2017	27101708	going to school
09/11/2017	27099074	Bachelor hospitality
09/11/2017	27098298	BSW
09/11/2017	27098079	Psychology
09/11/2017	27098014	AA
09/11/2017	27097928	AAS
09/11/2017	27097637	Bachelor of Science in Psychology
09/11/2017	27097459	Bachelor of Science in Education
09/11/2017	27097438	psychology
09/11/2017	27097382	Bat med
09/11/2017	27097322	Aas
09/07/2017	26998065	Associates of Science Architectural Engineering
09/07/2017	26995320	Associates of Applied Science
09/07/2017	26994758	High School Diploma
08/23/2017	26297657	PhD

3. Please select your graduate degree(s). (Hold down Ctrl key to select multiple)



Answer	Count	Percent	20% 40% 60% 80% 100%
Master of Accounting (M.Acc.)	25	6.87%	
Master of Agricultural Economics (M.A.E.)	8	2.2%	

Master of Agricultural Extension (M.A.Ext.)	3	0.82%
Master of Agriculture (M.Ag./M.Agr.)	1	0.27%
Master of Applied Anthropology (M.A.A.)	1	0.27%
Master of Architecture (M.Arch.)/Master of Science in Architecture (M.S.Arch.)	3	0.82%
Master of Arts (M.A./A.M.)	13	3.57%
Master of Arts in Art Education (M.A.A.E./M.A.A.Ed.)	3	0.82%
Master of Arts in Art Therapy (M.A.A.T.)	1	0.27%
Master of Arts in Arts Administration (M.A.A.A.)	2	0.55%
Master of Arts in Behavioral Science (M.A.B.S.)	1	0.27%
Master of Arts in College Teaching (M.A.C.T.)	2	0.55%
Master of Arts in Communications (M.A.C.)	3	0.82%
Master of Arts in Community Psychology (M.A.C.P.)	0	0%
Master of Arts in Computer Education (M.A.C.E.)	2	0.55%
Master of Arts/Science in Counseling (M.A.C./M.S.C.)	1	0.27%
Master of Arts/Science in Counseling Psychology (M.A.C.P./M.S.C.P.)	0	0%
Master of Arts in Cross-Cultural Studies (M.A.C.C.S.)	0	0%
Master of Arts/Science in Education (M.A.Ed./M.S.Ed.)	1	0.27%
Master of Arts in Family Counseling (M.A.F.C.)	0	0%
Master of Arts in the Humanities (M.A.H.)	2	0.55%
Master of Arts/Science in Teaching (M.A.T./M.S.T.)	1	0.27%
Master of Bioinformatics (M.B.)	0	0%
Master of Business Administration (M.B.A.)/Master of Science in Business Administration	22	6.04%
(M.S.B.A.)/Executive Master of Business Administration (E.M.B.A.)	4	1.1%
Master of City Planning (M.C.P.)/Master of City and Regional Planning	0	0%
(M.C.R.P./M.R.C.P.)/Master of Regional Planning (M.R.P.)	1	0.27%
Master of Clinical Medical Science (M.C.M.S.)	0	0%
Master of Community Health (M.C.H.)	2	0.55%
Master of Computer Science (M.C.S.)	1	0.27%
Master of Criminal Justice (M.C.J.)/Master of Arts/Science in Criminal Justice	2	0.55%
(M.A.C.J./M.S.C.J.)	0	0%
Master of Design (M.Des.)	0	0%
Master of Divinity (M.Div.)	0	0%
Master of Education (M.Ed.)	5	1.37%
Master of Engineering (M.E./M.Eng.)/Master of Science in Engineering (M.S.E.)	7	1.92%
Master of Science in Aeronautics and Astronautics (M.S.A.A.)	0	0%
Master of Aerospace Engineering (M.A.E./M.S.A.E.)	1	0.27%
Master of Architectural Engineering (M.A.E./M.S.A.E.)	2	0.55%
Master of Science in Artificial Intelligence (M.S.A.I.)	0	0%
Master of Science in Biomedical Engineering (M.S.B.E.)	0	0%
Master of Science in Ceramic Engineering (M.S.Cer.E.)	0	0%
Master of Chemical Engineering (M.C.E./M.S.Ch.E.)	1	0.27%
Master of Civil Engineering (M.C.E./M.S.C.E.)	3	0.82%
Master of Computer Engineering (M.C.E./M.S.C.E.)	0	0%
Master of Electrical and Computer Engineering (M.E.C.E.)	2	0.55%
Master of Electrical Engineering (M.E.E./M.S.E.E.)	0	0%
Master of Engineering Management (M.E.M./M.S.E.Mgt.)	1	0.27%
Master of Engineering Science (M.E.S.)	0	0%

Master of Science in Environmental Engineering (M.S.Env.E.)	1	0.27%
Master of Geological Engineering (M.G.E.)	0	0%
Master of Industrial Engineering (M.I.E./M.S.I.E.)	2	0.55%
Master of Manufacturing Engineering (M.M.E.)	1	0.27%
Master of Materials Science (M.M.S.)/Master of Materials Science and Engineering	0	0%
(M.M.S.E.)/(M.S.Mat.S.E.)	0	0%
Master of Mechanical Engineering (M.M.E./M.S.M.E.)	0	0%
Master of Science in Metallurgical Engineering (M.S.Met.E.)	1	0.27%
Master of Science in Nuclear Engineering (M.S.N.E.)	0	0%
Master of Science in Petroleum Engineering (M.S.Pet.E./M.S.P.N.G.E.)	0	0%
Master of Engineering Technology (M.E.T./M.S.E.T.)	1	0.27%
Master of Environmental Design (M.E.D.)/Master of Environmental Design Studies	0	0%
(M.E.D.S.)	0	0%
Master of Environmental Planning (M.E.P.)	0	0%
Master of Environmental Science/Studies (M.E.S.)	0	0%
Master of Family Therapy (M.F.T.)/Master of Marriage and Family Therapy (M.M.F.T.)	0	0%
Master of Fine Arts (M.F.A.)	3	0.82%
Master of Forestry (M.F.)/Master of Science in Forestry (M.S.F.)	0	0%
Master of Forest Engineering (M.F.E.)	0	0%
Master of Forest Resources (M.F.R.)	0	0%
Master of Health Administration (M.H.A.)/Master of Health Care Administration	3	0.82%
(M.H.C.A.)/Master of Health Care Management (M.H.C.M.)/Master of Health	2	0.55%
Services Administration (M.H.S.A.)/Master of Science in Health Administration	1	0.27%
(M.S.H.A.)/Health Care Administration (M.S.H.C.A.)	0	0%
Master of Hebrew Letters (M.H.L.)	0	0%
Master of Heritage/Historical Preservation (M.H.P.)	0	0%
Master of Home Economics (M.H.E.)	0	0%
Master of Hospitality Management (M.H.M.)	2	0.55%
Master of Human Resources (M.H.R.)/Master of Human Resource Development (M.H.R.D.)/	0	0%
Master of Science in Human Resources (M.S.H.R.)	1	0.27%
Master of Individualized/Interdisciplinary Studies (M.I.S.)	0	0%
Master of Information Resources Management (M.I.R.M.)	0	0%
Master of Information Technology (M.I.T.)	0	0%
Master of International Affairs (M.I.A.)	0	0%
Master of International Business/Business Administration (M.I.B./M.I.B.A.)	2	0.55%
Master of Industrial Design (M.I.D.)	1	0.27%
Master of Journalism (M.J.)/Master of Arts/Science in Journalism (M.A.J./M.S.J.)	1	0.27%
Master of Justice Administration (M.J.A.)	0	0%
Master of Landscape Architecture (M.L.Arch./M.L.A.)	0	0%
Master of Laws (LL.M.)	1	0.27%
Master of Comparative Law (M.C.L./LL.C.M.)	0	0%
Master of Liberal Studies (M.L.S.)/Master of Arts in Liberal Studies (M.A.L.S.)	0	0%
Master of Library Science (M.L.S.)/Master of Science in Library Science (M.S.L.S.)/Master	0	0%
of Library and Information Science (M.L.I.S.)	0	0%

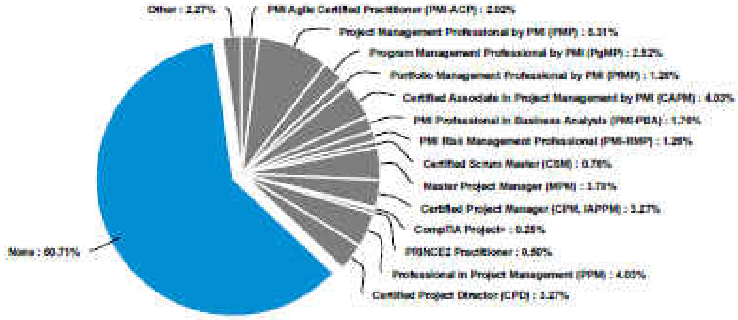
Master of Law Librarianship (M.L.L.)	0	0%
Master of Management (M.M.)	2	0.55%
Master of Manufacturing Management (M.M.M.)	1	0.27%
Master of Marine Affairs (M.M.A.)	0	0%
Master of Mass Communications (M.M.C.)	0	0%
Master of Music (M.M./M.Mus.)	0	0%
Master of Music Education (M.M.Ed.)	0	0%
Master of Music Therapy (M.M.T.)	0	0%
Master of Nursing (M.N.)/Master of Science in Nursing (M.S.N.)	2	0.55%
Master of Nursing Administration (M.N.A./M.S.N.A.)	0	0%
Master of Occupational Therapy (M.O.T./M.S.O.T.)	1	0.27%
Master of Pharmacy (M.Pharm.)	0	0%
Master of Philosophy (M.Phil.)	1	0.27%
Master of Physical Education (M.P.E./M.P.Ed.)	0	0%
Master of Physical Therapy (M.P.T.)/Master of Arts/Science in Physical Therapy	0	0%
(M.A.P.T./M.S.P.T.)	0	0%
Master of Planning (M.P.)	0	0%
Master of Professional Accounting (M.P.A./M.Prof.Acc.)	1	0.27%
Master of Public Administration (M.P.A.)/Master of Science in Public Administration	2	0.55%
(M.S.P.A.)	0	0%
Master of Public Health (M.P.H.)/Master of Science in Public Health (M.S.P.H.)	1	0.27%
Master of Public Health Education (M.P.H.E.)	1	0.27%
Master of Public and International Affairs (M.P.I.A.)	0	0%
Master of Public Management (M.P.M.)	1	0.27%
Master of Public Policy (M.P.P.)	0	0%
Master of Recreation Administration (M.R.A.)	0	0%
Master of Rehabilitation Counseling (M.R.C.)	1	0.27%
Master of Real Estate Development (M.R.E.D./M.S.R.E.D.)	0	0%
Master of Recreation and Parks Administration (M.R.P.A.)	0	0%
Master of Rehabilitation Medicine (M.R.M.)	0	0%
Master of Religious Education (M.R.E./M.Rel.Ed.)	0	0%
Master of Sacred Music (M.S.M.)/Master of Liturgical Music (M.Lit.M.)	0	0%
Master of Sacred Theology (S.T.M.)	0	0%
Master of Science (M.S.)	8	1.86%
Master of Science in Dentistry (M.S.D./M.Sc.D.)	0	0%
Master of Science in Economics (M.S.E.)	0	0%
Master of Science in Exercise and Sport Studies (M.S.E.S.S.)	0	0%
Master of Science in Finance (M.S.F.)	0	0%
Master of Science in Forensic Science (M.S.F.S.)	0	0%
Master of Science in Genetic Counseling (M.S.G.C.)	0	0%
Master of Science in Gerontology (M.S.G.)	0	0%
Master of Science in Information Science/Systems (M.S.I.S.)	0	0%
Master of Science in Management (M.S.M./M.S.Mgt.)	0	0%
Master of Science in Mass Communications (M.S.M.C.)	0	0%
Master of Science in Medical Illustration (M.S.M.I.)	0	0%
Master of Science in Medical Technology (M.S.M.T.)	0	0%
Master of Science in Natural Science (M.S.N.S.)	0	0%
Master of Science in Nurse Anesthesia (M.S.N.A.)	0	0%

Master of Science in Orthodontics (M.S.O.)	0	0%	
Master of Science in Pharmaceutical Sciences (M.S.P.S.)	0	0%	
Master of Social Work (M.S.W.)	0	0%	
Master of Taxation (M.T.)	0	0%	
Master of Technology (M.Tech.)	0	0%	
Master of Science in Textiles (M.S.Text.)	0	0%	
Master of Theology (Th.M.)	0	0%	
Master of Tourism Management (M.T.M./M.T.H.M.)	0	0%	
Master of Urban Planning (M.U.P.)/Master of Urban and Regional Planning	0	0%	
(M.U.R.P.)/Master of Urban Design (M.U.D)/Master of Urban Planning and Policy	0	0%	
(M.U.P.P.)	0	0%	
Master of Urban Studies (M.U.S.)	0	0%	
Master of Veterinary Science (M.Vet.Sc./M.V.S.)	1	0.27%	
Master of Women's Studies (M.W.S.)	0	0%	
None	172	47.25%	
Other	21	5.77%	
Total	364	100 %	

3. Please select your graduate degree(s). (Hold down Ctrl key to select multiple) - Text Data for Other

10/06/2017	28199817	yours
09/26/2017	27705403	Associates
09/18/2017	27363186	1
09/18/2017	27360948	Juris Doctorate
09/14/2017	27277091	Associates of Science Accounting
09/14/2017	27269980	0
09/13/2017	27227298	Conflict Resolution
09/13/2017	27227108	Traffic Management
09/11/2017	27110219	engineer
09/11/2017	27106299	PharmD
09/11/2017	27102535	associate
09/11/2017	27100066	Juris Doctorate
09/11/2017	27099534	other
09/11/2017	27097435	psychology
09/07/2017	25995191	master of science in biotech
09/07/2017	25996765	sports managment
09/07/2017	25994756	High school diploma
08/23/2017	26297697	PhD
08/23/2017	26297635	none
08/23/2017	26297620	none
08/23/2017	26297505	Ph.D.

4. Do you hold any of the listed project management related certification(s)? (Select all that apply)

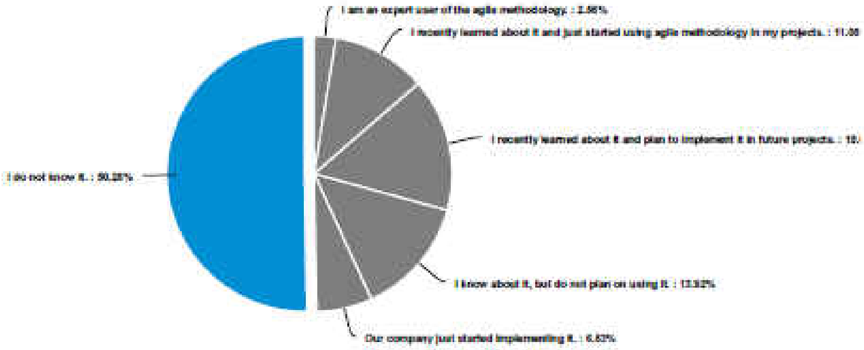


Answer	Count	Percent	20% 40% 60% 80% 100%
PMI Agile Certified Practitioner (PMI-ACP)	8	2.02%	
Project Management Professional by PMI (PMP)	33	8.31%	
Program Management Professional by PMI (PgMP)	10	2.52%	
Portfolio Management Professional by PMI (PfMP)	5	1.26%	
Certified Associate in Project Management by PMI (CAPM)	16	4.03%	
PMI Professional in Business Analysis (PMI-PBA)	7	1.76%	
PMI Risk Management Professional (PMI-RMP)	5	1.26%	
PMI Scheduling Professional (PMI-SP)	0	0%	
Certified Scrum Master (CSM)	3	0.76%	
Master Project Manager (MPM)	15	3.78%	
Certified Project Manager (CPM, IAPPM)	13	3.27%	
CompTIA Project+	1	0.25%	
PRINCE2 Practitioner	2	0.5%	
Professional in Project Management (PPM)	16	4.03%	
Certified Project Director (CPD)	13	3.27%	
None	241	60.71%	
Other	9	2.27%	
Total	397	100 %	

4. Do you hold any of the listed project management related certification(s)? (Select all that apply) - Text Data for Other

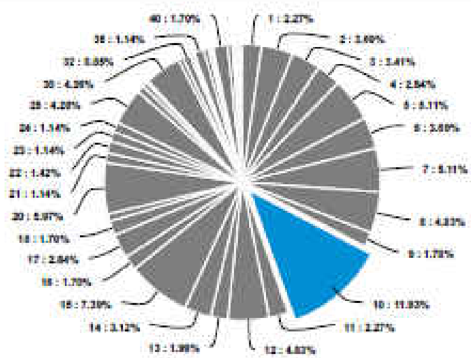
10/09/2017	28188817	none
09/13/2017	27244330	PM certificate
09/13/2017	27244728	LPS system administrator.
09/13/2017	27241389	PCI
09/13/2017	27232031	Certified purchasing manager
09/11/2017	27111240	Business management
09/11/2017	27103470	certified hotel general manager
09/11/2017	27101708	Asm
09/11/2017	27098308	fire inspection

5. How familiar are you with Agile Project Management?



Answer	Count	Percent
I am an expert user of the agile methodology.	9	2.56%
I recently learned about it and just started using agile methodology in my projects.	39	11.08%
I recently learned about it and plan to implement it in future projects.	55	15.62%
I know about it, but do not plan on using it.	49	13.92%
Our company just started implementing it.	23	6.53%
I do not know it.	177	50.28%
Total	352	100 %

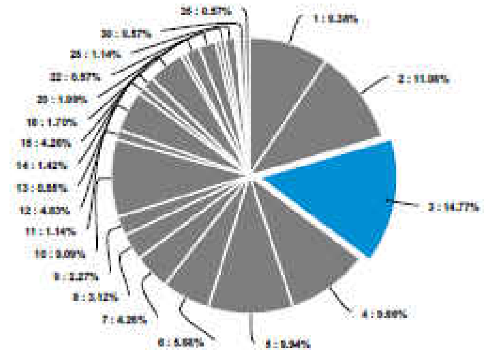
6. How many years of work experience do you have?



Answer	Count	Percent
None	0	0%
1	8	2.27%
2	13	3.69%
3	12	3.41%
4	10	2.84%
5	18	5.11%
6	13	3.69%
7	18	5.11%
8	17	4.83%
9	6	1.7%
10	42	11.93%
11	8	2.27%
12	17	4.83%
13	7	1.99%

14	11	3.12%
15	26	7.39%
16	6	1.7%
17	10	2.84%
18	6	1.7%
19	3	0.85%
20	21	5.97%
21	4	1.14%
22	5	1.42%
23	4	1.14%
24	4	1.14%
25	15	4.26%
26	3	0.85%
27	0	0%
28	2	0.57%
29	1	0.28%
30	15	4.26%
31	2	0.57%
32	3	0.85%
33	1	0.28%
34	1	0.28%
35	4	1.14%
36	2	0.57%
37	1	0.28%
38	1	0.28%
39	0	0%
40	6	1.7%
41	2	0.57%
42	1	0.28%
43	0	0%
44	0	0%
45	1	0.28%
46	0	0%
47	0	0%
48	0	0%
49	1	0.28%
50	0	0%
51+	1	0.28%
Total	352	100 %

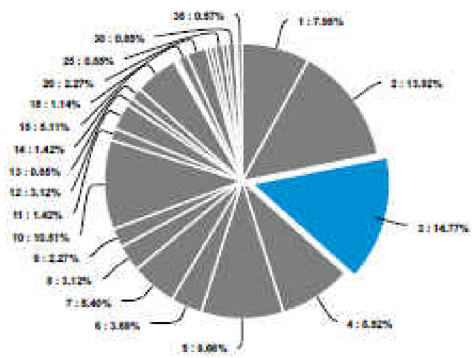
7. How many years of project management experience do you have?



Answer	Count	Percent	20% 40% 60% 80% 100%
None	0	0%	
1	33	9.38%	
2	39	11.08%	
3	52	14.77%	
4	34	9.66%	
5	35	9.94%	
6	20	5.68%	
7	15	4.26%	
8	11	3.12%	
9	8	2.27%	
10	32	9.09%	
11	4	1.14%	
12	17	4.83%	
13	3	0.85%	
14	5	1.42%	
15	15	4.26%	
16	2	0.57%	
17	0	0%	
18	6	1.7%	
19	0	0%	
20	7	1.99%	
21	2	0.57%	
22	2	0.57%	
23	0	0%	
24	0	0%	
25	4	1.14%	
26	1	0.28%	
27	0	0%	
28	1	0.28%	
29	0	0%	
30	2	0.57%	
31	0	0%	
32	0	0%	
33	0	0%	
34	0	0%	
35	2	0.57%	
36	0	0%	

37	0	0%
38	0	0%
39	0	0%
40	0	0%
41	0	0%
42	0	0%
43	0	0%
44	0	0%
45	0	0%
46	0	0%
47	0	0%
48	0	0%
49	0	0%
50	0	0%
51+	0	0%
Total	352	100 %

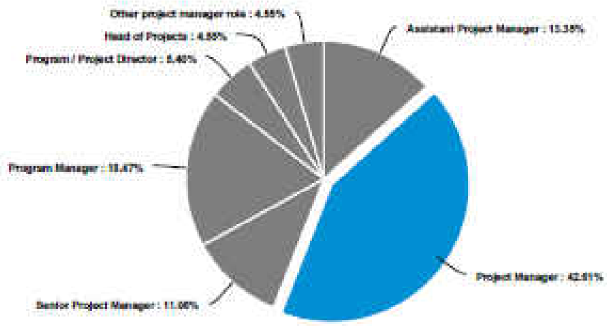
8. How many years have you actively managed projects in your career?



Answer	Count	Percent
None	0	0%
1	28	7.95%
2	49	13.92%
3	52	14.77%
4	30	8.52%
5	34	9.66%
6	13	3.69%
7	19	5.4%
8	11	3.12%
9	8	2.27%
10	37	10.51%
11	5	1.42%
12	11	3.12%
13	3	0.85%
14	5	1.42%
15	18	5.11%
16	1	0.28%
17	1	0.28%
18	4	1.14%
19	0	0%

20	8	2.27%
21	2	0.57%
22	2	0.57%
23	0	0%
24	0	0%
25	3	0.85%
26	2	0.57%
27	0	0%
28	0	0%
29	0	0%
30	3	0.85%
31	0	0%
32	0	0%
33	0	0%
34	1	0.28%
35	2	0.57%
36	0	0%
37	0	0%
38	0	0%
39	0	0%
40	0	0%
41	0	0%
42	0	0%
43	0	0%
44	0	0%
45	0	0%
46	0	0%
47	0	0%
48	0	0%
49	0	0%
50	0	0%
51+	0	0%
Total	352	100 %

9. Are you currently fulfilling any of the listed project manager functions?



Answer	Count	Percent
Assistant Project Manager	47	13.35%
Project Manager	150	42.61%
Senior Project Manager	39	11.08%
Program Manager	65	18.47%
Program / Project Director	19	5.4%
Head of Projects	16	4.55%
None	0	0%
Other project manager role	16	4.55%
Total	352	100 %

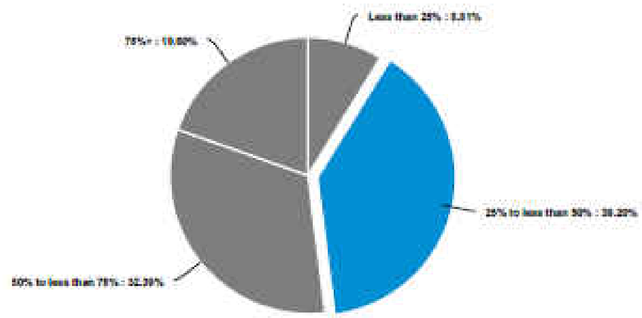
9. Are you currently fulfilling any of the listed project manager functions? - Text Data for Other project manager role

10/08/2017	28199095	Security Manager
09/26/2017	27710708	Project Accountant
09/26/2017	27699029	District Academic Administrator
09/14/2017	27278859	Design manager
09/13/2017	27229342	operations administrator
09/13/2017	27227298	Deputy Director
09/11/2017	27106028	Proposal Development Manager
09/11/2017	27102470	General Manager
09/11/2017	27101885	Compliance
09/11/2017	27101838	Mgr specified projects
09/11/2017	27097779	Team leader
09/11/2017	27097451	Project Team Leader
09/11/2017	27097179	Operations Manager
09/07/2017	26997097	Purchasing
09/07/2017	26996322	Project Coordinator
09/07/2017	26994758	Manager

10. Are you working in or managing IT projects?

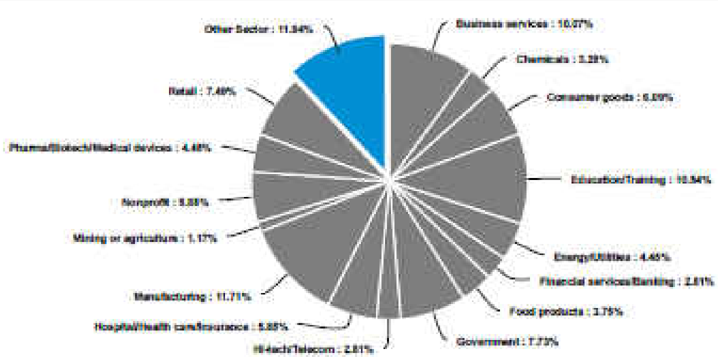
Answer	Count	Percent	20% 40% 60% 80% 100%
Yes	0	0%	
No	352	100%	
Total	352	100 %	

11. Approximately how much of your time is spent working on projects?



Answer	Count	Percent	20% 40% 60% 80% 100%
Less than 25%	31	8.81%	
25% to less than 50%	138	39.2%	
50% to less than 75%	114	32.39%	
75%+	69	19.6%	
Total	352	100 %	

12. Which sector(s) is your organization operating in? (Select all that apply)



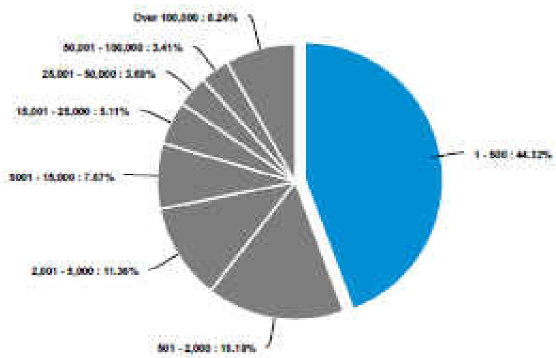
Answer	Count	Percent
Business services	43	10.07%
Chemicals	14	3.28%
Consumer goods	26	6.09%
Education/Training	45	10.54%
Energy/Utilities	19	4.45%
Financial services/Banking	12	2.81%
Food products	16	3.75%
Government	33	7.73%
Hi-tech/Telecom	12	2.81%
Hospital/Health care/Insurance	25	5.85%
Manufacturing	50	11.71%
Mining or agriculture	5	1.17%
Nonprofit	25	5.85%
Pharma/Biotech/Medical devices	19	4.45%
Retail	32	7.49%
Other Sector	51	11.94%
Total	427	100 %

12. Which sector(s) is your organization operating in? (Select all that apply) - Text Data for Other Sector

10/30/2017	20199095	Security
10/16/2017	20189974	gaming
10/09/2017	20148831	Paint facilities
09/26/2017	27713538	wholesale trade
09/26/2017	27712907	Events
09/26/2017	27710706	Engineering and Architecture
09/26/2017	27710053	transportation
09/26/2017	27704800	Property Management
09/26/2017	27704780	Real estate
09/18/2017	27381038	Government contracting
09/14/2017	27277495	Bulk transportation
09/14/2017	27276858	Design
09/14/2017	27274006	Defense
09/14/2017	27272700	Multi family
09/14/2017	27272553	engineering
09/14/2017	27268202	Consumer Services
09/14/2017	27267816	Construction
09/14/2017	27267022	Architecture
09/13/2017	27244330	Waste management
09/13/2017	27244329	Construction
09/13/2017	27242393	Graphic Design
09/13/2017	27238048	contruction
09/13/2017	27238135	hospitlity
09/13/2017	27237706	construction
09/13/2017	27235591	Engineering/Construction
09/13/2017	27234477	construction
09/13/2017	27234455	Construction
09/13/2017	27232401	hr
09/13/2017	27229278	Fashion
09/13/2017	27229418	film arts and exhibition
09/13/2017	27228761	Human services
09/13/2017	27228696	Hospitality

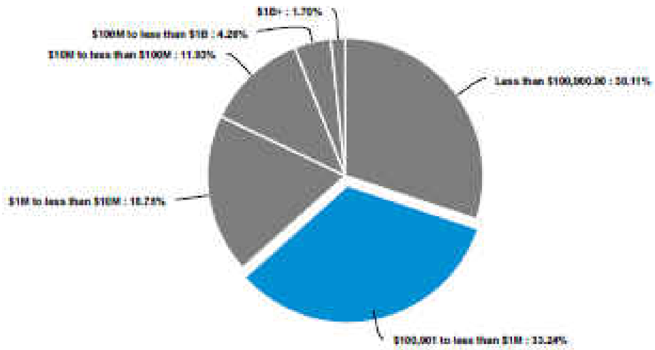
09/13/2017	27229048	Logistics
09/11/2017	27109142	Architecture
09/11/2017	27109117	Entertainment
09/11/2017	27108494	HVAC SYSTEMS
09/11/2017	27104701	Rigging
09/11/2017	27102470	Hospitality
09/11/2017	27102839	auto
09/11/2017	27098094	Multifamily Construction
09/11/2017	27097311	Construction
09/07/2017	26997008	Entertainment
09/07/2017	26995705	sports
09/07/2017	26995715	Social Services
09/07/2017	26995322	Medical Furniture
09/07/2017	26995269	electrical distribution/warehousing
09/07/2017	26995260	Publishing
09/07/2017	26995179	Construction
09/07/2017	26995038	Legal
08/23/2017	26297657	research in science
08/23/2017	26297635	Engineering

13. How many total employees are there in your company?



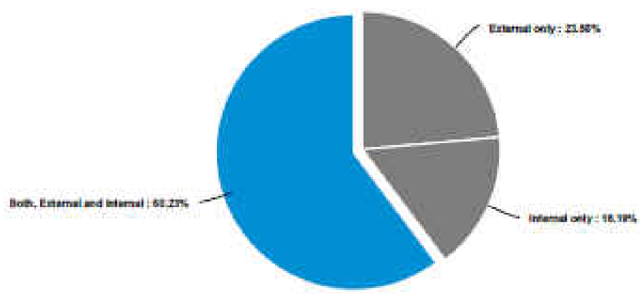
Answer	Count	Percent
1 - 500	156	44.32%
501 - 2,000	57	16.19%
2,001 - 5,000	40	11.36%
5001 - 15,000	27	7.67%
15,001 - 25,000	18	5.11%
25,001 - 50,000	13	3.69%
50,001 - 100,000	12	3.41%
Over 100,000	29	8.24%
Total	352	100 %

14. What is the average budget for a project at your organization?



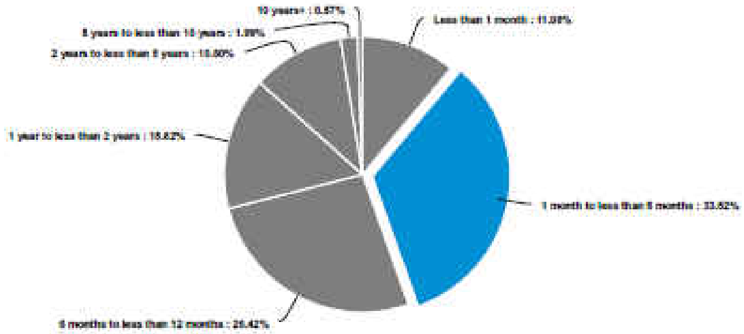
Answer	Count	Percent
Less than $100,000.00	106	30.11%
$100,001 to less than $1M	117	33.24%
$1M to less than $10M	66	18.75%
$10M to less than $100M	42	11.93%
$100M to less than $1B	15	4.26%
$1B+	6	1.7%
Total	352	100 %

15. Are your projects dealing with external customers (outside your company) or internal customers (within your company)?



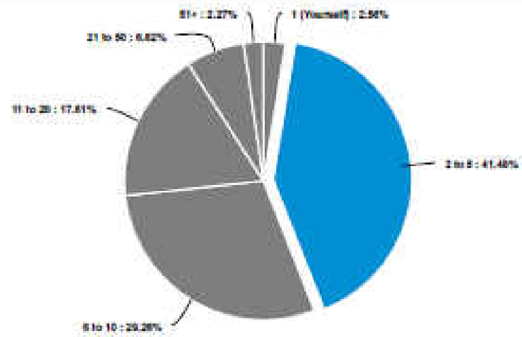
Answer	Count	Percent
External only	83	23.58%
Internal only	57	16.19%
Both, External and Internal	212	60.23%
Total	352	100 %

16. What is the typical duration of a project in your organization?



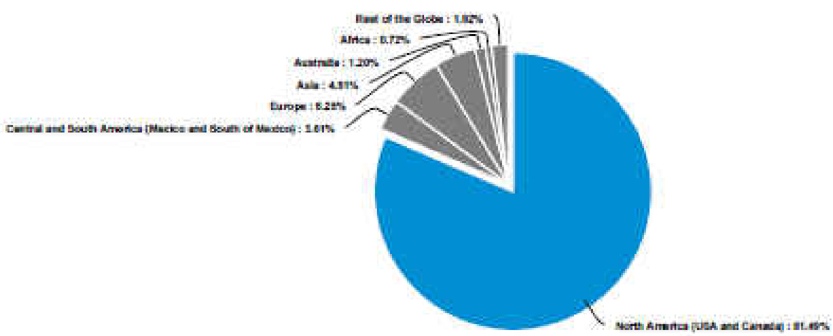
Answer	Count	Percent	20% 40% 60% 80% 100%
Less than 1 month	39	11.08%	
1 month to less than 6 months	118	33.52%	
6 months to less than 12 months	93	26.42%	
1 year to less than 2 years	55	15.62%	
2 years to less than 5 years	38	10.8%	
5 years to less than 10 years	7	1.99%	
10 years+	2	0.57%	
Total	352	100 %	

17. What is the typical size of your project team?



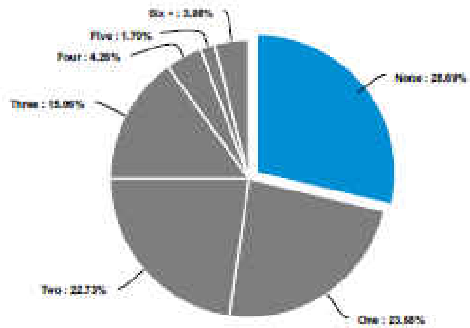
Answer	Count	Percent
1 (Yourself)	9	2.56%
2 to 5	146	41.48%
6 to 10	103	29.26%
11 to 20	62	17.61%
21 to 50	24	6.82%
51+	8	2.27%
Total	352	100 %

18. Where are your project team members located at? (Select all that apply)



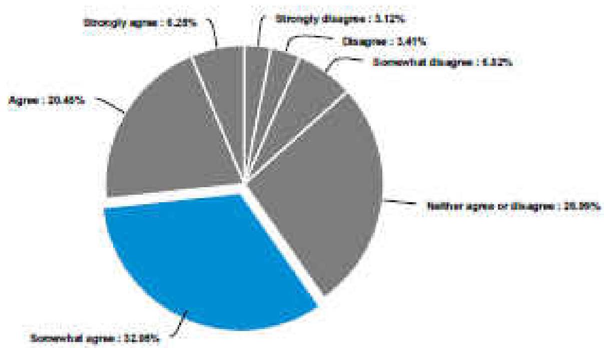
Answer	Count	Percent
North America (USA and Canada)	339	81.49%
Central and South America (Mexico and South of Mexico)	15	3.61%
Europe	26	6.25%
Asia	20	4.81%
Australia	5	1.2%
Africa	3	0.72%
Rest of the Globe	8	1.92%
Total	416	100 %

19. How many project sponsors (external customers or financiers for internal projects) do your projects typically have?



Answer	Count	Percent	20% 40% 60% 80% 100%
None	101	28.69%	
One	83	23.58%	
Two	80	22.73%	
Three	53	15.06%	
Four	15	4.26%	
Five	6	1.7%	
Six +	14	3.98%	
Total	352	100 %	

20. I would describe our project management as being agile.



Answer	Count	Percent	20% 40% 60% 80% 100%
Strongly disagree	11	3.12%	
Disagree	12	3.41%	
Somewhat disagree	24	6.82%	
Neither agree or disagree	95	26.99%	
Somewhat agree	116	32.95%	
Agree	72	20.45%	
Strongly agree	22	6.25%	
Total	352	100 %	

APPENDIX D: DESCRIPTIVE STATISTICS

Descriptive statistics for indicators of agile project management

Indicator	N	Range	Min	Max	Mean	Std. Deviation	Skewness		Kurtosis	
							Statistic	Std. Error	Statistic	Std. Error
Management factors	352	6.00	1.00	7.00	5.0843	1.19836	-.925	.130	.912	.259
Process factors	352	6.00	1.00	7.00	5.1070	.95925	-1.018	.130	2.592	.259
Project factors	352	6.00	1.00	7.00	4.8409	.91029	-.382	.130	1.787	.259
Organizational factors	352	6.00	1.00	7.00	5.4409	1.15664	-.994	.130	1.134	.259
People factors	352	6.00	1.00	7.00	5.0994	1.04406	-.562	.130	.483	.259
Technical factors	352	6.00	1.00	7.00	4.8004	.92225	-.278	.130	.720	.259

Descriptive statistics for indicators of project complexity

Indicator	N	Range	Min	Max	Mean	Std. Deviation	Skewness		Kurtosis	
							Statistic	Std. Error	Statistic	Std. Error
Project size	352	5.00	1.00	6.00	2.32	1.234	.851	.130	.150	.259
Project duration	352	6.00	1.00	7.00	2.90	1.277	.581	.130	-.169	.259
Ext./int. customers	352	2.00	1.00	3.00	2.37	.840	-.776	.130	-1.137	.259
# team members	352	3.00	1.00	4.00	2.8011	.86410	.156	.130	-1.211	.259
Geo team setup	352	1.00	0.00	1.00	.15	.358	1.963	.130	1.862	.259
# sponsors	352	4.00	1.00	5.00	2.5398	1.31336	.395	.130	-.979	.259

Descriptive statistics for indicators of project success

Indicator	N	Range	Min	Max	Mean	Std. Deviation	Skewness		Kurtosis	
							Statistic	Std. Error	Statistic	Std. Error
Quality achievement	352	6.00	1.00	7.00	5.7477	1.06645	-1.104	.130	1.011	.259
Scope compliance	352	6.00	1.00	7.00	5.6207	1.11019	-1.008	.130	1.240	.259
Timeliness	352	4.50	2.50	7.00	5.7820	.96181	-.956	.130	.471	.259
Cost target achievement	352	5.67	1.33	7.00	5.4716	1.02631	-.829	.130	.882	.259

Descriptive statistics for industry sector variables

Indicator	N	Range	Min	Max	Mean	Std. Deviation	Skewness		Kurtosis	
							Statistic	Std. Error	Statistic	Std. Error
Primary sector	352	1.00	0.00	1.00	.01	.119	8.246	.130	66.370	.259
Secondary sector	352	1.00	0.00	1.00	.32	.466	.784	.130	-1.393	.259
Tertiary sector	352	1.00	0.00	1.00	.17	.379	1.734	.130	1.011	.259
Quaternary sector	352	1.00	0.00	1.00	.46	.499	.172	.130	-1.982	.259
Other sector	352	1.00	0.00	1.00	.14	.352	2.026	.130	2.118	.259

Descriptive statistics for project managers with PM certification and familiarity with APM

PM Certification?	Q5 – How familiar are you with APM?	Frequency	Percent	Valid Percent	Cumulative Percent
Yes	I am an expert user of the agile methodology	7	2.0	6.2	6.2
	I recently learned about it and just started using agile methodology in my projects	25	7.1	22.1	28.3
	I recently learned about it and plan to implement it in future projects	31	8.8	27.4	55.8
	I know about it but do not plan on using it	24	6.8	21.2	77.0
	Our company just started implementing it	9	2.6	8.0	85.0
	I do not know it	17	4.8	15.0	100.0
	Total	113	32.1	100.0	
No		239	67.9		
Total		352	100.0		

Descriptive statistics for project managers without PM certification and familiarity with APM

PM Certification?	Q5 – How familiar are you with APM?	Frequency	Percent	Valid Percent	Cumulative Percent
No	I am an expert user of the agile methodology	2	.6	.8	.8
	I recently learned about it and just started using agile methodology in my projects	14	4.0	5.9	6.7
	I recently learned about it and plan to implement it in future projects	24	6.8	10.0	16.7
	I know about it but do not plan on using it	25	7.1	10.5	27.2
	Our company just started implementing it	14	4.0	5.9	33.1
	I do not know it	160	45.5	66.9	100.0
	Total	239	67.9	100.0	
Yes		113	32.1		
Total		352	100.0		

Descriptive statistics for project managers with PM certification and project management experience

PM Certification?	Q7 – How many years of project management experience do you have?	Frequency	Percent	Valid Percent	Cumulative Percent
Yes	2.00	9	2.6	8.0	8.0
	3.00	11	3.1	9.7	17.7
	4.00	17	4.8	15.0	32.7
	5.00	12	3.4	10.6	43.4
	6.00	14	4.0	12.4	55.8
	7.00	7	2.0	6.2	61.9
	8.00	5	1.4	4.4	66.4
	9.00	2	.6	1.8	68.1
	10.00	4	1.1	3.5	71.7
	11.00	8	2.3	7.1	78.8
	12.00	1	.3	.9	79.6
	13.00	7	2.0	6.2	85.8
	15.00	2	.6	1.8	87.6
	16.00	7	2.0	6.2	93.8
	17.00	1	.3	.9	94.7
	19.00	2	.6	1.8	96.5
	23.00	1	.3	.9	97.3
	26.00	2	.6	1.8	99.1
	36.00	1	.3	.9	100.0
	Total	113	32.1	100.0	
No		239	67.9		
Total		352	100.0		

Descriptive statistics for project managers who are familiar with APM and who believe that their project management approach is agile

Project manager familiar with APM?	Q20 – I would describe our project management as being agile.	Frequency	Percent	Valid Percent	Cumulative Percent
Yes	Strongly disagree	5	1.4	2.9	2.9
	Disagree	4	1.1	2.3	5.1
	Somewhat disagree	11	3.1	6.3	11.4
	Neither agree nor disagree	41	11.6	23.4	34.9
	Somewhat agree	60	17.0	34.3	69.1
	Agree	39	11.1	22.3	91.4
	Strongly agree	15	4.3	8.6	100.0
	Total	175	49.7	100.0	
No		177	50.3		
Total		352	100.0		

APPENDIX E: SPEARMAN'S RHO CORRELATION MATRIX

Correlations of agile project management factors

		Management Factors	Process Factors	Project Factors	Organizational Factors	People Factors	Technical Factors
Management Factors	Correl. Coeff.	1.000	.657**	.477**	.619**	.610**	.368**
	Sig. (2-tailed)	.	.000	.000	.000	.000	.000
	N	352	352	352	352	352	352
Process Factors	Correl. Coeff.	.657**	1.000	.606**	.741**	.761**	.566**
	Sig. (2-tailed)	.000	.	.000	.000	.000	.000
	N	352	352	352	352	352	352
Project Factors	Correl. Coeff.	.477**	.606**	1.000	.476**	.565**	.550**
	Sig. (2-tailed)	.000	.000	.	.000	.000	.000
	N	352	352	352	352	352	352
Organizational Factors	Correl. Coeff.	.619**	.741**	.476**	1.000	.750**	.390**
	Sig. (2-tailed)	.000	.000	.000	.	.000	.000
	N	352	352	352	352	352	352
People Factors	Correl. Coeff.	.610**	.761**	.565**	.750**	1.000	.503**
	Sig. (2-tailed)	.000	.000	.000	.000	.	.000
	N	352	352	352	352	352	352
Technical Factors	Correl. Coeff.	.368**	.566**	.550**	.390**	.503**	1.000
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.
	N	352	352	352	352	352	352

**. Correlation is significant at the 0.01 level (2-tailed).

Correlations of project complexity factors

		Project Size	Project Duration	Ext. / Int. Customers	# Team Members	Geo Team Setup	# Sponsors
Project Size	Correl. Coeff.	1.000	.441**	.128*	.398**	.097	.233**
	Sig. (2-tailed)	.	.000	.017	.000	.068	.000
	N	352	352	352	352	352	352
Project Duration	Correl. Coeff.	.441**	1.000	.112*	.395**	.168**	.285**
	Sig. (2-tailed)	.000	.	.036	.000	.002	.000
	N	352	352	352	352	352	352
Ext. / Int. Customers	Correl. Coeff.	.128*	.112*	1.000	.150**	.090	.224**
	Sig. (2-tailed)	.017	.036	.	.005	.093	.000
	N	352	352	352	352	352	352
# Team Members	Correl. Coeff.	.398**	.395**	.150**	1.000	.201**	.380**
	Sig. (2-tailed)	.000	.000	.005	.	.000	.000
	N	352	352	352	352	352	352
Geo Team Setup	Correl. Coeff.	.097	.168**	.090	.201**	1.000	.164**
	Sig. (2-tailed)	.068	.002	.093	.000	.	.002
	N	352	352	352	352	352	352
# Sponsors	Correl. Coeff.	.233**	.285**	.224**	.380**	.164**	1.000
	Sig. (2-tailed)	.000	.000	.000	.000	.002	.
	N	352	352	352	352	352	352

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Correlations of project success factors

		Quality Achievement	Scope Compliance	Timeliness	Cost Target Achievement
Quality Achievement	Correl. Coeff.	1.000	.694**	.693**	.528**
	Sig. (2-tailed)	.	.000	.000	.000
	N	352	352	352	352
Scope Compliance	Correl. Coeff.	.694**	1.000	.678**	.516**
	Sig. (2-tailed)	.000	.	.000	.000
	N	352	352	352	352
Timeliness	Correl. Coeff.	.693**	.678**	1.000	.578**
	Sig. (2-tailed)	.000	.000	.	.000
	N	352	352	352	352
Cost Target Achievement	Correl. Coeff.	.528**	.516**	.578**	1.000
	Sig. (2-tailed)	.000	.000	.000	.
	N	352	352	352	352

**. Correlation is significant at the 0.01 level (2-tailed).

Correlations of industry sector variables

		Industry Primary Sector	Industry Secondary Sector	Industry Tertiary Sector	Industry Quaternary Sector	Industry Other Sector
Industry Primary Sector	Correl. Coeff.	1.000	.021	.008	-.014	-.049
	Sig. (2-tailed)	.	.693	.874	.796	.355
	N	352	352	352	352	352
Industry Secondary Sector	Correl. Coeff.	.021	1.000	-.087	-.505**	-.264**
	Sig. (2-tailed)	.693	.	.103	.000	.000
	N	352	352	352	352	352
Industry Tertiary Sector	Correl. Coeff.	.008	-.087	1.000	-.285**	-.167**
	Sig. (2-tailed)	.874	.103	.	.000	.002
	N	352	352	352	352	352
Industry Quaternary Sector	Correl. Coeff.	-.014	-.505**	-.285**	1.000	-.329**
	Sig. (2-tailed)	.796	.000	.000	.	.000
	N	352	352	352	352	352
Industry Other Sector	Correl. Coeff.	-.049	-.264**	-.167**	-.329**	1.000
	Sig. (2-tailed)	.355	.000	.002	.000	.
	N	352	352	352	352	352

**. Correlation is significant at the 0.01 level (2-tailed).

APPENDIX F: CONFIRMATORY FACTOR ANALYSIS

Comparison of parameter estimates for APM measurement models

Indicator	Initial Model Estimate	S.E.	C.R.	P	Revised Model Estimate	S.E.	C.R.	P
Project factors	0.725	0.060	12.099	***	0.735	0.060	12.228	***
Organizational factors	1.150	0.076	15.054	***	1.111	0.077	14.392	***
Management factors	1.000				1.000			
Process factors	0.989	0.063	15.761	***	1.010	0.063	16.019	***
People factors	1.063	0.070	15.260	***	0.996	0.069	14.466	***
Technical factors	0.650	0.061	10.677	***	0.649	0.061	10.605	***

Note: *** $p < 0.001$

Comparison of parameter estimates for project complexity measurement models

Indicator	Initial Model Estimate	S.E.	C.R.	P	Revised Model Estimate	S.E.	C.R.	P
Project duration	1.120	0.156	7.195	***	1.134	0.172	6.604	***
Ext./int. customers	0.326	0.087	3.762	***	0.375	0.103	3.636	***
Project size	1.000				1.000			
# team members	0.884	0.127	6.974	***	1.070	0.172	6.210	***
Geo Team Setup	0.145	0.038	3.860	***	0.171	0.045	3.801	***
# sponsors	0.997	0.165	6.042	***	1.180	0.209	5.660	***

Note: *** $p < 0.001$

Comparison of parameter estimates for project success measurement models

Indicator	Initial Model Estimate	S.E.	C.R.	P	Revised Model Estimate	S.E.	C.R.	P
Timeliness	0.967	0.054	17.935	***	0.933	0.053	17.579	***
Scope compliance	1.080	0.060	17.920	***	1.085	0.061	17.856	***
Cost target achievement	0.791	0.061	13.036	***	0.741	0.062	11.940	***
Quality achievement	1.000				1.000			

Note: *** $p < 0.001$

Comparison of parameter estimates for initial and revised structural models

Indicator	Initial Model Estimate	S.E.	C.R.	P	Revised Model Estimate	S.E.	C.R.	P
Project success ← APM	0.938	0.072	13.011	***	1.047	0.076	13.749	***
Project success ← Project complexity	-0.150	0.076	-1.969	.049	-0.150	0.076	-1.972	.049
Project success ← Primary sector	0.504	0.295	1.708	.088	Deleted			
Project success ← Secondary sector	0.303	0.120	2.522	.012	Deleted			
Project success ← Tertiary sector	0.108	0.118	0.917	.359	Deleted			
Project success ← Quaternary sector	0.085	0.123	0.687	.492	Deleted			
Project success ← Other sector	0.314	0.147	2.145	.032	Deleted			
Project factors ← APM	0.727	0.061	12.017	***	0.696	0.064	10.915	***
Organizational factors ← APM	1.159	0.078	14.837	***	1.204	0.084	14.364	***
Management factors ← APM	1.000				1.000			
Process factors ← APM	0.996	0.063	15.875	***	0.984	0.062	15.986	***
People factors ← APM	1.036	0.070	14.832	***	1.072	0.075	14.270	***
Technical factors ← APM	0.674	0.062	10.926	***	0.704	0.068	10.409	***
Project duration ← Project complexity	1.122	0.170	6.584	***	1.069	0.163	6.575	***
Ext./int. customers ← Project complex.	0.370	0.103	3.599	***	0.357	0.100	3.589	***
Project size ← Project complexity	1.000				1.000			
# team members ← Project complexity	1.073	0.171	6.278	***	1.058	0.166	6.372	***
Geo team setup ← Project complexity	0.176	0.045	3.882	***	0.167	0.044	3.824	***
# sponsors ← Project complexity	1.188	0.209	5.680	***	1.174	0.202	5.810	***
Timeliness ← Project success	0.807	0.045	17.790	***	0.693	0.044	15.613	***
Scope compliance ← Project success	0.956	0.052	18.330	***	0.870	0.052	16.762	***
Cost target achieve. ← Project success	0.642	0.054	11.827	***	0.552	0.051	10.780	***
Quality achievement ← Project success	1.000				1.000			

Note: *** $p < 0.001$

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