2020-01-01

Performance Measure Methodology Of Project Management Practices In Local Government Agencies

Johanes Johanes Makahaube
University of Texas at El Paso

PERFORMANCE MEASURE METHODOLOGY OF PROJECT MANAGEMENT

PRACTICES IN LOCAL GOVERNMENT AGENCIES

JOHANES SOMBO MAKAHAUBE

Doctoral Program in Civil Engineering

APPROVED:

Carlos M. Chang, Ph.D., Chair

Eric D. Smith, Ph.D.

Adeeba A. Raheem, Ph.D.

Shane Walker, Ph.D.

Stephen Crites, Ph.D.
Dean of the Graduate School

Dedication

I dedicate my dissertation work to my family. A special feeling of gratitude to my loving parents; my mom Judith Siti Melontige and my late father, Barnabas Kemenangan Makahaube. To my late sister, Stellany Makahaube, who I know will never stop encouraging me to keep pursuing my dreams. To my younger sister Susana Bishop and my younger brother Aprilexius L. Makahaube who always inspired me to keep going and not to give up. To my fiancé, Yustina Astuti, whose words of encouragement and push for tenacity ring in my ears. I also dedicate this dissertation to Lorena Makahaube and Mica Carrasco, who has been my closest family away from home and have supported me throughout the process.

PERFORMANCE MEASURE METHODOLOGY OF PROJECT MANAGEMENT PRACTICES IN LOCAL GOVERNMENT AGENCIES

by

JOHANES SOMBO MAKAHAUBE, M.S.

DISSERTATION

Presented to the Faculty of the Graduate School of

The University of Texas at El Paso

in Partial Fulfillment

of the Requirements

for the Degree of

DOCTOR OF PHILOSOPHY

Department of Civil Engineering

THE UNIVERSITY OF TEXAS AT EL PASO

December 2020

Acknowledgment

I would like to express my special thanks and gratitude to the following individuals who have guided and supported me during this journey in their unique way. First, to my advisor, Dr. Carlos M. Chang, P.E., for his advice, continuing support, and encouragement in completing the dissertation. Second, to Dr. Erick Smith for his guidance and directions in my discoveries of system dynamics. Third, Dr. Raheem and Dr. Walker for their support and recommendations to overcome the data collection challenge. Special thanks and appreciation to Dr. Carlos Ferregut, Chair of the Civil Engineering Department, for providing financial support. Last but not least, to Vicky Ruiz, EIT (El Paso International Airport - Project Manager), Margaret Schroeder, P.E. (City of El Paso - Division Manager), Gilbert Saldaña, P.E. (County of El Paso – Division Manager), and Dr. George Pinal (City of El Paso – Project Manager) for their feedback throughout the development of this dissertation.

Abstract

Local government agencies have adopted project management practices to deliver public work projects. The agencies need to measure project management performance to ensure the consistency, control, and monitoring of the project delivery process. However, local government agencies have not adopted a systematic method to measure the organization's project-management performance. At present, there is a gap regarding methods to measure project management performance in delivering construction projects. This study aims to assist local government agencies in improving their project management processes by implementing a comprehensive methodology to assess project management's performance. This dissertation is organized into three major chapter-papers: the first chapter describes the assessment of the project management maturity level through the analysis of the knowledge areas involved in the project management process. The second chapter explains the development of a systematic approach to determine the project management performance level by assessing the agency's management process, capacity, and capability.

Finally, the third chapter depicts a method to measure a local government agency's project-management performance using system dynamics. A case study is performed to demonstrate the method's applicability in three local government agencies: The City of Sunland Park, the County of El Paso, and the City of El Paso. The findings of this research study are expected to contribute towards the quality of public works by improving the project management practices in local government agencies.

Table of Contents

List of Tables

List of Figures

Chapter 1

Introduction

The increase of public demands for transparency and accountability, coupled with the depletion of funding sources, has further changed public works projects' construction and management. These increased demands began with the recognition of "who is the true customer" in the late 1990s in response to the public perception that at all levels, government agencies have developed a reputation for being incognizant and unresponsive to the needs of the tax-paying customer - their true customer. As a result, the National Performance Review (NPR) was formed in March 1993 to establish a goal of creating a government that "works better and costs less" (Winistorfer, 1996).

Local governments responded to these challenges by implementing a hiring freeze, reducing the workforce, and distributing workloads to remaining employees. Typically, the reduction of force is accomplished through attrition by not replacing vacated positions due to retirements or by realigning and combining some functions. With the decrease in the workforce, a fundamental question arises, how does the reduction of workforce affect the performance of a local government in delivering public works projects?

The Government Performance and Results Act of 1993 and the Government Accounting Standard Board (GASB) require that government agencies submit strategic plans and performance measures for budget justification and approval (GASB, 2002). These requirements aim to improve transparency and accountability (Chmielewski and Phillips, 2002). Commonly, performance measures are used to support the decision-making process, program monitoring, service performance improvement, and reporting. These requirements apply not only to the federal government but also to the local government seeking to fund local projects using federal grants or subsidies. However, despite the requirements and benefits of using performance measures, many local governments have not systematically used performance measures for delivering public works projects (Bernstein, 2000). Subsequently, another fundamental question arises; how a local government assesses its performance?

Typically, in local government agencies, project performance reports traditionally refer to the scope, budget, and schedule. These three indicators, although critical, do not measure the department management's performance in delivering projects. Measuring department management performance is critical to ensure consistency of the project delivery process, control, and monitoring. Moreover, performance measures should be carefully selected to fit their purpose and shall be based on standards comparison; but a single performance measure is not sufficient (Behn, 2003). Hence, it is necessary to develop a set of performance measures that meet the need of local government agencies.

For delivering projects, local government agencies have adopted some form of project management practice to enable the agencies to execute projects with improved effectiveness and efficiency. Considerable research studies have been done in the private sector to improve project management performance with the primary goal of increasing profitability and sustainable competitive advantage (Winter et al., 2006). These goals are not aligned with local government entities because the local government agency is not seeking profit either competing with other local government agencies. Despite the common usage of project management, there are few research studies on performance measures that apply to project management practices for local government agencies, and currently, there is a research gap regarding performance measures in the project management area (Thompson, 2009).

The scarcity of budgets and increasing demand for quality products or services have created a new scenario in which budgets are never going to be as clear as they were in the past (Price et al., 2011). The old mantra of doing more with less is replaced by a never-ending call to improve productivity or do even more with even less. Moreover, internally, a local government not only has to face the scarcity of funding and bureaucracy but also competing interests (Winistofer, 1996). The funding scarcity and competing interests have also caused slashing of funding for staff development that ultimately produces a reduction of intellectual property affecting performance.

Adopting performance measures is critical for any organization; however, there is no agreed method to assess the performance of local government agencies in managing construction projects (Demikersen and Ozohon, 2017). Furthermore, it is critical to select performance measures that best fit a local government agency (Behn, 1996). The in-depth study of this paradigm is not part of this research; however, this study considers the challenges local government agencies face, such as funding scarcity and reduction of intellectual property. Hence, the following considerations should guide the process to find the best-fit of project management performance measures in local governments:

- Affordability: the cost of implementing the performance measure shall be affordable.
- Adaptability: the performance measure shall be adaptable to the organization's massive bureaucracy.
- Usability/user-friendly: the performance measure shall not be too complex to understand and shall not require extensive training.
- Practical: the performance measure shall be realistic and applicable in a local government organizational environment.

1.1 Aim and Objectives

This study aims to assist local government agencies in assessing their project management performance level in delivering public works. This aim is expressed through the following objectives, and each of these objectives is discussed in detail in the subsequent chapters.

1. Develop a methodology to assess the project-management performance maturity level.
2. Identify critical performance factors and develop performance metrics to measure the project management performance level.
3. Develop a project-management performance measuring method using system dynamics.

This dissertation is organized into three major chapter-papers in harmony with the three objectives: the first chapter addresses the assessment of project management maturity level through the evaluation of knowledge area processes. The second chapter covers the development of project performance level metrics through the assessment of project management maturity, capacity, and capability of the local government agency. Finally, the third chapter describes the development of the project-management performance measuring method using system dynamics.

1.2 Study Approach

Currently, the determination of project management success relies on the traditional scope, budget, and schedule, a fragmented approach in measuring performance. The approach adopted for this study is looking at the project management practices for delivering projects in a systematic, holistic way to simplify complex interactions between various elements of project management. By definition, a system is a group of devices or artificial objects or an organization forming a network distributing something or serving a common purpose. Moreover, the approach of the study considers leadership involvement, project management processes, and project-manager ability as critical factors in the project execution process in a local government agency. These critical factors influence the project management performance level, which is measured by assessing the maturity, capacity, and capability of the agency. These performance level components are utilized in the development of the system dynamics performance model.

This research began with the preparation of a survey to collect information about project management practices. The survey questionnaire is provided in the Appendix. The survey questionnaire consisted of forty-nine questions covering the organizational structure and selected project management processes as described in the Project Management Body of Knowledge (PMBOK, 6th ed., 2017). The Project Management Maturity Model (PMMM) has been adapted to assess the maturity level of the project management processes. After the data are collected and analyzed, a performance level metric was developed to assess the project management performance level. Finally, a performance measuring model for project management was developed using a system dynamics approach. Additionally, a case study was performed to demonstrate the applicability of the proposed methodology in three local government agencies. Three local government agencies participated in this study: The City of Sunland Park, New Mexico, the County of El Paso, Texas, and the City of El Paso, Texas. These agencies were selected because they are located within the same economic region. The estimated total budget of each agency for the fiscal year 2020 provided a perspective of the "size" of these organizations. The City of Sunland Park had a total budget of $10 million, the County of El Paso has a total budget of $500,000 million, and the City of El Paso has approximately $1 billion of a total annual budget.

1.3 Conclusions

The major conclusions of this study are:

a) The methodology developed in this study addresses the research gap of performance measures in the project management area by introducing a method that relies on leadership, project management processes, and project manager's ability. This study introduces local government agencies with a conceptual framework for a more comprehensive and collaborative approach in conducting a project management performance assessment. It also introduces a performance evaluation method where the distribution of responsibility applies at all management levels. Moreover, this study presents a framework for the standardization of project management performance. Finally, it introduces a venue to increase leadership involvement by monitoring the project manager's performance and encouraging professional development that will ultimately improve the project manager retention rate.

b) Eight performance contributing factors affecting the project management performance level have been identified during this study: the number of the project manager, capability, capacity, process maturity level, utilization, knowledge growth, investment for project manager development, and project manager retention. These contributing factors are categorized into primary and secondary factors. The primary factors directly affecting the performance management level are the number of project managers, capability, capacity, and maturity level. The secondary factors indirectly affecting the performance level include the utilization, knowledge growth, investment for project manager development, and project manager retention. It is critical to recognize leadership involvement in these factors. For the primary factors, leadership has an indirect involvement in the decision-making processes, where for the secondary factors, the leadership's direct involvement is necessary to achieve the desired performance.

c) The methodology developed in this study to assess project management performance in local government agencies is summarized in Figure 1.1.

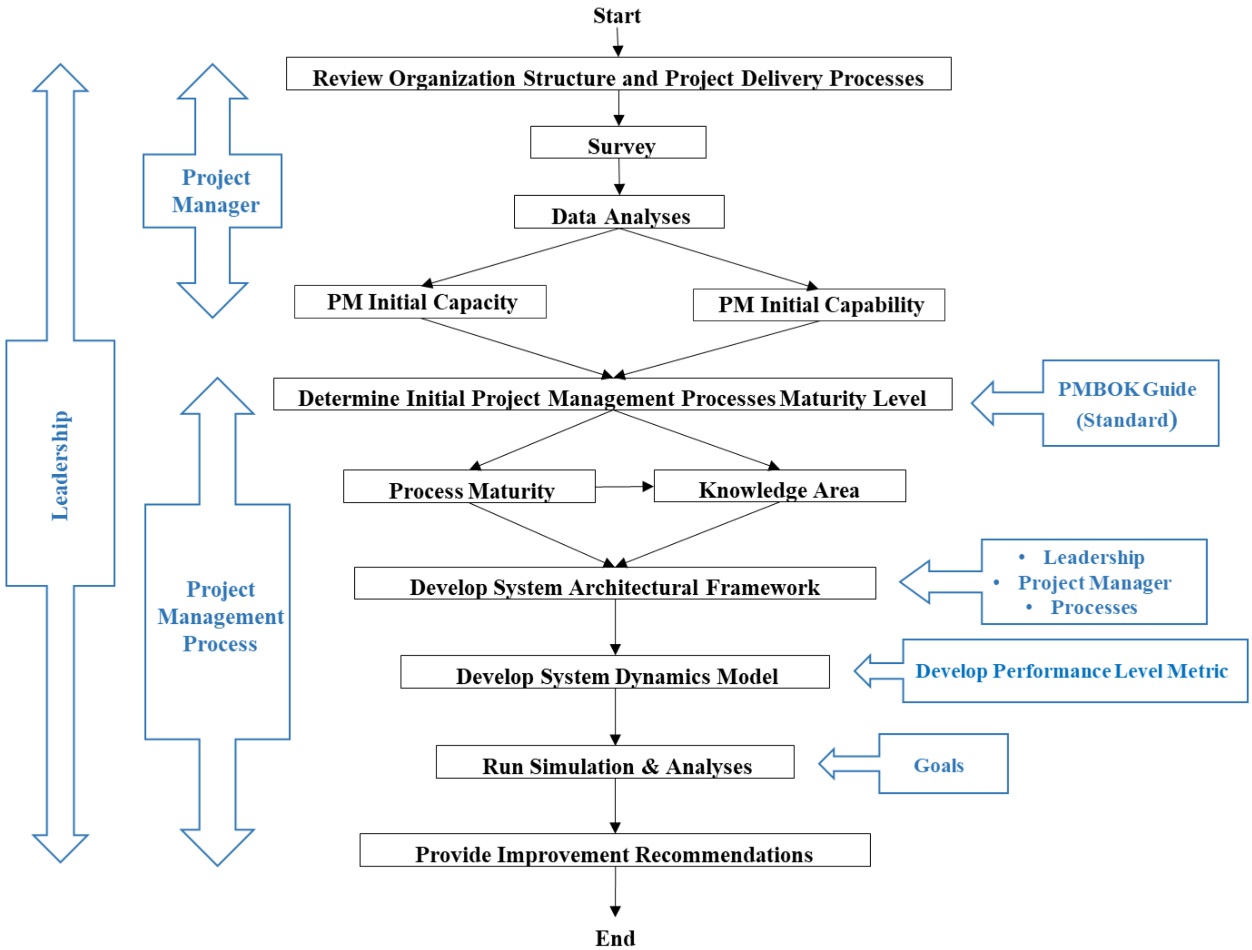

Figure 1.1 Performance Measuring Methodology of Project Management Practices

1.4 Recommendation for future research

The following are recommendations for future research:

- Once this methodology is implemented and additional data become available, examining the conceptual development of the performance level equation is highly recommended to define better the relationship of performance components.
- Expanding the survey questionnaire to capture the project manager's skills and knowledge of project management processes in more detail. Also, increasing the number of

project managers who represent an agency should improve the maturity level determination.

- Establishing the relationship between the dedicated amount of investment for project manager development and the consequential project manager's ability is necessary to estimate better the project manager's skills and knowledge of the project management processes. Moreover, it is also critical to establish the relationship between the project manager's workload and the utilization level to better estimate the overall organization's capacity.
- From a practical perspective, feedback from the implementation of the proposed methodology in local government agencies should enhance the approach. It should also assist in identifying other performance contributing factors unique to each agency. Additionally, the proposed methodology can assist in the evaluation of the project delivery organization structure.

1.5 Contribution to Local Government Agencies

The contributions of this research to local government agencies are:

- This study introduces a method for assessing the project management performance at local government agencies instead of investing in an over-the-shelf system that may not be applicable.
- The methodology can be used as a tool to identify areas of improvement through the assessment of the project management's knowledge area. Identifying project management processes that require improvement is necessary to enhance the overall project management process and, thereby, the organizations' project management performance.

- The methodology can also assist in the strategic planning process by identifying investment priorities to enhance the agency's management performance.
- Finally, the proposed methodology allows local government agencies to assess their project management practices while enhancing transparency, accountability, and improved credibility.

1.6 Limitations

- The survey results represent one representative (project manager) 's responses from each local government agency that participated in this study.
- The survey results may not represent other local government agencies' project management practices serving larger communities.
- The performance variable values, such as knowledge growth and utilization, are estimated based on observation and experience due to insufficient historical data.
- The survey questionnaire to assess the project management processes consists of only one question per maturity level; therefore, the answer may not be specific enough to describe the level of maturity in the processes.
- The traditional design-bid-build project delivery process is considered in this study. No other project delivery methods are addressed in this dissertation. Different project delivery processes may require separate processes due to the different project's owner requirements.
- The scope of this study is intended to assess project management performance during the construction phase. It is the policy of most local government agencies not to award the design and construction of a project to one firm. Design and construction are awarded to separate firms.

Chapter 2

Knowledge Assessment of Project Management Processes to Improve Local Government Performance Level

Abstract

The adoption of project management by local government agencies to execute public works projects is not new; the agencies have implemented project management processes to improve effectiveness and efficiency in delivering projects. However, many agencies have not implemented performance measures to assess their project management performance, and there is a gap in regard to performance measures in the project management area for local agencies

This paper presents a methodology to assess project management performance by determining the maturity level of the process. The Project Management Body of Knowledge (PMBOK) guidelines, in combination with the Project Management Maturity Model (PMMM), is used to develop the methodology. A case study demonstrates the applicability of this method in three government agencies: The City of Sunland Park, the County of El Paso, and the City of El Paso.

The results of the case study show that the method proposed to assess the project management process is implementable in local governmental agencies; It is envisioned that this method will assist local governments in improving their performance in delivering projects.

Keywords: project management practices, project management assessment, local government, project management maturity, PMBOK.

2.1 Introduction

Many, if not most of the local government agencies, have adopted some form of project management practices for delivering public work projects. However, many of these agencies have not implemented a systematic approach to evaluate project management performance. A literature study reveals that there is a performance measure gap in the project management area. Furthermore, not a single performance measure may fit all agencies. This study addresses the gap in performance measures in the project management area and explains the assessment methodology. The study proposes a methodology to assess the project-management process to improve the performance of local government agencies for delivering public work projects. A case study is included to demonstrate the applicability of the approach in three government agencies.

This paper is structured into four sections: introduction, background, methodology, study case, and conclusion. The introduction section briefly discusses the present need and the purpose of this study; the background section summarizes the literature review of the research's topic and briefly discusses the approach of the study to deploy the project management maturity model in a local government environment. The methodology section describes the assessment of the maturity level for the project management process. The section explains the determination of the project assessment survey, survey participants, and project-management maturity level. A case study demonstrates the application of the methodology in three local government agencies: The City of Sunland Park, the County of El Paso, and the City of El Paso. Finally, the conclusion presents the findings and future research recommendations.

2.2 Background

Increased demand for transparency and accountability has encouraged local governments to assess their project management performance in delivering projects. To improve project management performance, the local government agency should adopt a performance measurement methodology that fits its purpose. Also, each agency should develop its performance measure because there is no one "fits all performance measure approach; moreover, the performance measure should be based on a standard (Behn, 2003). A literature study reveals that many local governments have not used performance measures despite the benefits (Bernstein, 2000).

Considerable research studies to improve performance have been done in the private sector with the primary goal of creating value for stakeholders such that profitability and sustainable competitive advantage are enhanced (Winter et al., 2006). However, the goal is not aligned with government agencies because the governments are not in the business of making a profit or competing against other government agencies. A literature study revealed that there is a performance measure gap in the project management area (Thompson, 2009), and there has not been consensus about assessing the management performance in construction projects (Demikersen and Ozohon, 2017). Also, the literature review suggested that the best strategy is to improve performance through a continuous quality improvement program centered on project management (Wysocki, 2004) since the quality of work is the most critical attribute of project performance measurement (Ali et al., 2013).

This study aims to assist local government agencies in improving project management performance by developing a methodology to assess the project management process. The study adopts the Project Management Institute – PMBOK, 2017, as a standard, and the Project Management Maturity Model (PMMM) to determine the process maturity level. A maturity level is defined as "the state, fact, or period of being reached in the most advanced stage in a process" (Oxford Dictionary, 2013). The approach of this study is to determine the project management performance level by assessing the maturity level of the knowledge areas. As described in the PMBOK, 2017, a knowledge area is an identified area of project management defined by its knowledge requirements and described in terms of its component processes, practices, inputs, outputs, tools, and techniques. The following subsection discusses the historical development of the PMMM.

2.2.1 Project Management Maturity Model

The concept of the maturity model initially became popular through the Capability Maturity Model (CMM) proposed by the Software Engineering Institute of Carnegie-Mellon University between 1986 and 1993. Process maturity is defined as the extent to which a specific process is explicitly defined, managed, measured, controlled, and effective (Paulk et al., 1993). There are five levels of maturity in the CMM: Level 1(Initial), Level 2 (Repeatable), Level 3 (Defined), Level 4 (Managed), and Level 5 (Optimizing). These maturity levels are defined to assess the process's capability of organizations against an agreed scale (Paulk et al., 1993 and Goh et al., 2013). Many studies were made to expand the use of the maturity model to other disciplines to include project management (Goh and Rowlinson, 2013). A direct relationship between the maturity level and project performance can be established by generalizing the maturity construct; therefore, it is rational to propose a maturity model to holistically measure sustainable management development in delivering construction projects (Dooley et al., 2001 and Zoe et al., 2010).

The Project Management Maturity Model (PMMM) is the adaption of the CMM to the project management field. The PMMM adapts the five-level maturity of the CMM. The use of the PMMM has started since the mid-'90s. The maturity model provides an assessment framework that enables an organization to compare its project delivery with the best practices and ultimately defines a structured route to improvement (Pennypacker, 2003). Additionally, the assessment data can improve the effectiveness of the selection process of project management initiatives (Seidman and McCauley, 1996). In conclusion, this study adopts the PMMM maturity model to assess the project management processes in a local government through a comparison with the processes described in the Project Management Institute PMBOK Guide.

2.2.2 Local Government Environment

Figure 2.1 depicts the typical local government project execution environment for a council-manager form of government; a different government may have a separate project execution environment. It illustrates the project execution process where the project is managed by a construction manager hired by the agency, and the agency's project manager supervises the construction manager. Also, automatically, the agency's project manager is overseeing both the contractor and the construction manager within the local government infrastructure management scheme. Figure 2.1 also depicts the infrastructure management scheme that consists of strategic, network, project selection, and project level. This scheme can be simplified into two basic working or operational levels: the network and project management levels (Hudson et al., 1997). The main purpose of the network management level is developing a priority program. It requires information about all infrastructure projects; therefore, it requires a major data collection effort due to its size and complexity. The network management level is outside the scope of this research; therefore, it is not included in the scope of this research. On the other hand, the project level represents the physical implementation of the network's decisions. Projects are executed at this level; therefore, this research concentrates on the project level of the infrastructure management scheme.

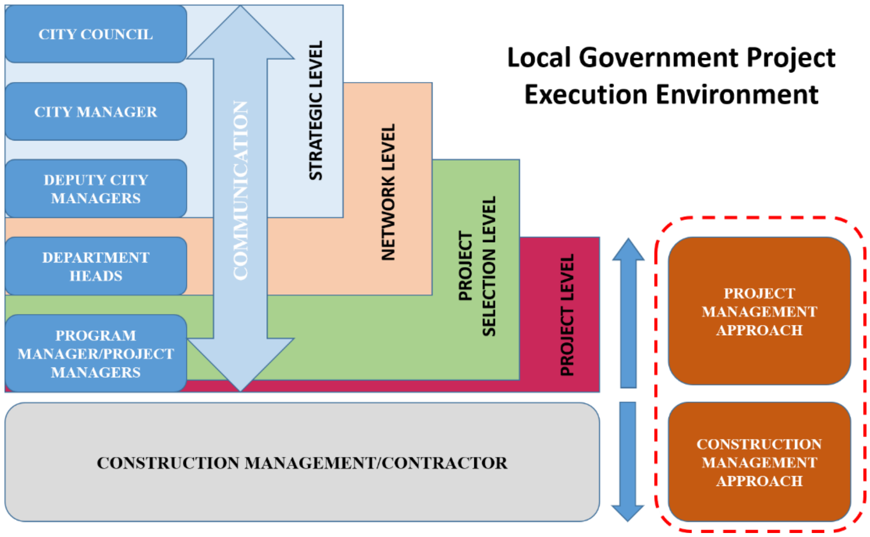

Figure 2.1 Local Government Project Execution Environment (Makahaube, 2020)

2.3. Methodology to Assess Project Management Process Maturity Level

This section discusses the approach used to collect and assess the information in project delivery management practices. This methodology builds upon the assumption that project management processes in a local government agency are not clearly defined and structured as described in the PMBOK. Furthermore, in overseeing the project execution, the local government relies on its project manager skills and knowledge of the project management processes. Consequently, these conditions make the project manager the central figure in executing the project management activities. It is, therefore, rational to characterize the maturity level through the assessment of project management knowledge areas.

The project management process and knowledge areas described in the PMBOK (2017) have been adapted to assess the existing project management practices at local government agencies, and the Project Management Maturity Model (PMMM) has been adopted to determine the project management maturity level. The scope of this study is limited to the construction phase of the project life cycle.

The research began with conducting a survey and analyzing the results to determine the maturity level of each process. Once the maturity level of the process was identified, the maturity level of the knowledge area was calculated by taking the average value of the maturity levels of all processes categorized in the same area. In this study, there was a total of seven knowledge areas that covered thirty project management processes. After the maturity levels of all knowledge areas were obtained, the organization project-management process maturity level was determined by calculating the average of all the maturity level scores. This process is illustrated in Figure 2.2.

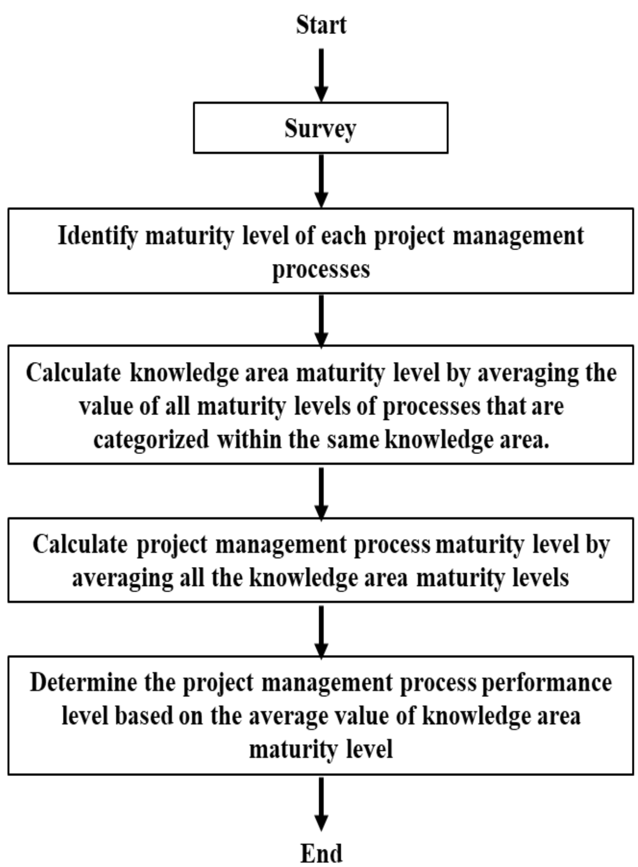

Figure 2.2 Methodology to Determine the Project Management Process Performance Level

The description of the methodology is structured into three subsections: survey participants, project-management practice survey, and determination of the project-management process maturity level.

2.3.1 Survey Participants

Three local government agencies participated in this study: The City of Sunland Park (New Mexico), the County of El Paso (Texas), the City of El Paso (Texas). The City of Sunland Park was represented by a project manager from the Public Works Department, and the County of El Paso was represented by a division manager from the Road and Bridges Department. Two departments represented the City of El Paso, the Capital Improvement Department, and the International Airport. A division manager represented the Capital Improvement Department, and a project manager represented the International Airport. In the City of El Paso, the Capital Improvement Department is the primary department that executes most, if not all, of the public works projects. The owner of the project is the "user" department; as an example, the International Airport is the owner or the user department. These municipalities are geographically located within the same proximity to each other and serve communities with a population below eight-hundred thousand people. The geographic locations of these communities are depicted in Figure 2.3

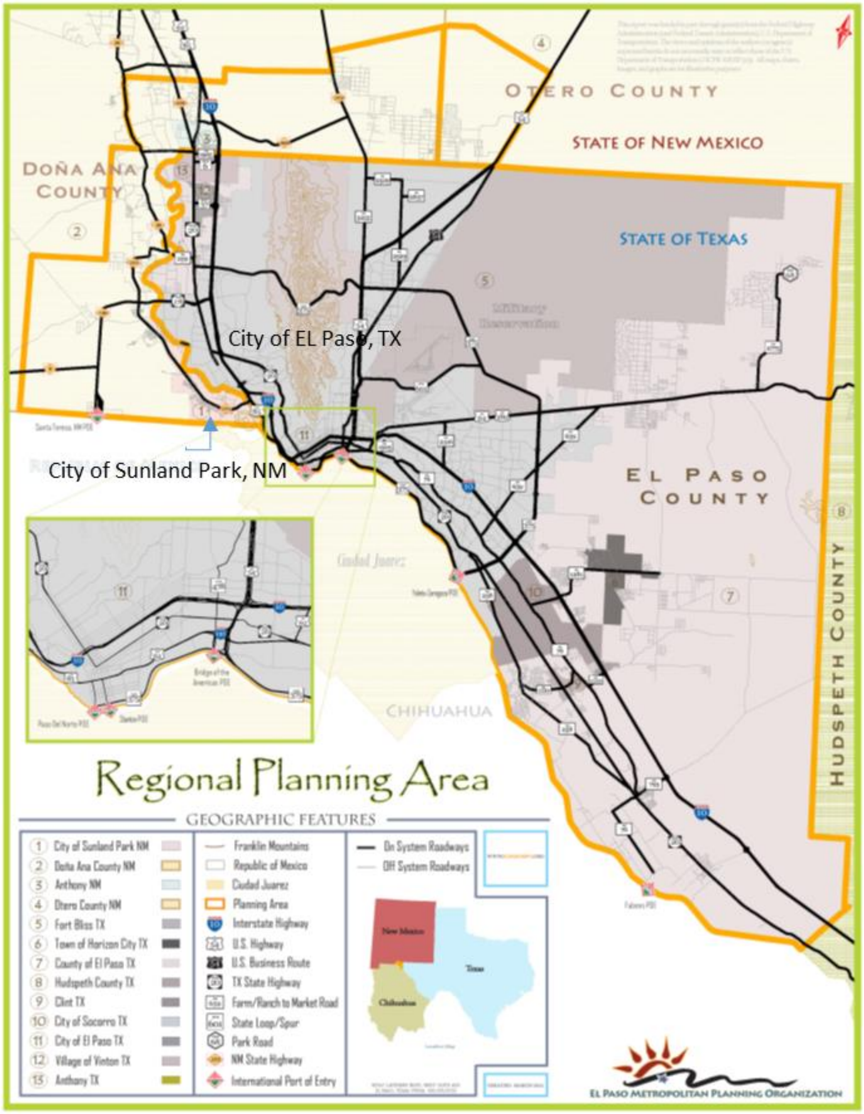

Figure 2.3 Geographic Location of Agencies (EL Paso MPO, 2012)

2.3.2 Project Management Practice Survey

A web-based survey tool, QuestionPro, is used to collect information about project management practices. The survey questionnaire encompasses the thirty project management processes and their associated knowledge areas. The processes and their knowledge areas were adapted from the PMBOK, 2017, the Project Management Process Group and Knowledge Area Mapping. In the PMBOK, there are ten knowledge areas with 49 individual processes within the five groups of project management processes. However, not all knowledge areas and processes are applicable to the local government's structural organization. Hence, only seven knowledge areas with thirty individual processes are used to design a survey questionnaire. Table 2.1 depicts the selected knowledge areas and project management processes.

The survey questionnaire assigns five statements to each of the project management processes. The five statements represent the present status of the process. The five statements define the characteristics of each maturity level. The respondents were asked to select one out of five statements to determine the maturity level of the project management process. Table 2.2 shows the structure of the survey questionnaire.

The Project Management Maturity Model (PMMM) is adapted to create the questionnaire. The PMMM provided a five-level maturity level scale similar to those of the CMM, with level one being the lowest maturity level and level five the highest.

Table 2.1 Selected Project Management Knowledge Areas and Processes (Adapted from PMBOK, 2017)

Knowledge Areas	Project Management Process Groups				
	1. Initiating Process Group	**2. Planning Process Group**	**3. Executing Process Group**	**4. Monitoring and Controlling Process Group**	**5. Closing Process Group**
1. Project Integration Management		• Project Plan Development	• Project Plan Execution	• Integrated Change Control	
2. Project Scope Management	• Initiation	• Scope Planning • Scope Definition		• Scope Verification • Scope Change Control	
3. Project Schedule Management		• Activity Definition • Activity Sequencing • Activity Duration Estimating • Schedule Development		• Schedule Control	
4. Project Cost Management		• Resource Planning • Cost Estimating • Cost Budgeting		• Control Costs	
5. Project Quality Management		• Quality Planning	• Quality Assurance	• Quality Control	
6. Project Communications Management		• Communication Planning	• Information Distribution	• Performance Reporting	• Administration Closure
8. Project Risk Management		• Risk Management Planning • Risks Identification • Qualitative Risk Analysis • Quantitative Risk Analysis • Risk Response Planning		• Risks Monitoring & Control	

Table 2.2 Survey Maturity Level Questionnaire Structure

No.	Knowledge Area	Project Management Process	Maturity Level Statements
1		Project Development Plan	Leveil 1, Level 2, Level 3, Level 4, and Level 5
2	Integration Management	Project Plan Execution	Leveil 1, Level 2, Level 3, Level 4, and Level 5
3		Integrated Change Control	Leveil 1, Level 2, Level 3, Level 4, and Level 5
4		Initiation	Leveil 1, Level 2, Level 3, Level 4, and Level 5
5		Scope Planning	Leveil 1, Level 2, Level 3, Level 4, and Level 5
6	Scope Management	Scope Definition	Leveil 1, Level 2, Level 3, Level 4, and Level 5
7		Scope Verification	Leveil 1, Level 2, Level 3, Level 4, and Level 5
8		Scope Change Control	Leveil 1, Level 2, Level 3, Level 4, and Level 5
9		Activity Definition	Leveil 1, Level 2, Level 3, Level 4, and Level 5
10		Activity Sequencing	Leveil 1, Level 2, Level 3, Level 4, and Level 5
11	Time Management	Activity Duration Estimate	Leveil 1, Level 2, Level 3, Level 4, and Level 5
12		Schedule Development	Leveil 1, Level 2, Level 3, Level 4, and Level 5
13		Schedule Control	Leveil 1, Level 2, Level 3, Level 4, and Level 5
14		Resource Planning	Leveil 1, Level 2, Level 3, Level 4, and Level 5
15	Budget Management	Cost Estimating	Leveil 1, Level 2, Level 3, Level 4, and Level 5
16		Cost Budgeting	Leveil 1, Level 2, Level 3, Level 4, and Level 5
17		Cost Control	Leveil 1, Level 2, Level 3, Level 4, and Level 5
18		Quality Planning	Leveil 1, Level 2, Level 3, Level 4, and Level 5
19	Quality Management	Quality Assurance	Leveil 1, Level 2, Level 3, Level 4, and Level 5
20		Quality Control	Leveil 1, Level 2, Level 3, Level 4, and Level 5
21		Communication Planning	Leveil 1, Level 2, Level 3, Level 4, and Level 5
22	Communication Management	Information Distribution	Leveil 1, Level 2, Level 3, Level 4, and Level 5
23		Performance Reporting	Leveil 1, Level 2, Level 3, Level 4, and Level 5
24		Administration Closure	Leveil 1, Level 2, Level 3, Level 4, and Level 5
25		Risk Management Planning	Leveil 1, Level 2, Level 3, Level 4, and Level 5
26		Risk Identification	Leveil 1, Level 2, Level 3, Level 4, and Level 5
27	Risk Management	Qualitative Risk Analysis	Leveil 1, Level 2, Level 3, Level 4, and Level 5
28		Quantitative Risk Analysis	Leveil 1, Level 2, Level 3, Level 4, and Level 5
29		Risk Response Planning	Leveil 1, Level 2, Level 3, Level 4, and Level 5
30		Risk Monitoring & Control	Leveil 1, Level 2, Level 3, Level 4, and Level 5

2.3.3 Project-Management Maturity Level Determination

The survey to determine the project-management maturity level was structured based on the PMMM five-level maturity processes. Not all characteristics from the original model were utilized; only one critical characteristic from each level was selected for the survey. The selection was made to the degree that the characteristics of each level are maintained. Also, this step is necessary to ease responses from the survey participants. Figure 2.4 depicts the selected characteristics of the maturity level.

The adapted description of each maturity level is described as follows:

Level 1: Initial Process is the maturity level where there are no standards, and project management processes are informal. The use of the project management processes is entirely at the discretion of the project managers. However, it does not mean that projects will fail or be subject to poor management; it only means that project management is mostly dependent upon the knowledge possessed and practiced by the project managers.

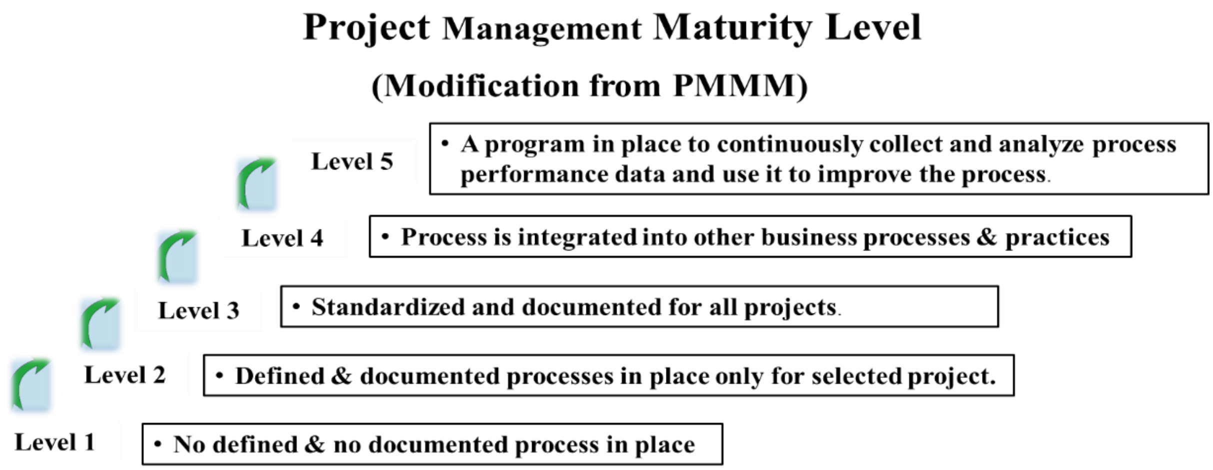

Figure 2.4 Adapted Project Management Maturity Level

Level 2: Structured Process is the maturity level where several project management processes may exist and are documented within the organization; however, the processes are not required for the projects. Project managers use these processes when it fits their needs. Project status reporting is informal and not consistent across projects.

Level 3: Institutional Process is the maturity level where a standard has been adopted and documented for all projects.

Level 4: Managed Process is the maturity level where the project management process and other management systems are integrated. Moreover, the performance across the projects is monitored by senior management.

Level 5: Optimizing Process is the maturity level where the focus is on the improvement of the in-place project management process. At this level, this process identifies and addresses the performance issue related to the processing by incorporating the best practices and lessons learned from the response to the project management improvement.

In the PMMM, the maturity level of project-management practice is determined by assessing the maturity level of each process (Wysocki, 2004). This approach is commonly used in the manufacturing field; however, it does not fit into the local government management process because of the significant differences in the purpose and functionality of the organization. Thereby, this study determines the project management maturity level by assessing the knowledge areas. After the maturity level of each process is obtained from the survey, the knowledge area maturity level can be determined. The maturity level of the knowledge area is equal to the average of the maturity level of the processes in the same knowledge area. Equation 1 expressed this relationship.

- Maturity level of the process in a knowledge-area

$$mpi = \sum_{i=1}^{n} \frac{Pl(i)}{n} \qquad \text{Equation 1}$$

mpi = Knowledge area maturity level

Pl = Project management process maturity level

Once the maturity level of a knowledge area is determined, the overall project-management maturity level can be calculated by averaging all the knowledge area maturity levels, as expressed in Equation 2.

$$Ml = \sum_{i=1}^{j} \frac{mp(i)}{j} \qquad \text{Equation 2}$$

J = Number of project management knowledge area

Ml = Overall Project Management Maturity Level

The value of the knowledge area maturity level must be an integer, and it is rounded down.

The knowledge areas, as described in the PMBOK, tie directly to the function of divisions within an organizational structure. Depending on the size and structure of the agencies, a knowledge area or several knowledge areas may be required for a department's division. In other words, a division may perform multiple functions that require multiple knowledge areas, and this condition frequently occurs for a small-town government agency in which a division performs multiple functions.

2.4 Case Study

This section discusses the project management processes and knowledge area maturity level of the project management processes of three local government agencies: The City of Sunland Park, the County of El Paso, and the City of El Paso. The project management processes were categorized into seven knowledge areas: project integration management, project scope management, project schedule management, project cost management, project quality management, project communication management, and project risk management. The implementation of the project management processes in each agency was studied by comparing the maturity levels among the participants.

2.4.1 Project Delivery Structure Organization

The survey indicated that there are five to six divisions involved in the project delivery process in each of the participants. These divisions may be housed within the same department or several different departments.

- The City of Sunland Park utilized project management, construction management, procurement, building permit, and code compliance.
- The County of El Paso utilized planning, transportation planning, design, construction inspection, and code compliance.
- The City of El Paso – Capital Improvement Department utilized transportation planning, design, project management, construction management, construction inspection, and contract compliance

- The City of El Paso – International Airport utilized the project-management, construction management, procurement, building permit, and code compliance.

The survey indicated that none of the agencies possess the best management practices to assist them in conducting project management activities. They rely on the experience possesses by each of their project managers or informal in-house project's guidelines.

2.4.2 Project Management Processes and Knowledge Areas Maturity Level

This subsection describes the assessment of the maturity level of the seven knowledge and project management processes. In identifying the opportunity area of improvement, only a process with maturity level one or two is considered for potential improvement. At these levels, project management processes have not been documented or standardized by the agency.

- **Project Integration Management**

Figure 2.5 shows the project management processes within the management knowledge area: project development plan, project plan execution, and integrated change control. Both the City of Sunland Park and the County of El Paso are performing at maturity level one in all three processes.

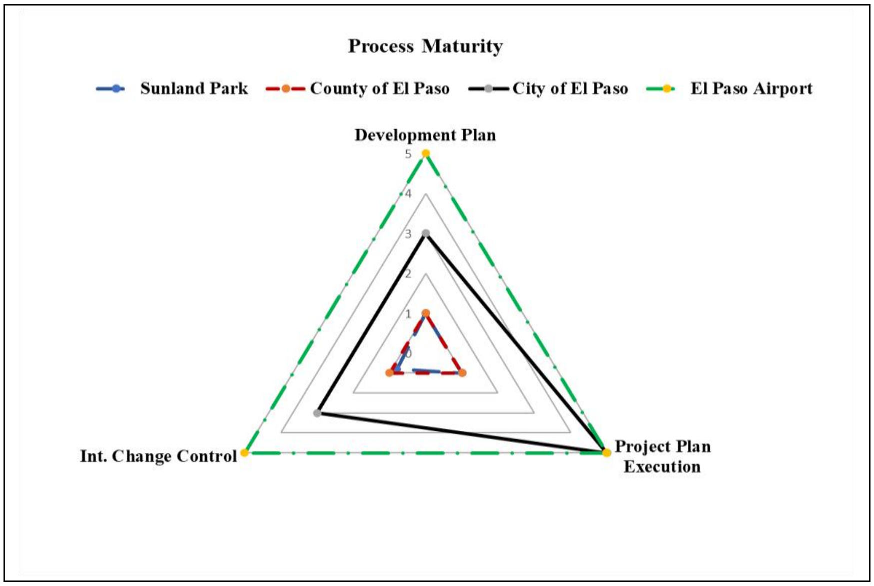

Figure 2.5 Integration Management Process Maturity

The City of El Paso – CID (EP-CID) performed better than the other two cities; it performed at maturity level three in both project development plans and integrated change control processes. In the project plan execution process, it performed at maturity level five. There was a lack of consistency among the three processes; nonetheless, the City had reached maturity level three. The City of El Paso – Airport (EP-Airport) performed better than the EP-CID; it performed at maturity level 5 p in the three processes.

Figure 2.6 shows the average value of the three project management processes within the knowledge area. Both the City of Sunland Park and the County of El Paso performed at the maturity level one. The results of the EP-CID and EP-Airport were unexpected. As the leading department in delivering projects, The EP-CID was expected to have a better outcome; however, in this case, the EP-Airport showed better results.

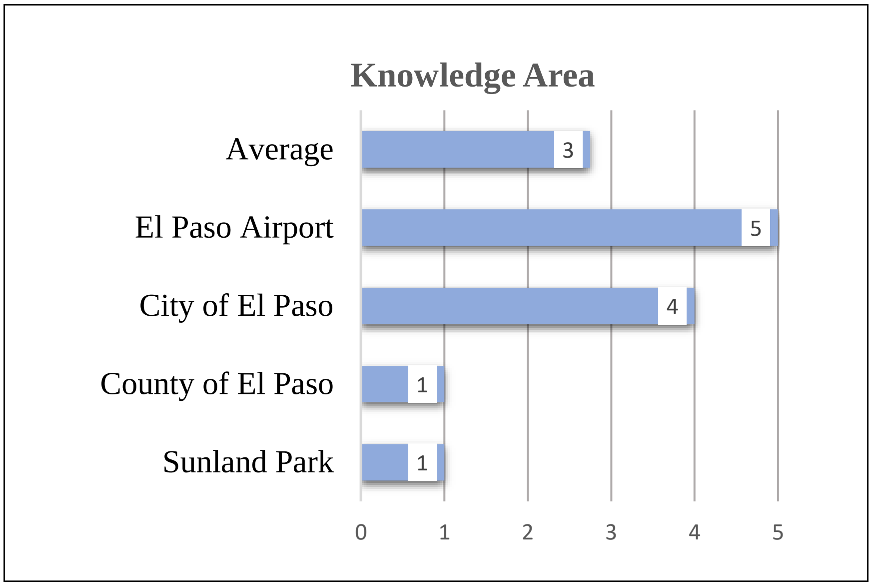

Figure 2.6 Integration Management Knowledge Area Maturity

The knowledge area maturity levels of EP-CID and EP-Airport were four and five, consecutively. Table 2.3 presents opportunity improvement areas for each of the participants. Only the project management process with a maturity level of two or below was considered for improvement.

Table 2.3 Integration Management Process Opportunity Improvement Areas

Local Government	Opportunity Areas for Improvement
City of Sunland Park	Project Development Plan, Project Plan Execution, Int Change Control
County of El Paso	Project Development Plan, Project Plan Execution, Int Change Control
City of El Paso CID	None
City of El Paso Airport	None

- **Project Scope Management**

The knowledge-area of project scope management consists of five processes: initiation, scope planning, scope definition, scope verification, and scope change control. As shown in Figure 2.7, the City of Sunland Park performed at level three for the initiation and scope planning processes; it performed at level one for the scope definition, scope verification, and scope change control. The County of El Paso performed at level two for the initiation, scope planning, and scope change control; it performed at level one both for scope definition and scope verification. The City of El Paso – CID performed at level three for four processes, except for the scope definition, it performed at level two. The City of El Paso – Airport performed at level three for the initiation, scope planning, and scope change control; it performed at level one for scope definition and scope verification.

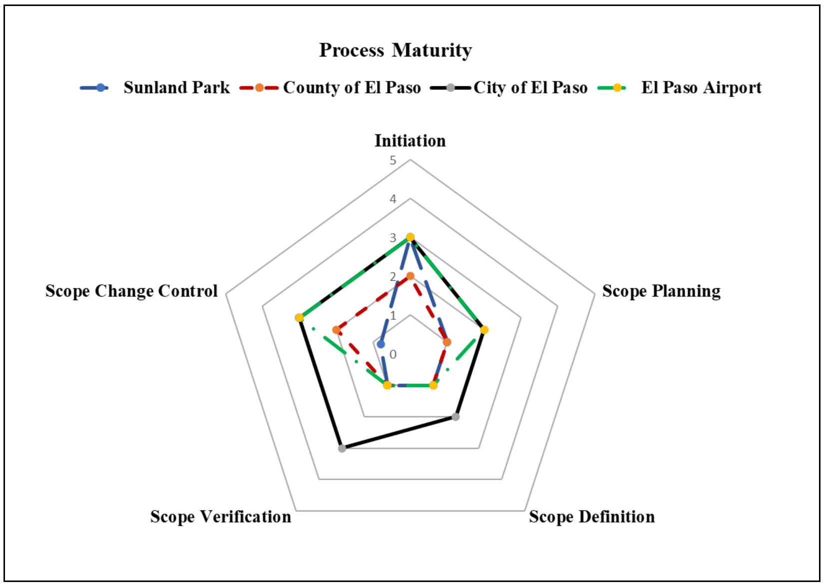

Figure 2.7 Maturity of the Scope Management Process

The knowledge area maturity level for each of the participants is shown in Figure 2.8. All the participants expressed the need for improvements. Both the City of Sunland Park and the County of El Paso performed at maturity level one; these results were expected. The City of El Paso – CID and Airport performed at maturity level two. As the primary department in managing projects, the City of El Paso – CID should have performed better than the Airport as the user department. However, these results may also indicate that inconsistency in performance should be expected when a process is not standardized.

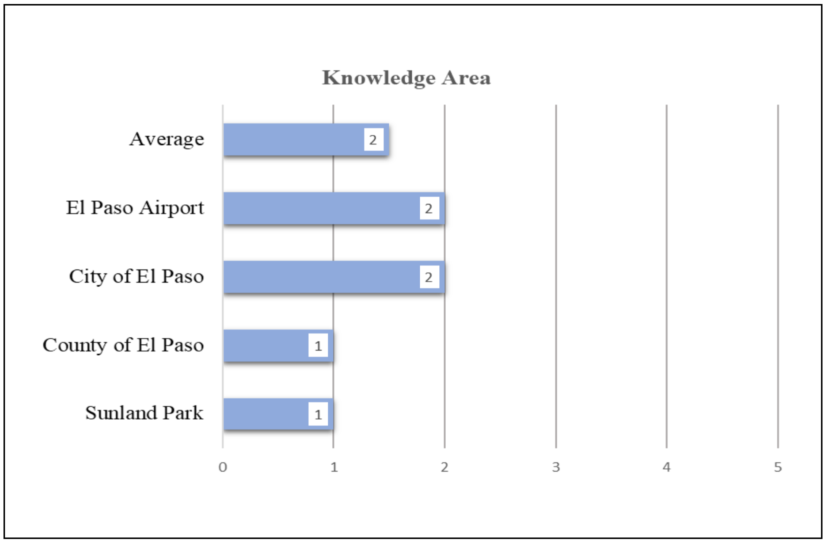

Figure 2.8 Scope Management Knowledge Area

Table 2.4 below indicated opportunity improvement areas for the project management processes with a maturity level of two and below.

Table 2.4 Scope Management Process Improvement Opportunity

Local Government	Opportunity Areas for Improvement
City of Sunland Park	Scope Definition, Scope Verification, and Scope Change Control
County of El Paso	Initiation, Scope Planning, Scope Definition, Scope Verification, and Scope Change Control
City of El Paso CID	Scope Definition
City of El Paso – Airport	Scope Definition and Scope Verification

- **Project Schedule Management**

The project schedule management knowledge-area consists of five processes: activity definition, activity sequencing, activity duration estimate, schedule development, and schedule control. The City of Sunland Park performed at knowledge area maturity level one in all the processes. The County of El Paso performed at level one for the activity definition, activity sequencing, and schedule control; it performed at level two for activity duration estimate and schedule development. The City of El Paso – CID performed consistently at level three, where the Airport performed at level one for all processes. These results are shown in Figure 2.9.

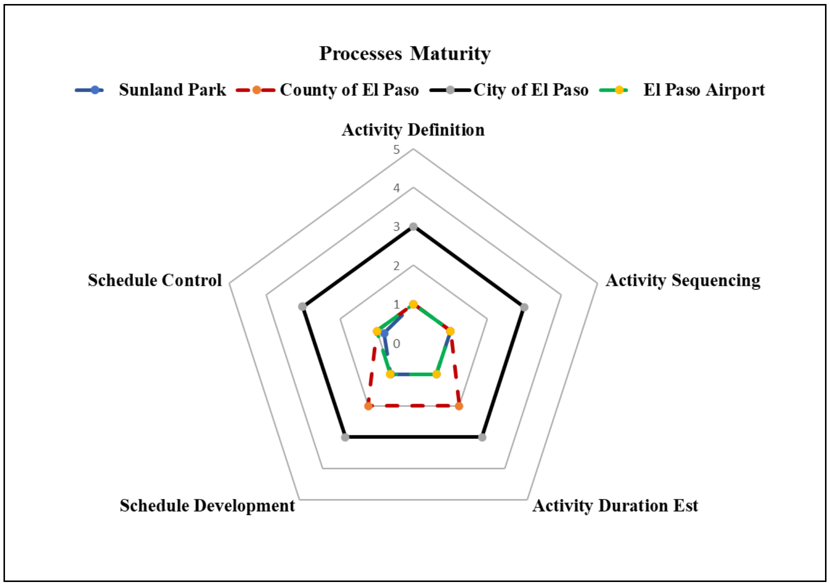

Figure 2.9 Maturity of the Schedule Management Process

Figure 2.10 presents the results of the knowledge area maturity level of the participants. The City of El Paso – CID performed at level three, where the City of Sunland Park, the County of El Paso, and the City of El Paso – Airport performed at level one.

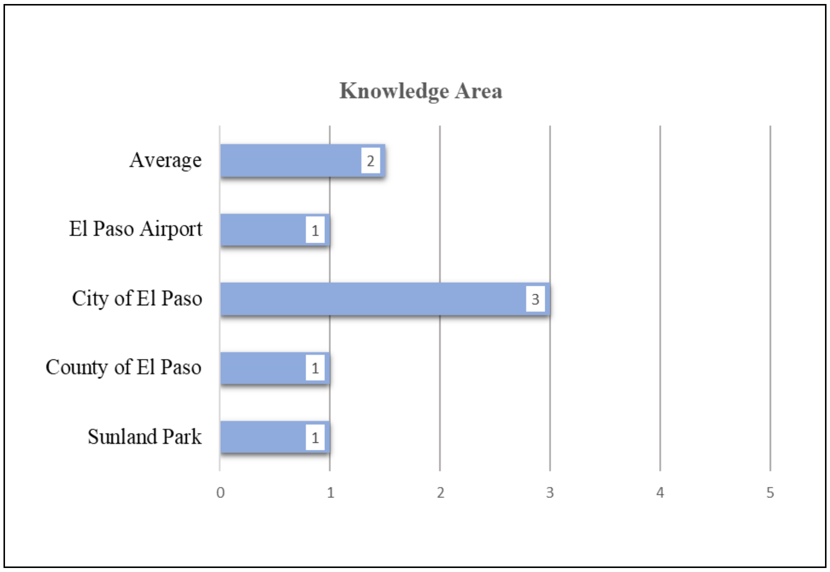

Figure 2.10 Schedule Management Knowledge Area

Table 2.5 below presents opportunity areas for improvement for processes with a maturity level of two and below.

Table 2.5 Schedule Management Process Improvement Opportunity

Local Government	Opportunity Areas for Improvement
City of Sunland Park	Activity Definition, Activity Sequencing, Activity Duration Estimate, Schedule Development, and Schedule Control
County of El Paso	Activity Definition, Activity Sequencing, Activity Duration Estimate, Schedule Development, and Schedule Control
City of El Paso CID	None
City of El Paso – Airport	Activity Definition, Activity Sequencing, Activity Duration Estimate, Schedule Development, and Schedule Control

- **Project Cost Management**

There are four processes in this knowledge area: cost estimating, cost budgeting, cost control, and resource planning. As shown in Figure 2.11, the City of Sunland Park performed at maturity level three for all processes. The County of El Paso performed at maturity level two in both resource planning and cost estimating; it performed at level three for cost budgeting and at level one for cost control.

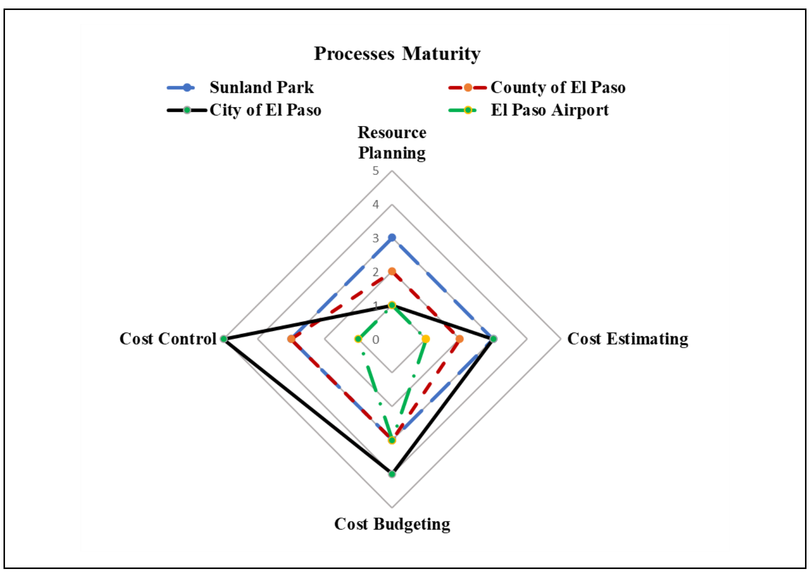

Figure 2.11 Maturity of the Cost Management Process

The City of El Paso – CID performed at various maturity levels with resource planning at the lowest and cost control at the highest level; it performed at level three and four for cost estimating and cost budgeting, consecutively. Finally, the City of El Paso – Airport performed at level one for resource planning and cost estimating; it performed at level three for cost budgeting and cost control.

Figure 2.12 presents the knowledge area maturity level of project cost management. The City of Sunland Park performed consistently at level three for all the processes. The City of Sunland Park only had one project manager; therefore, these results most probably were a reflection of the project manager's ability rather than the maturity of the process. The County of El Paso performed at maturity level two. The City of El Paso – CID performed at maturity level three. The City of El Paso – Airport performed at level two. These results could be an expression of the different levels of skills and knowledge possessed by the project manager in the City of El Paso as the primary department in managing projects as compared to the project manager in the Airport as the user department.

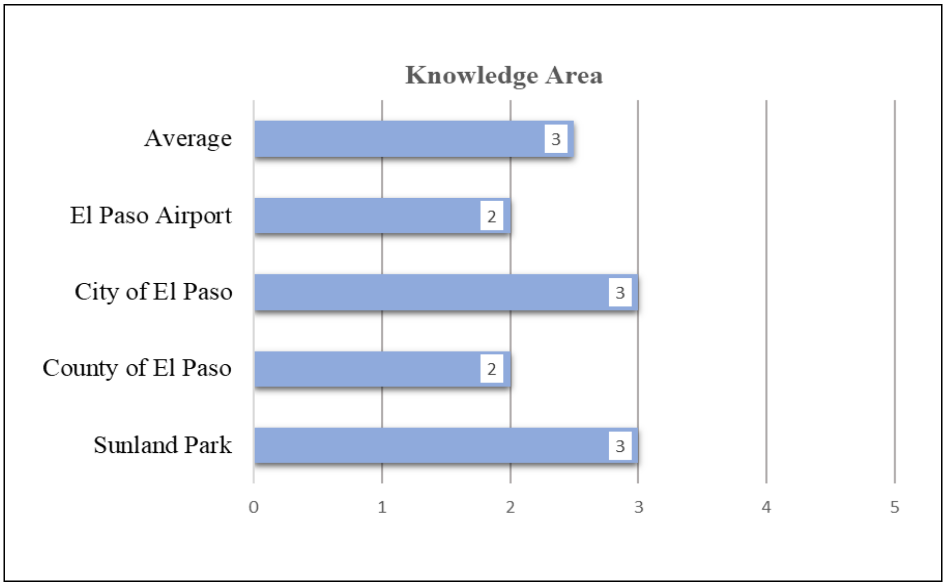

Figure 2.12 Cost Management Knowledge Area

Table 2.6 presents opportunity areas for improvement for processes with a maturity level of two and below.

Table 2.6 Cost-Management Process Improvement Opportunity

Local Government	Opportunity Areas for Improvement
City of Sunland Park	None
County of El Paso	Resource Planning, Cost Estimating, and Cost Control
City of El Paso - CID	Resource Planning
City of El Paso - Airport	Resource Planning and Cost Estimating

- **Project Quality Management**

The project-quality management knowledge area consists of three project management processes: quality planning, quality assurance, and quality control. As shown in Figure 2.13, the City of Sunland Park performed at maturity level one in all the processes. The County of El Paso performed at maturity level two for quality assurance and quality control; it performed at level one for quality planning. Both the City of El Paso – CID and Airport consistently performed at maturity level three for all the processes.

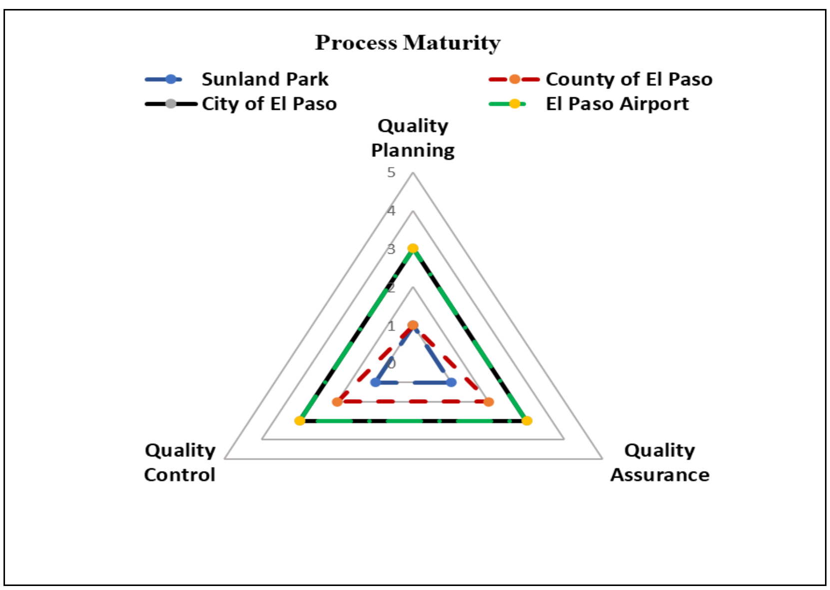

Figure 2.13 Maturity of the Quality Management Process

Figure 2.14 shows the knowledge area maturity level. The City of Sunland Park performed at level one maturity in all the processes. The County of El Paso performed at level one for quality planning and level two for quality assurance and quality control. The City of El Paso – CID and Airport both performed at level three.

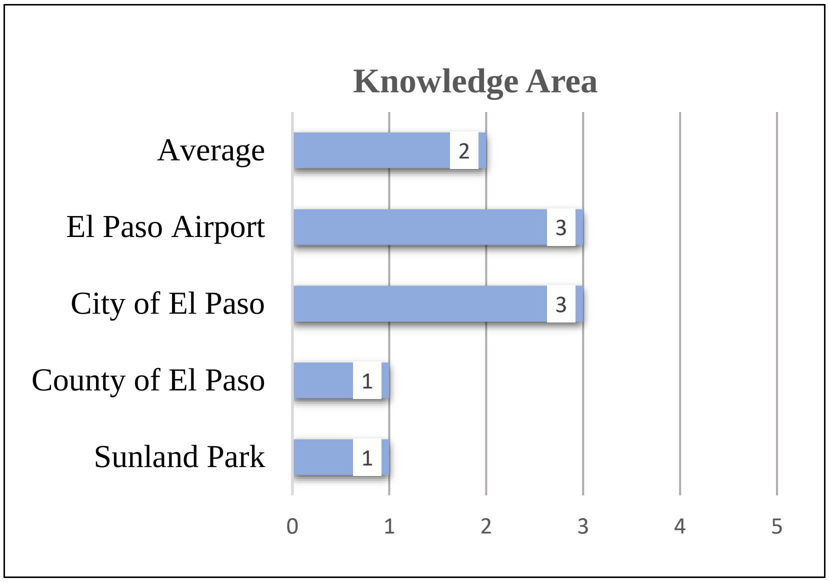

Figure 2.14 Quality Management Knowledge Area

Table 2.7 below presents opportunity areas for improvement for processes with a maturity level of two and below.

Table 2.7 Quality Management Process Improvement Opportunity

Local Government	Opportunity Areas for Improvement
City of Sunland Park	Quality Planning, Quality Assurance, and Quality Control
County of El Paso	Quality Planning, Quality Assurance, and Quality Control
City of El Paso CID	None
City of El Paso - Airport	None

- **Project Communication Management**

The communication management knowledge area consists of four processes: communication planning, information distribution, performance reporting, and administration closure. The City of Sunland Park performs at level one in all the processes; the same pattern occurred with the County of El Paso. The City of El Paso – CID performed at level three in the communication planning and information distribution; it performed at level one in performance reporting and level five in administrative closure. The Airport performed consistently at maturity level three for all processes. These results are shown in Figure 2.15.

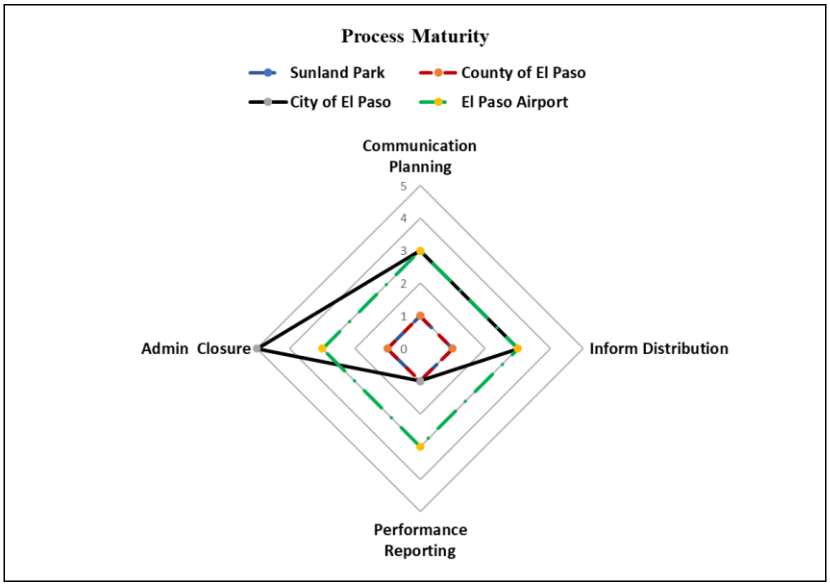

Figure 2.15 Maturity of the Communication Management Process

The project-management knowledge area maturity levels of the participants were shown in Figure 2.16. The City of Sunland Park and the County of El Paso performed at maturity level one, and the City of El Paso – CID and Airport performed at level three.

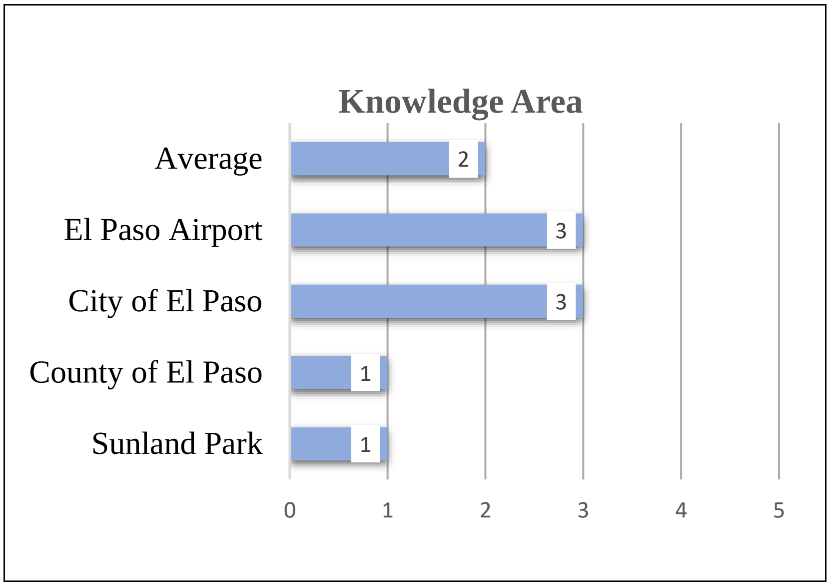

Figure 2.16 Communication Management Knowledge Area

Table 2.8 presents opportunity areas for improvement for processes with a maturity level of two and below.

Table 2.8 Communication Management Process Improvement Opportunity

Local Government	Opportunity Areas for Improvement
City of Sunland Park	Communication Planning, Information Distribution, Performance Reporting, and Administration Closure
County of El Paso	Communication Planning, Information Distribution, Performance Reporting, and Administration Closure
City of El Paso CID	Performance Reporting
City of El Paso - Airport	None

- **Project Risk Management**

The risk management knowledge area consists of six processes: risk management planning, risk identification, qualitative risk analysis, quantitative risk analysis, risk response planning, and risk monitoring and control. Figure 2.17 showed that all the processes are at a maturity level one for all the participants, with the exception of the County of El Paso, which performed at level two for the risk response planning. It is likely that this result reflected what happened in the Summer of 2006. The El Paso regions experienced heavy rains and flash floods that devastated Western

Texas and Southern New Mexico. As a result, the County of El Paso had to perform risk management activities. The results suggested that the project management processes for risk management are outside the existing project delivery process.

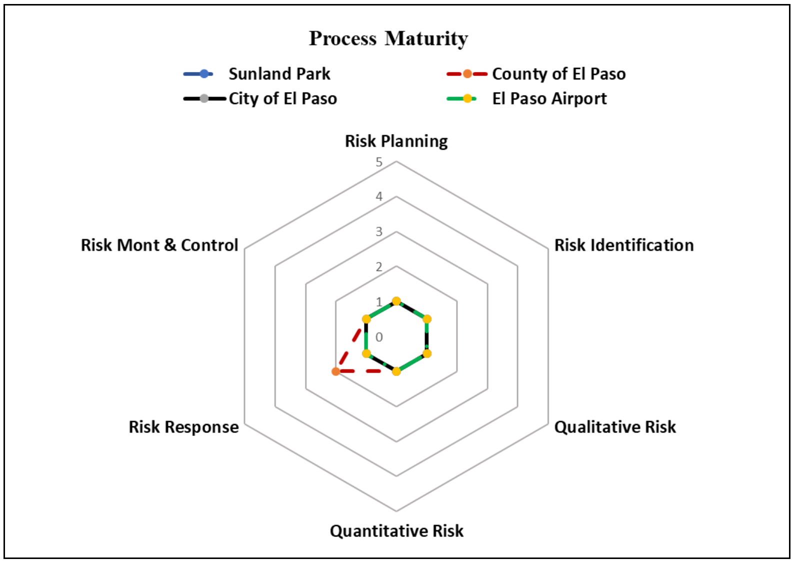

Figure 2.17 Maturity of the Risk Management Process

Figure 2.18 shows the knowledge area maturity levels for the participants.

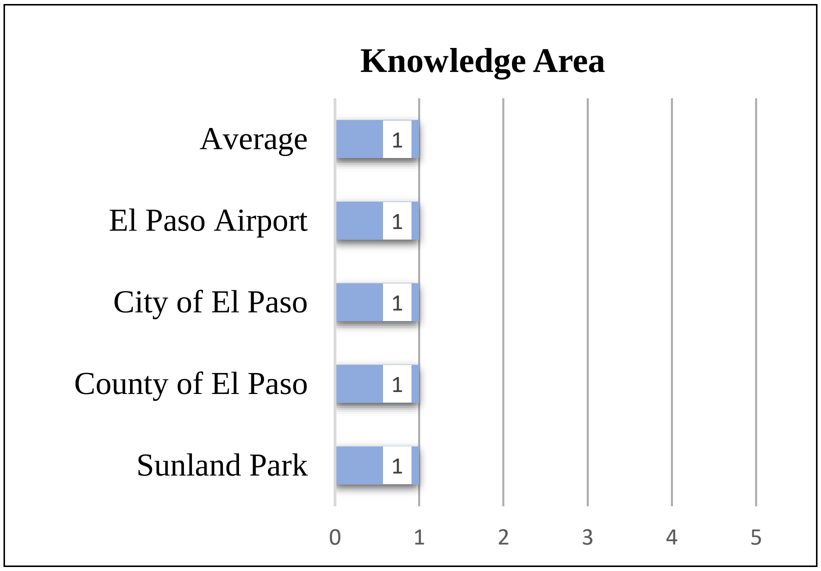

Figure 2.18 Risk Management Knowledge Area

Table 2.9 presents the opportunity areas of improvement for processes with a maturity level of two and below.

Table 2.9 Risk-Management Process Improvement Opportunity

Local Government	Opportunity Areas for Improvement
City of Sunland Park	Risk Mgmt. Planning, Risk Identification, Qualitative Risk Analysis, Quantitative Risk Analysis, Risk Response Planning, Risk Monitoring & Control.
County of El Paso	Risk Mgmt. Planning, Risk Identification, Qualitative Risk Analysis, Quantitative Risk Analysis, Risk Response Planning, Risk Monitoring & Control
City of El Paso CID	Risk Mgmt. Planning, Risk Identification, Qualitative Risk Analysis, Quantitative Risk Analysis, Risk Response Planning, Risk Monitoring & Control
City of El Paso - Airport	Risk Mgmt. Planning, Risk Identification, Qualitative Risk Analysis, Quantitative Risk Analysis, Risk Response Planning, Risk Monitoring & Control

2.4.3 Project-Management Process Maturity Level

Figure 2.19 shows the maturity level of the seven project management knowledge areas for each of the participants.

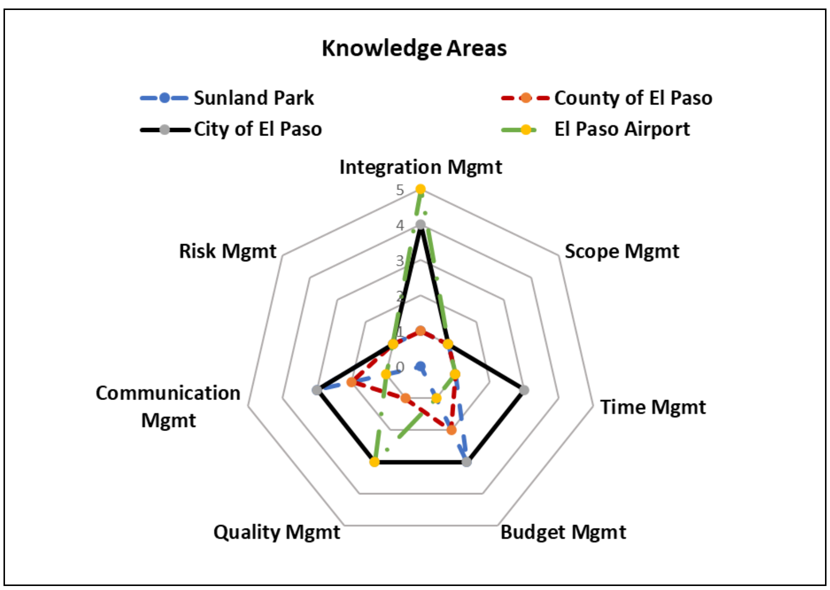

Figure 2.19 Knowledge Area Maturity level

The average of these knowledge areas for each participant represents the maturity level of the project management practices. Figure 2.20 depicts the maturity level for each participant.

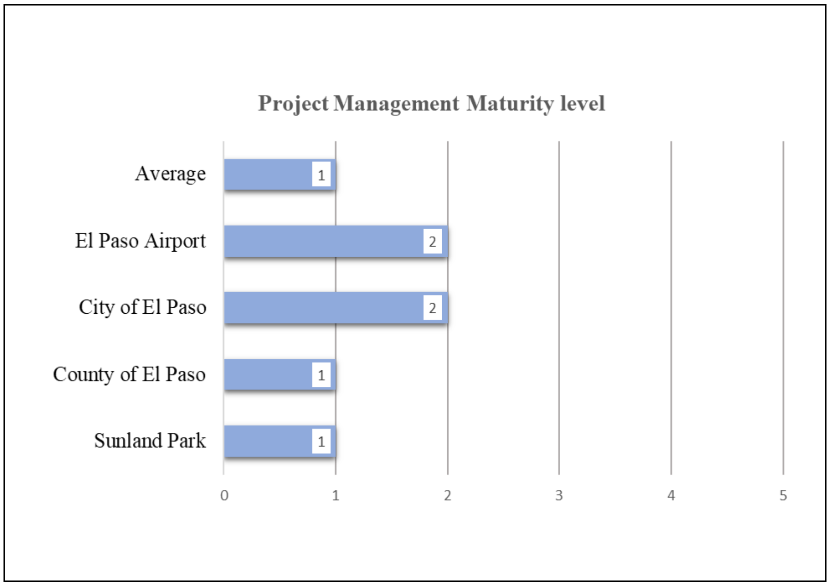

Figure 2.20 Maturity Level of Project-Management Practices

The results showed that the City of Sunland Park and the County of El Paso performed at project management maturity level one. The City of El Paso CID and Airport performed at level two of the project management maturity level.

2.5 Summary of Project Management Process Area of Improvements

This section discusses the maturity level of project management processes in each knowledge area category. The purpose was to identify project management processes for improvement in order to increase the agency's performance. Only processes with maturity levels one and two were considered as potential candidates for improvement. This step was necessary to determine the targeted processes for improvement that can be used by an agency to decide on a strategy for improvement. Depending on the magnitude of the scope and budget, an agency may decide a strategy for implementation. Table 2.10 shows the number of processes for each maturity level. The grey area highlights the process with maturity levels one and two.

Table 2.10 Summary of the Number of Project Management Processes for Improvements

Agency	Knowledge Area	Number of Processes	Number of Processes for Each Maturity Level				
			Level 1	Level 2	Level 3	Level 4	Level 5
City of Sunland Park	Integration Management	3	3				
	Scope Management	5	3				
	Time Management	5	5				
	Budget Management	4			4		
	Quality Management	3	3				
	Communication Management	4	4				
	Risk Management	6	6				
	Potential Process for Improvement		24		NA	NA	NA
County of El Paso	Integration Management	3	3				
	Scope Management	5	2	3			
	Time Management	5	3	2			
	Budget Management	4	1	2	1		
	Quality Management	3	1	2			
	Communication Management	4	4				
	Risk Management	6	5	1			
	Potential Process for Improvement		19	10	NA	NA	NA
City of El Paso	Integration Management	3			2		1
	Scope Management	5		1	4		
	Time Management	5			5		
	Budget Management	4	1		1	1	1
	Quality Management	3			3		
	Communication Management	4	1		2		1
	Risk Management	6	6				
	Potential Process for Improvement		8	1	NA	NA	NA
Airport - City of El Paso	Integration Management	3					3
	Scope Management	5	2		3		
	Time Management	5	5				
	Budget Management	4	2		2		
	Quality Management	3			3		
	Communication Management	4			4		
	Risk Management	6	6				
	Potential Process for Improvement		15		NA	NA	NA

Figure 2.20 shows that the City of Sunland Park and the County of El Paso had a project management maturity level of one, and the City of El Paso (both the CID and Airport) had a maturity level of two. Even though the difference of project management maturity levels between the City of Sunland Park and the County of El Paso to those of the City of El Paso (both CID and Airport) merely one level, there are significant differences in the number of project management processes for potential improvement. There were twenty-four processes identified for the City of Sunland Park for potential improvements; these are processes at maturity level one. For the County of El Paso, there were twenty-nine processes identified for possible improvements. Nineteen of them are at a maturity level one, and ten of them are at maturity level two. A total of nine processes were identified for possible improvements for the City of El Paso (CID); eight of them are at

maturity level one and one at maturity level two. For the City of El Paso – Airport, there were fifteen processes identified for improvement, and all of them are at maturity level one.

These findings suggest that the investments to improve project management performance level for the City of Sunland Park and the County of El Paso may be much higher than those of the City of El Paso. Also, the findings suggest that the City of El Paso, over the years, has been improving its project management processes. Meanwhile, both the City of Sunland Park and the County of El Paso may not have to make considerable effort to improve their processes because of their organizational structure and purpose of these agencies. These results are expected because the City of El Paso manages public works projects with a significantly higher operating budget than the City of Sunland Park and the County of El Paso.

2.6 Conclusion

The following are conclusions that can be drawn from the results of the case study.

- Many local governments have adopted project management practices; however, their project management maturity level is still at Level 1 (Initial Stage), where the project management process has not been defined or documented. Some have reached Level 2 (Structured), where project management processes exist but have not been consistently implemented for all projects. The lack of progress may be due to the lack of a methodology to assess their project management performance. This study provides a method for local agencies to evaluate their project management performance.
- The results indicate that all the agencies do not have standardized and documented project management processes. This finding suggests that the agencies rely heavily on their project manager's ability to execute project management activities; thereby, a methodology

centered on the project-manager ability, as described in this study, applies to local government agencies.

- The results of this study suggest that this methodology can be utilized to improve the project performance of local government agencies by determining the maturity level of their project management processes and identifying the opportunity areas for improvement. With the ability to recognize opportunity areas of improvement, an agency can decide on a strategy to improve the project management performance level.
- The assessment methodology discussed in this study addresses the gap in project management performance measures by providing a tool to assess the performance of project management practices at local government agencies.
- The application of this methodology applies to large agencies with some modifications. The modifications consist of expanding the survey questionnaire to include additional project management processes, expanding the maturity level questionnaire structure, and increasing the number of representatives for each agency.

2.6.1 Reflection

While the concept of improving project management performance level is a noble idea, local agencies with small communities such as the City of Sunland Park or the County of El Paso may not have enough capital for investing in the improvement process. Each of the agencies has twenty-four and twenty-nine processes for potential improvement; the investment cost associated with the improvement processes may not be affordable for these communities. Additionally, the improvement process may require a sustainable and continuous commitment from the leadership that might not be feasible because of the political environment. Thereby, a step-by-step approach following a methodological process is needed for the implementation of the improvement process.

However, the agency may decide to keep current management practices and operate with the project-manager centered approach. Moreover, the five-level PMMM maturity model may not be the best fit for small communities because achieving maturity level five becomes an unattainable goal.

The City of El Paso (CID) has seventeen processes at maturity level three, one process at maturity level four, and three at maturity level five. The Airport has twelve processes at maturity level three and three processes at level five. These findings indicate that a local government agency can achieve maturity level. This study also shows that the City of El Paso has further developed its project management processes to reach maturity level three.

2.7 Recommendations for future research

Future research could be performed by expanding the survey questionnaire to include a series of questions for each project management process to better determine the maturity level of each process. Also, increasing the number of project managers representing an agency should improve the determination of the maturity level. In addition, future research on the project-delivery organization structure is critical in improving the agency's project management performance. This research should include divisions that will directly or indirectly affect the agency's performance and their aligning functions as related to the project management processes described in the PMBOK.

2.8 Contribution to Local Government Agencies

- This study introduces a method for assessing the project management performance of local government agencies.
- Local government agencies can use the proposed method to identify the project management processes that need improvement.

2.9 Limitations

- The survey results in the case study represent the response of one representative, a project manager from each local government.
- The survey results may not represent other local government agencies' project management practices serving larger communities.
- The survey questionnaire to assess the project management processes consists of one question per maturity level; therefore, one single response may not be sufficient to capture the level of maturity of the process.
- The traditional design-bid-build project delivery process is considered in the survey for analysis, and no other project delivery methods are addressed in the study.
- The scope of this study is limited to the construction phase only because the local government treats the design phase and construction phase as separate phases.

References

Abdul Rasid, S. Z., Wan Ismail, W. K., Mohammad, N. H., & Long, C. S. (2014). Assessing the adoption of project management knowledge areas and maturity level: A case study of a public agency in Malaysia. *Journal of Management in Engineering*, *30*(2), 264–271.

Andersen, E. S., & Jessen, S. A. (2003). Project maturity in organizations. *International Journal of Project Management*, *21*(6), 457–461.

Auger, D. A. (2019). Public management of privatization and contracting. In *Public productivity handbook* (pp. 155–188). CRC Press.

Bassioni, H. A., Price, A. D. F., & Hassan, T. M. (2004). Performance measurement in construction. *Journal of Management in Engineering*, *20*(2), 42–50.

Bay, A. F., & Skitmore, M. (2006). Project management maturity: some results from Indonesia. *Journal of Building and Construction Management*, *10*, 1–5.

Behn, R. D. (2003). Why measure performance? Different purposes require different measures. *Public Administration Review*, *63*(5), 586–606.

Bernstein, D. J. (2000). *Local government performance measurement use: Assessing system quality and effects*. George Washington University.

Bontis, N., Bart, C., Isaac, R. G., Herremans, I. M., & Kline, T. J. B. (2009). Intellectual capital management: pathways to wealth creation. *Journal of Intellectual Capital*.

Brookes, N., Butler, M., Dey, P., & Clark, R. (2014). The use of maturity models in improving project management performance: An empirical investigation. *International Journal of Managing Projects in Business*, *7*(2), 231–246.

Brookes, N., & Clark, R. (2009). Using Maturity Models to Improve Project Management Practice. *POMS 20th Annual Conference*, *1*(2001), 1–12.

Chmielewski, T. L., & Phillips, J. J. (2002). Measuring Return-on-Investment in Government: Issues and Procedures. *Public Personnel Management*, *31*(2), 225–237. https://doi.org/10.1177/009102600203100208

Chou, J.-S., Irawan, N., & Pham, A.-D. (2013). Project management knowledge of construction professionals: A cross-country study of effects on project success. *Journal of Construction Engineering and Management*, *139*(11), 4013015.

Cooke-Davies, T. J., Schlichter, J., & Bredillet, C. (2001). Beyond the PMBOK guide. *Proceedings of the 32nd Annual Project Management Institute 2001 Seminars and Symposium, Nashville, TN*.

Cooke-Davies, T. J., & Arzymanow, A. (2003). The maturity of project management in different industries: An investigation into variations between project management models. *International Journal of Project Management*, *21*(6), 471–478.

Cooke-Davies, T. (2004). Project management maturity models. *The Wiley Guide to Managing Projects*, 1234–1255.

Crawford, J. K. (2006). Project management maturity model. *Information Systems Management* (Vol. 23, Issue 4). Taylor & Francis. https://doi.org/10.1201/1078.10580530/46352.23.4.20060901/95113.7

de Lancer Julnes, P. (2004). The utilization of performance measurement information: Adopting, implementing, and sustaining. *Public Administration and Public Policy-New York-*, *107*, 353–376.

Demir, C., & Kocabaş, İ. (2010). Project management maturity model (PMMM) in educational organizations. *Procedia-Social and Behavioral Sciences*, *9*, 1641–1645.

Demirkesen, S., & Ozorhon, B. (2017). Measuring project management performance: a case of the construction industry. *Engineering Management Journal*, *29*(4), 258–277.

Demirkesen, S., & Ozorhon, B. (2017). Impact of integration management on construction project management performance. *International Journal of Project Management*, *35*(8), 1639–1654.

Dooley, L., & O'Sullivan, D. (2001). Structuring innovation: a conceptual model and implementation methodology. *Enterprise and Innovation Management Studies*, *2*(3), 177–194.

Eastham, J., Tucker, D. J., Varma, S., & Sutton, S. M. (2014). PLM software selection model for project management using hierarchical decision modeling with criteria from PMBOK® knowledge areas. *Engineering Management Journal*, *26*(3), 13–24.

Ford, D. N., Lyneis, J. M., & Taylor, T. (2007). Project controls to minimize cost and schedule overruns: A model, research agenda, and initial results. *2007 International System Dynamics Conference*, 23–27.

Forrester, J. W. (1985). The model versus a modeling process. *System Dynamics Review*, *1*(1), 133–134.

Goh, C. S., & Rowlinson, S. (2013). A conceptual maturity model for sustainable construction. *Journal of Legal Affairs and Dispute Resolution in Engineering and Construction*, *5*(4), 191–195.

Grafton, J., Lillis, A. M., & Widener, S. K. (2010). The role of performance measurement and evaluation in building organizational capabilities and performance. *Accounting, Organizations, and Society*, *35*(7), 689–706.

Guide, P. (2017). A guide to the project management body of knowledge. Sixth Edit. *Project Management Institute, Inc*, 2–111.

Halman, J. I. M., & Voordijk, J. T. (2012). Balanced framework for measuring the performance of supply chains in house building. *Journal of Construction Engineering and Management*, *138*(12), 1444–1450.

Hashim, E. M. M. (2016). *Project managers' knowledge management and competency model for construction in Malaysia*.

Hughes, S. W., Tippett, D. D., & Thomas, W. K. (2004). Measuring project success in the construction industry. *Engineering Management Journal*, *16*(3), 31–37.

Jin, Y., Kunz, J., Levitt, R., Ramsey, M., Rivero, C., & Thaeler, C. (2009). *Project management system and method*. Google Patents.

Julnes, P. de L., & Holzer, M. (2001). Promoting the Utilization of Performance Measures in Public Organizations: An Empirical Study of Factors Affecting Adoption and Implementation. *Public Administration Review*, *61*(6), 693–708. https://doi.org/10.1111/0033-3352.00140

Kagioglou, M., Cooper, R., & Aouad, G. (2001). Performance management in construction: a conceptual framework. *Construction Management and Economics*, *19*(1), 85–95.

Kemp, R. (2004). Fundamentals of project performance measurements. *Hampton, VA: Humphreys*.

Kerzner, H. (2003). *Advanced project management: Best practices on implementation*. John Wiley & Sons.

Kerzner, H. (2019). *Using the project management maturity model: strategic planning for project management*. John Wiley & Sons.

Khoshgoftar, M., & Osman, O. (2009). Comparison of maturity models. *2009 2nd IEEE International Conference on Computer Science and Information Technology*, 297–301.

Kravchuk, R. S., & Schack, R. W. (1996). Designing effective performance-measurement systems under the Government Performance and Results Act of 1993. *Public Administration Review*, 348–358.

Krishnaswamy, N., & Selvarasu, A. (2016). Exploring interrelationship between three performance indicators with 'PMI's Nine Knowledge Areas for successful Project Management. *Int. J Latest Trends Fin. Eco. Sc. Vol*, *6*(3), 1162.

Kwak, Y. H., & Ibbs, C. W. (2000). Calculating project ' 'management's return on investment. *Project Management Journal*, *31*(2), 38–47.

Kwak, Y. H., & Ibbs, C. W. (2002). Project management process maturity (PM) 2 model. *Journal of Management in Engineering*, *18*(3), 150–155.

Mark Mullaly, P. M. P., & Thomas, J. (2008). *Researching the value of project management*.

Meng, X., Sun, M., & Jones, M. (2011). A maturity model for supply chain relationships in construction. *Journal of Management in Engineering*, *27*(2), 97–105.

Milosevic, D., & Patanakul, P. (2005). Standardized project management may increase the development project's success. *International Journal of Project Management*, *23*(3), 181–192.

Munteanu, I., & Newcomer, K. (2020). Leading and Learning through Dynamic Performance Management in Government. *Public Administration Review*, *80*(2), 316–325. https://doi.org/10.1111/puar.13126

Nassar, N., & AbouRizk, S. (2014). Practical application for integrated performance measurement of construction projects. *Journal of Management in Engineering*, *30*(6), 4014027.

Ngacho, C., & Das, D. (2014). A performance evaluation framework of development projects: An empirical study of Constituency Development Fund (CDF) construction projects in Kenya. *International Journal of Project Management*, *32*(3), 492–507.

Nicholson-Crotty, S., Theobald, N. A., & Nicholson-Crotty, J. (2006). Disparate measures: Public managers and performance-measurement strategies. *Public Administration Review*, *66*(1), 101–113.

Nitzl, C., Sicilia, M., & Steccolini, I. (2019). Exploring the links between different performance information uses, NPM cultural orientation, and organizational performance in the public sector. *Public Management Review*, *21*(5), 686–710. https://doi.org/10.1080/14719037.2018.1508609

Pennypacker, J. S., & Grant, K. P. (2003). Project management maturity: An industry benchmark. *Project Management Journal*, *34*(1), 4–11.

Plant, T., & Agocs, C. (2000). *From measuring to managing performance: recent trends in the development of municipal public sector accountability*. Institute of Public Administration of Canada.

Propper, C., & Wilson, D. (2003). The use and usefulness of performance measures in the public sector. *Oxford Review of Economic Policy, 19*(2), 250–267.

Robbins, S. (n.d.). *P.,(1997), Essentials of Organizational Behavior*. Prentice Hall International, Inc., New Jersey.

Robinson, H. S., Carrillo, P. M., Anumba, C. J., & Al-Ghassani, A. M. (2005). Knowledge management practices in large construction organizations. *Engineering, Construction, and Architectural Management*.

Rubenstein, R., Schwartz, A. E., & Stiefel, L. (2003). Better than raw: A guide to measuring organizational performance with adjusted performance measures. *Public Administration Review*, *63*(5), 607–615.

Simeone, R., Carnevale, J., & Millar, A. (2005). A Systems Approach to Performance-Based Management: The National Drug Control Strategy. *Public Administration Review*, *65*(2), 191–202.

Skulmoski, G. (2001). Project maturity and competence interface. *Cost engineering-Ann Arbor then Morgantown-*, *43*(6), 11–24.

Sodade, B. A. A. (2011). Project management complexities in municipal projects, (p. 1-80)-PhD-Diss. *University of Calgary, Canada*.

Tang, Y. H., & Ogunlana, S. O. (2003). Modeling the dynamic performance of a construction organization. *Construction Management & Economics*, *21*(2), 127–136.

Tarnow, T. A. (2003). *Project management techniques that contribute to information technology project success in the finance industry.*

Thompson, D. G. (2009). *The impact of organizational performance measures on Project Management 'Institute's nine knowledge areas: An exploratory study of project 'managers' perceptions*. Capella University.

Wang, X., & Berman, E. (2001). Hypotheses about performance measurement in counties: Findings from a survey. *Journal of Public Administration Research and Theory*, *11*(3), 403–428.

Ward, S. C., Curtis, B., & Chapman, C. B. (1991). Objectives and performance in construction projects. *Construction Management and Economics*, *9*(4), 343–353.

Winter, M., & Smith, C. (2006). Rethinking project management. *Final Rep*.

Yazici, H. J. (2009). The role of project management maturity and organizational culture in perceived performance. *Project Management Journal*, *40*(3), 14–33.

Zhu, J., & Mostafavi, A. (2017). Discovering complexity and emergent properties in project systems: A new approach to understanding project performance. *International Journal of Project Management*, *35*(1), 1–12.

Zou, P. X. W., Chen, Y., & Chan, T.-Y. (2010). Understanding and improving your risk management capability: Assessment model for construction organizations. *Journal of Construction Engineering and Management*, *136*(8), 854–863.

Chapter 3

A Systematic Approach to Determine the Project Management Performance Level at Local Governments

Abstract

Local government project management performance relies on overseeing if a project is completed within the scope, budget, and schedule. Although critical, these three indicators may not be the best-fit indicators for monitoring public work projects' delivery by local government agencies. Also, there is no consensus on a systematic approach for evaluating local government project management practices. This paper presents a systematic methodology that relies on leadership involvement, project management processes, and the agency's project management ability. These critical factors influence the project management performance level, measured by assessing the local agency's project-management process maturity, capacity, and capability. The Project Management Body of Knowledge (PMBOK) guidelines, combined with quality management principles and a customized survey, is used to determine the project management performance metrics. A case study is presented to gauge this approach's applicability in three government agencies: The City of Sunland Park, the County of El Paso, and the City of El Paso. The case study results showed that the proposed approach to determine the project management critical performance factors is implementable at local agencies. It is envisioned that by implementing this approach, local agencies should know better the factors affecting their performance as well as transparency, accountability, and reporting capabilities.

Keywords: performance measure, local government, project management, performance methodology.

3.1 Introduction

Increase demand for transparency and accountability, coupled with the depletion of funding sources, has forced local agencies to improve their project management performance and reporting process. However, several local agencies have not implemented a systematic approach to evaluate project management practices aligned with the organizational and working environment (Bernstein, 2000; Behn, 2003). This paper discusses project management performance metrics' development, including the process maturity, capacity, and capability of the local government agency. This study provides a systematic approach to evaluating local government project management practices using performance level metrics to identify factors affecting the agency’s performance as well as transparency, accountability, and reporting capabilities. Furthermore, this study aims to provide a local government with a comprehensive and collaborative approach to assess project management performance at all management levels.

This methodology relies on leadership involvement, project management processes, and project-manager ability, and it applies throughout the project life cycle. The paper is structured into five sections: literature review, methodology, case studies, interpretation of results, and conclusions.

3.2 Background

In overseeing the project delivery process, some local government agencies have adopted some form of project management practices to enable the organizations to execute the project with some level of effectiveness and efficiency. A historical review indicates that project management has been practiced since the construction of pyramids in Egypt. Some experts argued that despite geographical locations and cultural differences, builders shared the common practice of project planning, implementation, and achievement (Tarnow, 2003). Builders recognize three typical constraints known by current project management practitioners: the project schedule, project cost, and project performance (Thompson, 2009). Despite the common usage of project management, there are minimal research studies in the performance measurement of project management practices for local government agencies.

Traditionally, project performance measures are provided by the public works or engineering department. Performance measures are used by the department's head to support the decision-making process, program monitoring, service performance improvement, and reporting. These requirements apply to the federal government and local governments, especially when a project is funded using federal grants or subsidies.

A project performance report traditionally relies on whether a project is completed within the scope, budget, and schedule. These three indicators, although critical, do not provide a measure of the project management performance. Assessing department performance in delivering a project is critical to ensure the project delivery process's consistency, control, monitoring, and obtaining project funding. However, many local governments have not systematically developed and used performance measures (Bernstein, 2000).

Substantial research studies have been done in the private sector to increase profitability and sustainable competitive advantage (Winter et al., 2006). However, local governments are not in the business of making a profit or competing with other local governments. There is currently a gap regarding performance measures in the project management area (Thompson, 2009), and there has not been consensus on a method (Demikersen and Ozohon, 2017). This study addresses the gap in performance measures by introducing a methodology to assess project management performance.

3.2.1 Performance Measures: No One Fits All

One critical function of government is to improve the quality of life of its citizens through infrastructure projects. Effective and efficient project delivery processes enhance service performance, reporting, and accountability of federal, state, and local government agencies. The delivery process's performance measures are needed to ensure the effectiveness and efficiency of infrastructure projects' delivery. Public agencies could use performance measures to achieve different purposes, including evaluating, controlling, allocating budget, motivating, promoting, celebrating, learning, and improving (Behn, 2003). The government agencies need to choose their goals selectively to identify or create specific performance measures for each goal.

Furthermore, agency leadership needs to consider what should be measured and how to implement such measurements. No single performance measure or a collection of performance measures is appropriate for all circumstances. The search for a collection of measures for all needs should be avoided because the needs and interests among key users are different (Kravchuk and Schack, 1996). Agencies may use historical records as a baseline to measure performance; however, a public agency's leaders should not be searching for one "fits all" performance measure approach. Instead, agencies should begin by deciding on the managerial purposes to which performance measurement may contribute (Behn, 2003). Selecting performance measures is a complex process due to the dynamic nature involved in the evolution of project management delivery. Therefore, flexibility is needed to choose the best performance measure approach. Additionally, performance measures shall be based on standard procedures to compare the measures (Behn, 2003). Hence, it is critical to select performance measures that best fit an agency or local government management practices.

3.2.2 Methodologies for Measuring Project Management Performance

One of the purposes of performance measures is to identify processes that require improvement. The following are performance measure methodologies developed to improve the management process:

- Quality management approach: The International Standard Organization (ISO) 9001.
- Activity Capability (Result Oriented) management approach: The Capability Maturity Model Integration (CMMI).
- Project management approach: The Project Management Institute (PMI).

The first two approaches are used widely for process improvement in industrial or manufacturing and information technology fields. The project management approach is typical for service delivery or the construction field. Furthermore, ISO 9001 is a standard for a quality management system, and it comprises generic standard requirements governing the quality management system of certified companies or other organizations. The CMMI is a model that consists of a collection of characteristics of effective processes that guides the improvement of organizations. PMI is a US-based professional organization that issued the Project Management Body of Knowledge (PMBOK) as a project management standard reference. Implementation of a new process or system, such as ISO 9001 or CMMI, faces many major challenges in an organization with complex bureaucratic processes. These challenges are budget scarcity, resistance to change, structural organization and culture's inflexibility, and lack of intellectual property (Isaac et al., 2009; Sodade, 2011). Besides, the cost may not be affordable for many local governments.

On the other hand, many local governments have adopted project management practices, and therefore, the project management approach is the most feasible for local agencies. The approach is viable as long as the agency has practiced project management with a certain level of expertise. Furthermore, implementing improvement initiatives for project management practices may not require costly and significant organizational structure and culture changes. For proper implementation of project management processes, a guide was developed by the Project Management Institute.

3.2.3 A Guide to the Project Management Body of Knowledge (PMBOK, 6th Edition)

The Project Management Institute (PMI) developed a guide to the Project Management Body of Knowledge (PMBOK Guide) based on the Standard for Project Management, the Approved American National Standard (ANSI). The PMI is a global nonprofit professional organization for project management established in 1969 and recognized as the project management industry's nonprofit standards body. PMI defined project management as the application of knowledge, skills, tools, and techniques to project activities to meet the project requirements. Furthermore, project management is implemented through the appropriate use of the project management processes' application and integration.

The PMBOK Guide, Sixth Edition, from here on, is referred to as the Guide. The Guide describes three major components in the management process of a project: a) project management processes; b) project management knowledge areas; c) and the role of a project manager. These three components are critical in the successful implementation of a project management program in an organization

A. Project Management Processes. There are forty-nine project management processes. These processes are assembled into five process groups within a project life cycle: 1) the initiating process, 2) the planning process, 3) the executing process, 4) the monitoring/controlling process, and 5) the closing process group (PMBOK, 2017**)**. Each of the process groups is described as follows:

Initiating Process Group consists of processes that are performed in defining a new project by obtaining authorization to start the project and identifying project stakeholders.

Planning Process Group consists of processes required to establish the projects' scope, refine the objectives, and define the course of action necessary to attain the project objectives.

Executing Process Group consists of processes performed to complete the work defined in the project management plan to satisfy the project requirements.

Monitoring and Controlling Process Group consists of processes required to track, review, and regulate the project's progress and performance and identify areas in which changes to the plan are needed.

Closing Process Group consists of processes required to formally complete or close the project, phase, or contract.

Figure 3.1 depicts the relationship between the knowledge area, the project management process group, and the project phases within a project life cycle.

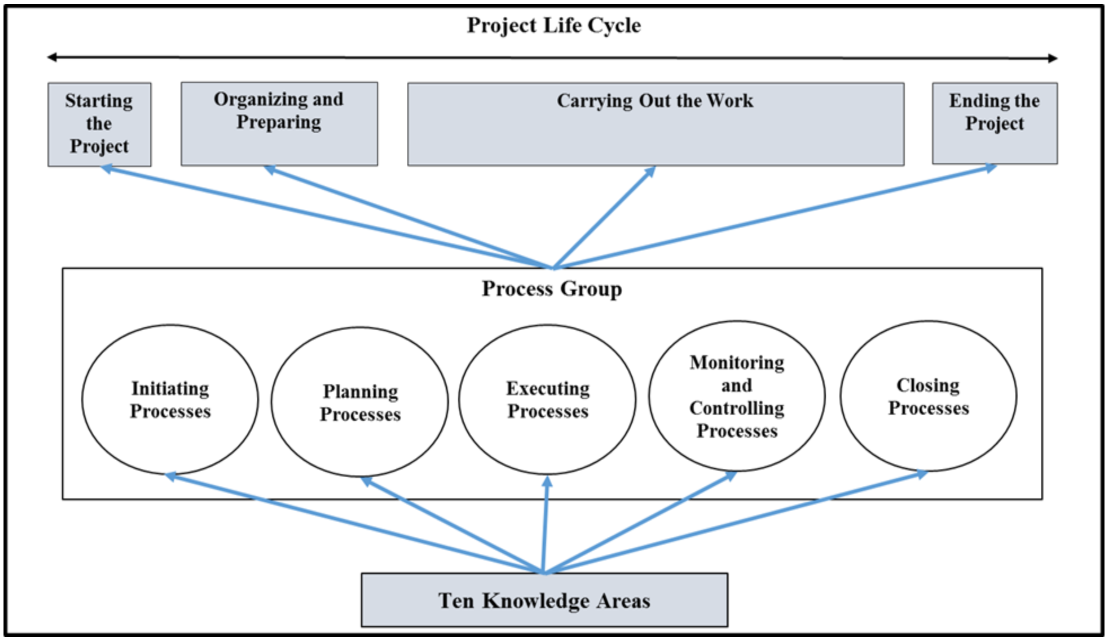

Figure 3.1 Interrelationship of PMBOK Guide Key Components in Projects (PMBOK, 2017)

B. Knowledge Areas. The forty-nine project management processes are grouped into the knowledge areas that are required to perform the processes. The Guide categorizes the processes into ten knowledge areas: 1) project integration management, 2) project scope management, 3) project schedule management, 4) project cost management, 5) project quality management, 6) project resource management, 7) project communication management, 8) project risk management, 9) project procurement management, and 10) project stakeholder management (PMBOK, 2017) These knowledge areas are described as follows:

Project Integration Management is the knowledge of the processes and activities required to identify, define, combine, unify, and coordinate various processes and project management activities.

Project Scope Management is the knowledge of the processes required to ensure the project includes all the work needed to complete the project successfully.

Project Schedule Management is the knowledge of the processes required to manage the timely completion of the project.

Project Cost Management is the knowledge of the processes required in planning, estimating, budgeting, financing, funding, managing, and controlling costs so that the project is completed within the approved budget.

Project Quality Management is the knowledge of the processes required in incorporating the organization's quality policy regarding planning, managing, and controlling projects. Also, to manage product quality requirements to fulfill stakeholder's expectations.

Project Resource Management is the knowledge of the processes required to identify, acquire, and manage the resources needed to complete the project successfully.

Project Communications Management is the knowledge of the processes required to ensure timely and appropriate planning, collection, creation, distribution, storage, retrieval, management, control, monitoring, and ultimate project information disposition.

Project Risk Management is the knowledge of the processes required for risk management planning, identification, and analysis; it includes response planning, response implementation, and monitoring risk on a project.

Project Procurement Management is the knowledge of the processes required to purchase or acquire products, services, or results needed from the outside project team.

Project Stakeholder Management is the knowledge of the processes needed to identify the stakeholder’s expectations to engage them in project decisions and execute them effectively.

Table 3.1 shows a matrix of project management process groups and the critical knowledge areas.

Table 3.1 PM Process Groups and Knowledge Area Mapping, PMBOK 6th Edition, 2017

Knowledge Areas	Project Management Process Groups				
	1. Initiating Process Group	**2. Planning Process Group**	**3. Executing Process Group**	**4. Monitoring and Controlling Process Group**	**5. Closing Process Group**
1. Project Integration Management	• Develop Project Charger	• Develop Project Management Plan	• Direct & Manage Project Work • Manage Project Knowledge	• Monitor & Control Project Work • Integrated Change Control	• Close Project or Phase
2. Project Scope Management		• Plan Scope Management • Collect Requirements • Define Scope • Create WBS		• Validate Scope • Control Scope	
3. Project Schedule Management		• Plan Schedule Management • Define Activities • Sequence Activities • Estimate Activity Durations • Develop Schedule		• Control Schedule	
4. Project Cost Management		• Plan Cost Management • Estimate Costs • Determine Budget		• Control Costs	
5. Project Quality Management		• Plan Quality Management	• Manage Quality	• Control Quality	
6. Project Resource Management		• Plan Resource Management • Estimate Activity Resources	• Acquire Resources • Develop Team • Manage Team	• Control Resources	
7. Project Communications Management		• Plan Communication Management	• Manage Communications	• Monitor Communication	
8. Project Risk Management		• Plan Risk Management • Identify Risks • Qualitative Risk Analysis • Quantitative Risk Analysis • Plan Risk Responses	• Implement Risk Responses	• Monitor Risks	
9. Project Procurement Management		• Plan Procurement Management	• Conduct Procurements	• Control Procurements	
10. Project Stakeholder Management	• Identify Stakeholders	• Plan Stakeholder Engagement	• Manage Stakeholder Engagement	• Monitor Stakeholder Engagement	

C. Role of Project Manager. The Guide places a crucial function of a project manager in the project management processes, even though a project manager's role may vary from one organization to another. Moreover, the Guide compared a project manager's functions as a conductor for a large orchestra responsible for leading and managing the team to achieve project objectives.

The Guide provided a talent-triangle, PMI Talent Triangle, as the prerequisite of an effective project manager, as shown in Figure 3.2. The talent-triangle focuses on three key skill sets: technical project management, leadership, and strategic and business management (PMBOK, 2017).

Technical Project Management is defined as the knowledge, skills, and behaviors related to specific domains of project, program, or portfolio management.

Leadership is defined as the knowledge, skills, and behaviors needed to guide, motivate, and direct a team to achieve its business goals.

Strategic and Business Management is defined as the industry and the organization’s knowledge and expertise that enhance performance and better deliver business outcomes.

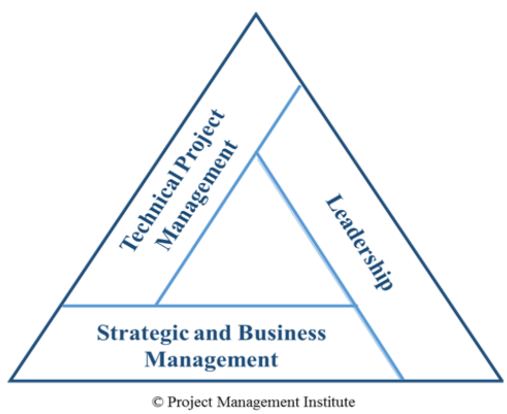

Figure 3.2 Talent Triangle, PMBOK, 2017

3.2.4 Juran's Quality Handbook (6th Edition)

The quality management perspective defines the project management process as a business process. A business process is a logical organization of people, materials, energy, equipment, and information into work activities designed to produce a required result of both projects or services (Pall, 1986; Juran and De Feo, 2010). There are three principal dimensions for measuring the performance of a business process: effectiveness, efficiency, and adaptability.

- The process is *effective* if the output meets customer needs.
- The process is *efficient* when it is effective at the least cost.
- The process is *adaptable* when it remains effective and efficient in the face of changes that may occur over time.

Organizational adaptability is the ability to detect and react to threats and opportunities from within and from outside (Juran and De Feo, 2010). Organizational adaptability is necessary for the private industry. In government agencies that are heavy with bureaucracy, adaptability may not be the best-fit performance measure for their project management practices. Local governments rely on established processes to perform their functions; thus, an acceptable performance measure for government agencies is the process maturity level. Consequently, in local government environments, the three principal dimensions for measuring performance components are effectiveness, efficiency, and maturity.

Additionally, there is an analogous relationship between the components of performance measurement and organizational components. For example, an improvement in the maturity level may indicate positive alteration to the organization structure (Pennypacker, 2006); an improvement in capacity may indicate an improvement in effectiveness; improvement in capability may reflect an improvement in efficiency, and improvement in performance level may indicate an increase in the quality level (Juran et al., 2010).

In the same perspective, an improvement in employee performance is an indicator of organizational performance improvement. Human capital and organizational performance are positively and significantly related; the role of human capital in increasing organizational performance is critical (Alipour et al., 2012). Furthermore, the measure of employee performance determines financial profitability and growth attributed to the organization's individual employee contribution (Hashim, 2000; Makau, 2017). In other words, organizational performance reflects on the individual performance of each employee.

3.3 Methodology to Determine Project Management Performance Level

The project management processes, the knowledge area, and the project manager's ability are the basic components in developing performance metrics. The maturity level of the project management process and the knowledge area determine the extent to which a specific project management process is explicitly defined, managed, measured, controlled, and effective. The project manager's ability is measured against the PMI talent triangle.

This section describes the methodology used to develop performance metrics, and it is depicted in Figure 3.3. The process began with a web-based survey followed by the development of a performance level equation. The equation was developed, first, by identifying the project management performance components according to the PMBOK, and secondly, by identifying quality management performance components using the quality management perspective. The performance level metric is then established by drawing a correlation between the two perspectives of performance components. Finally, a weighting factor for each component was incorporated into the performance metric. An example of the performance level calculation is provided as part of a case study as proof of implementation concepts.

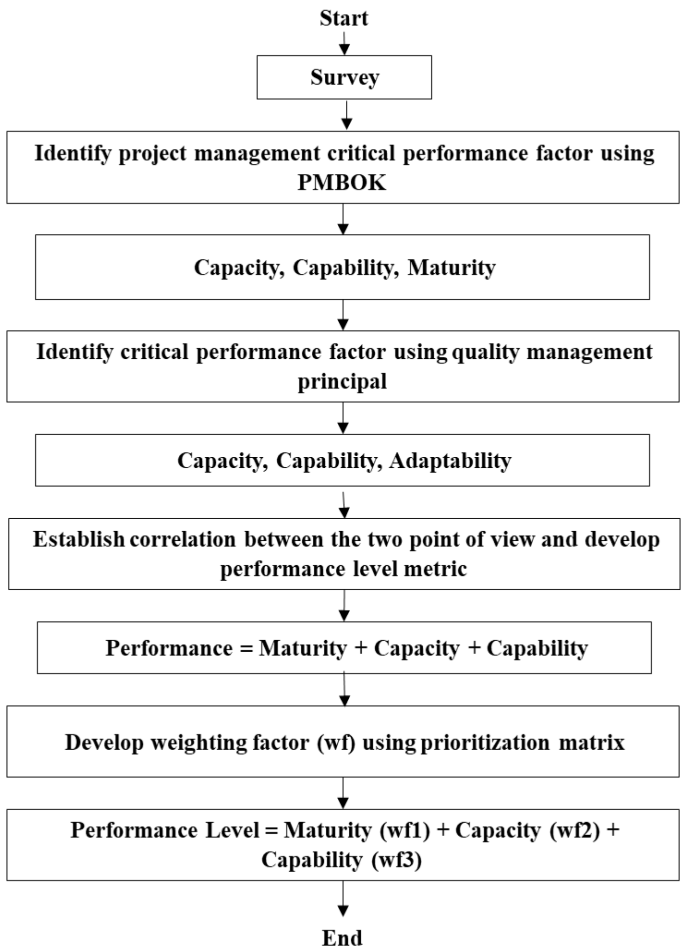

Figure 3.3 Performance Metric Development Process

3.3.1 Survey Participants

Three local government agencies participated in developing this methodology: The County of El Paso, TX, the City of El Paso, TX, and the City of Sunland Park, NM. These municipalities are geographically located within the same proximity to each other and serve communities with a population below eight hundred thousand people in the same economic region. The geographic locations of these three communities are depicted in Figure 3.4. The City of El Paso was represented by a division manager from the Capital Improvement Department and a project manager from the International Airport. The Capital Improvement Department is acting as the primary department in executing projects, and the International Airport is the "owner" of the projects. The City of Sunland Park was represented by a project manager from the Public Works Department, and the County of El Paso was represented by a division manager from the Road and Bridges Department.

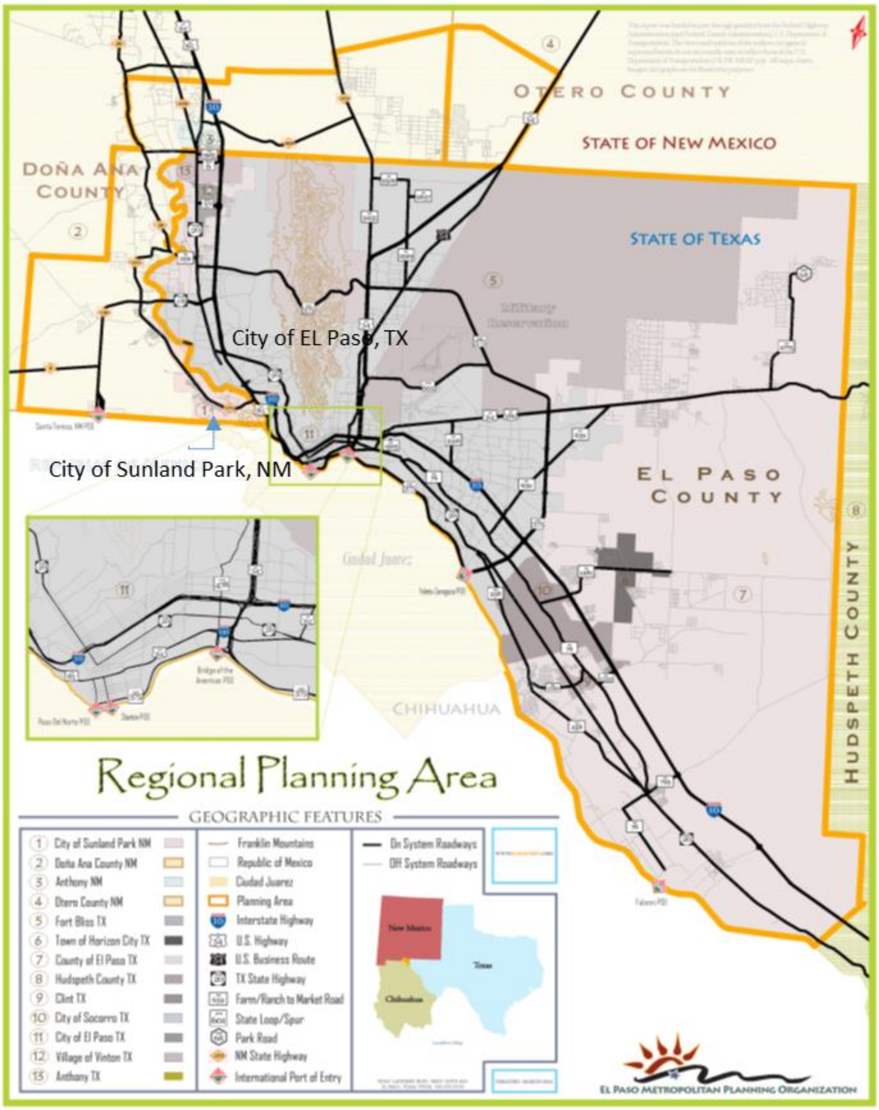

Figure 3.4 Geographic Location of Agencies (EL Paso MPO, 2012)

3.3.2 Project Management Survey

This study utilized a survey tool to assess the current project management practices in local government agencies. The survey's primary purpose is to collect information about the organization composition and project management processes in each of the agencies.

The survey has two sections: an organizational component questionnaire and a project management process questionnaire. The organizational component consists of nineteen questions to include inquiries about the project manager's skill and experience in the management field, workload, etc. The project management process questionnaire consists of thirty project-management assessment questions covering seven knowledge areas applicable to local governments. These knowledge areas are adapted from the PMBOK and consists of integration management, scope management, schedule management, cost management, quality management, communication management, and risk management. An online survey software, "Question-Pro," was used to create the survey and questionnaires. The participants responded to the on-line questionnaires through the following link, https://utep.questionpro.com/t/APHKEZfSDl.

3.3.3 Project-Management Performance Level Equation

There is a parallel relationship between project management and quality management; hence in developing an equation to determine the project-management practice performance level, the PMBOK and Juran's Quality Handbook were utilized. The equation captures the relationship between the performance variables and the performance level.

A. A Guide to the Project Management Body of Knowledge (PMBOK, 6th Edition)

For developing the performance level metric, two critical components that influence project management performance, as discussed in the PMBOK, are used as the building blocks. These components are the project-manager ability and project management processes. PMBOK described a direct correlation between the two components and project management performance levels. Therefore, the higher the project manager's ability, the higher the probability of improving the performance level. The same correlation applies to project management processes; a better execution of a process will yield a better performance level.

The PMBOK does not discuss the assessment of the project management processes. However, the literature review indicates that the processes are assessed by measuring each process's maturity level. The maturity level is defined as the extent to which processes are explicitly defined, managed, measured, controlled, and functioned (Business Process Maturity Model, 2007). The Project Management Maturity Model (PMMM) is adapted to assess the maturity level. The PMMM maturity level consists of five levels, with maturity level one as the lowest and level five as the highest. Assessing each project management process's maturity level can not be performed because of time limitations in conducting this study. Instead, project management processes were evaluated by the assessment of each knowledge area that is required to perform the processes.

The project manager's ability was assessed by evaluating the PMI talent triangle's project management skills and knowledge. The PMI talent triangle is described as the three essential skills: technical project management, leadership, and business management. A project manager's ability is measured against these three skills to indicate the project manager's capacity and capability in performing the work; thereby, measuring capacity and capability means measuring performance. Based on the PMBOK, there are three elements for successful management practices: project manager capability, project manager capacity, and maturity of project management processes. These are the variables that determine the project management performance level. The following section discusses the development of an equation to determine the organization's project-management performance level.

B. Relationship between capacity, capability, and performance

It is generally accepted that capacity and capability are independent variables of performance. However, defining capacity and capability in terms of local governments' performance measures is challenging because capacity is multidimensional (Gargan, 1981). Despite the common usage of the terms, there is a lack of precision as to their meaning. The breadth of terms related to capacity and capability can lead to vagueness (Hou et al., 2003). A study was conducted by Hou et al., 2003 to explore the links between capacity, management, and performance in a public organization; the study considered the extent to which capacity facilitates performance in financial management. The results indicated a link between capacity and performance; consequently, there was a link between capability and performance (Hou et al., 2003). To conclude, these studies suggest a "narrow-lens" approach in defining the relationship between capacity, capability, and performance. The narrow-lens approach is needed to limit the scope and focus on project manager competencies to assess the performance level.

From the perspective of quality management, capacity and capability are defined as follows:

- Capacity is the amount of output that a system can sustain over a given time; it is loosely calculated as available time divided by the longest production cycle time (Juran et al., 2010, p.342).
- Capability refers to an ability, based on tested performance, to achieve measurable results. (Juran et al., 2010, p.656)

From a project management perspective, this study drew a parallel definition as follows:

- Capacity is the number of projects that a project manager is capable of sustaining over a given time. It is defined as the ratio of the target workload divided by the actual workload.

$$\text{Capacity (\%)} = \frac{Target\ Workload}{Actual\ Workload} \times 100\% \quad \text{(Equation 1)}$$

Example of Target workload = 6 projects/project manager/day, which is equivalent to 1.3 hours/project/day assuming 8 hours working day

- Capability refers to the ability of a project manager to complete assigned tasks/projects. It is defined as the average value of project-manager experience and knowledge of the PMI talent triangle, see Figure 3.5.

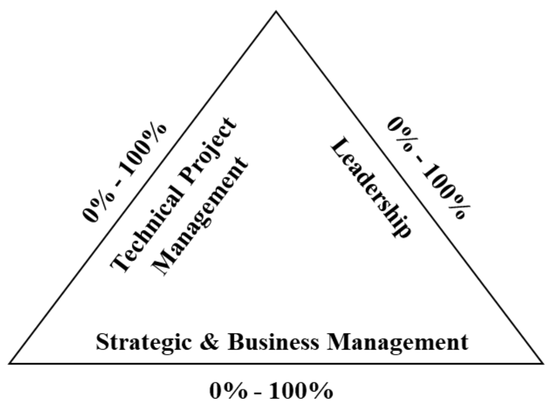

Figure 3.5 Capability Scale of PMI Talent Triangle

Capability (%) = Average of percent value project-manager experience and knowledge in technical project management, leadership, and strategic and business management skills obtained from the Project Management Survey.

Many earlier studies have shown that employee performance determines organizational performance; improved performance is achieved through the organization's employee (Armstrong, 2009). This study proposes the following equation to determine the organization project-management performance level:

Performance Level (%) = Maturity (%) + Capacity (%) + Capability (%)

(Equation 2)

C. Weighting Factors

Weighting factors are introduced in Equation 2 to determine priority based on the goals of each agency. There are many methods available to determine the weighting factor, such as the weighted scoring method, decision matrix, analytic hierarchy process, etc. However, these methods require specialized training for local government staff. Based on the simplicity and ease of use, the prioritization matrix is selected in this study to develop weighting factors. The prioritization matrix is a management and planning tool commonly used in business management to rank options.

Weighting factors must be developed based on a set of criteria; therefore, the criteria have been developed based on the survey data in this study. However, when implementing this methodology, the criteria must be established by the local government agency.

The criteria include improvement cost, complexity, development time, best management practices, number of project managers, project-manager experience, and training budget:

- Improvement cost is associated with the effort to perform an improvement to elevate the performance level.
- Complexity considers the level of effort in implementing any improvement.
- Development time is the time required to implement an improvement.
- Best management practices indicate the maturity of project management processes.
- The number of project managers reflects the size of the organization.
- Project manager experience is related to the ability of the project manager (Alipour, 2012).
- The training budget is an indicator of leadership commitment to staff development (Makau, 2017).

The weighting factor is determined by the ratio of a performance factor to the sum of all performance factors. The score of a performance factor is calculated by multiplying the importance factor by the association factor. The importance factor has a scale from one to ten based on the organization's level of importance.

Association factors of zero, one, three, and nine were applied to describe the strength of the relationship between each performance factor to each criterion. The number zero represents no relationship, one represents a weak relationship, three represents a moderate relationship, and nine represents a strong relationship. In conclusion, the performance level equation is defined as follows:

Performance Level (%) = Maturity (%) x (wf1) + Capacity (%) x (wf2) + Capability (%) x (wf3)

wf = weighting factor

(Equation 3)

D. Example of Performance Level Calculation

From the survey, the average value of the knowledge area of all project management processes is 1; this means that project management is operating at level 1 out of a maximum of 5. Therefore:

1. Project Management Maturity Level = 1/5 x 100% = 20%.
2. The calculated capacity value is 30%.
3. The calculated capability value is 50%.

From the project management survey responses in the Appendix.

Technical Project Management = 40%

Leadership = 60%

Strategic & Business Management = 50%

4. The weighting factors (from the prioritization matrix) are 0.45, 0.35, and 0.20 for the maturity, capacity, and capability, consecutively.
4. Using equation 3,

$$\text{Performance Level (\%)} = \text{Maturity x (0.45)} + \text{Capacity x (0.35)} + \text{Capability x (0.20)}$$

$$= 20\% \text{ x } 0.45 + 30\% \text{ x } 0.35 + 50\% \text{ x } 0.20 = 29.5\%$$

The project-management performance level for the organization 29.5% of a maximum performance level of 100%.

3.4 Case Studies and Results

The purpose of the case study is to demonstrate the methodology's applicability to determine a local agency's project management performance level. The results indicate that local agencies perform between 47%-51%. The City of Sunland Park performs at 51%, the County of El Paso and the City of El Paso – Airport at 47%, and the City of El Paso-CID at 50%. These results also indicate that the size of an organization does not necessarily affect the performance level.

3.4.1 Case Study 1 - The City of Sunland Park (NM)

As per the US Census Bureau 2018, the City of Sunland Park population was approximately 17,500 people, with a population per square mile of roughly 1240 people. The median household income per the 2018 US Census Bureau is $27,400.00. It has an elevation of 1,136 meters (above sea level) with a latitude of 31.8092821 degrees and a longitude of -106.58396 degrees. Sunland Park is a city that lies in the southern Dona Ana County, New Mexico, on Texas's borders and the Mexican State of Chihuahua.

A. Staff Profile

Table 3.1 describes the staff profile in the City of Sunland Park. Due to the size of the agency, one project manager manages all the projects.

Table 3.1 Staff Profile - City of Sunland Park

Project Manager	Experience (Years)	License	PMI Certification	Workload / Project Manager	Typical Project Value
1	6-10	None	None	6-10 Projects	< $500,000

B. Knowledge and Skills Profile

Table 3.2 describes the three essential talents as defined by the PMBOK as well as the project manager development plan and allocated annual training budget.

Table 3.2 Knowledge, Skills, and Development Profile – City of Sunland Park

Technical Project Management	Leadership	Strategic and Business Management	Project Manager Development Plan	Training Budget (Annual)
60%	60%	80%	None	$1K - $5K

- *Technical Project Management is the technical aspect required to perform the role of a project manager (Scale from 0 – 100%).*
- *Leadership is the skills to guide, motivate, and direct a team to help an organization achieve its business goals (Scale from 0-100%).*
- *Strategic and Business Management is the skill that is required to enhance the performance of an organization and better delivers business outcomes (Scale from 0-100%).*

C. Project Management Best Management Practice

The project manager in the City of Sunland Park relies on personal judgment and experience to perform the work.

D. Performance Level Determination

Table 3.3 presents the three calculated performance factors: maturity level, capacity, and capability. The maturity level is the average of the knowledge area of the project management processes that were equal to one. The capacity value is an average workload of eight projects per project manager (Table 3.1), and capability value is the average of PMI's talent triangle (Table 3.2, columns 1, 2, and 3).

Table 3.3 Performance Factors – City of Sunland Park

Maturity Level	Capacity	Capability
20%	75%	67%

Table 3.4 shows the weighted factors obtained using the prioritization matrix.

Table 3.4 Weighted Factor Matrix – City of Sunland Park

Performance Factors	Improvement Cost	Complexity	Development time	Best Management Practices	# of Project Manager	Project Manager Experience	Training Budget	Total Score	Weighted Factor
Importance Score	*8*	*7*	*7*	*4*	*7*	*8*	*4*		
Maturity Level	9	3	3	9	3	9	3	255	0.40
Capacity	3	3	3	1	3	9	9	199	0.30
Capability	3	3	3	1	3	9	9	199	0.30

Performance Level = Maturity Level x (0.40) + Capacity x (0.30) + Capability x (0.30)

= 20% x (0.40) + 75% x (0.30) + 67% x (0.30) = 51%

3.4.2 Case Study 2 - The County of El Paso (TX)

The County of El Paso encompassing eight towns/cities; Anthony town, Clint town, El Paso city, Horizon City, San Elizario city, San Elizario city, Socorro city, and Vinton village, with a population of approximately 840,000 people. The average household income as per the US 2018 Census Bureau is $44,500.00. El Paso County has a latitude of 31.8040 degrees and longitude: -106.2051 degrees; it lies at an elevation of 1,188 meters above sea level, on the borders of New Mexico and the Mexican State of Chihuahua. It has a population of approximately 790 people per square mile.

A. Staff Profile

Table 3.5 describes the staff profile in the County of El Paso.

Table 3.5 Staff Profile – County of El Paso

Project Manager	Experience (Years)	License	PMI Certification	Workload / Project Manager	Typical Project Value
5	6-10	1 PE	None	6-10 Projects	< $500,000

B. Knowledge and Skills Profile

Table 3.6 describes the three essential talents as defined by the PMBOK as well as the project manager development plan and allocated annual training budget.

Table 3.6 Knowledge, Skills, and Development Profile – County of El Paso

Technical Project Management	Leadership	Strategic and Business Management	Project Manager Development Plan	Training Budget (Annual)
40%	60%	60%	None	$1K - $5K

- *Technical Project Management is the technical aspect required to perform the role of a project manager (Scale from 0 – 100%).*
- *Leadership is the skills to guide, motivate, and direct a team to help an organization achieve its business goals (Scale from 0-100%).*
- *Strategic and Business Management is the skill that is required to enhance the performance of an organization and better delivers business outcomes (Scale from 0-100%).*

C. Project Management Best Management Practice

Project managers rely on their experience and judgment to perform the work.

D. Performance Level Determination

Table 3.7 presents the calculated performance factors. The maturity level is the average of the knowledge area of project management processes that was equal to one. The capacity value is an average workload of eight projects per project manager (Table 3.5), and capability value is the average of PMI's talent triangle (Table 3.6, columns 1, 2, and 3).

Table 3.7 Performance Factors – County of El Paso

Maturity Level	Capacity	Capability
20%	75%	53%

Table 3.8 shows the weighted factors obtained using the prioritization matrix.

Table 3.8 Weighted Factor Matrix – County of El Paso

Performance Factors	Improvement Cost	Complexity	Development time	Best Management Practices	# of Project Manager	Project Manager Experience	Training Budget	Total	Weighted Factor
Importance Score	*8*	*8*	*7*	*4*	*7*	*8*	*4*		
Maturity Level	9	3	3	9	3	9	3	258	0.38
Capability	3	3	3	1	3	9	9	202	0.31
Capacity	3	3	3	1	3	9	9	202	0.31

Performance Level (%) = Maturity Level x (0.38) + Capacity x (0.31) + Capability x (0.31)

= 20% x (0.38) + 75% x (0.31) + 53% x (0.31) = 47%

3.4.3 Case Study 3 - The City of El Paso (TX) – Capital Improvement Department (CID)

The City of El Paso has approximately 680,000 people, with a population per square mile of roughly 2543 people. The median household income as per the 2018 US Census Bureau is $45,600.00. It lies at an elevation of 1,188 meters above sea level with a latitude of 31.8483649 degrees and a longitude of -106.43287 degrees. El Paso lies in El Paso County, Texas, on the borders of New Mexico and the Mexican State of Chihuahua.

A. Staff Profile

Table 3.9 describes the staff profile in the City of El Paso – Capital Improvement Department.

Table 3.9 Staff Profile – City of El Paso

Project Manager	Experience (Years)	License	PMI Certification	Workload / Project Manager	Typical Project Value
22	6-10	5 PE	None	10-15Projects	$5 M - $10 M

B. Knowledge and Skills Profile

Table 3.10 describes the profile of project management knowledge and skills in three essential talents, as well as the project manager development plan.

Table 3.10 Knowledge, Skills, and Development Profile – City of El Paso

Technical Project Management	Leadership	Strategic and Business Management	Project Manager Development Plan	Training Budget (Annual)
80%	80%	80%	None	$1K - $5K

- *Technical Project Management is the technical aspect required to perform the role of a project manager (Scale from 0 – 100%).*
- *Leadership is the skills to guide, motivate, and direct a team to help an organization achieve its business goals (Scale from 0-100%).*
- *Strategic and Business Management is the skill required to enhance an organization's performance and better deliver business outcomes (Scale from 0-100%).*

C. Project Management Best Management Practice

Project managers rely on their experience and judgment to perform the work. However, in 2018 the department introduced the project delivery manual to the project managers.

D. Performance Level Determination

Table 3.11 presents the calculated performance factors. The maturity level is the average of the knowledge area of project management processes that was equal to two. The capacity value is an average workload of thirteen projects per project manager (Table 3.9), and capability value is the average of PMI's talent triangle (Table 3.10, columns 1, 2, and 3).

Table 3.11 Performance Factors – City of El Paso

Maturity Level	Capacity	Capability
40%	46%	80%

Table 3.12 shows the weighted factors obtained using the prioritization matrix.

Table 3.12 Weighted Factor Matrix – City of El Paso

Performance Factors	Improvement Cost	Complexity	Development time	Best Management Practices	# of Project Manager	Project Manager Experience	Training Budget	Total	Weighted Factor
Importance Score	*8*	*8*	*7*	*6*	*7*	*8*	*4*		
Maturity Level	9	3	3	9	3	9	3	276	0.40
Capability	3	3	3	1	3	9	9	204	0.30
Capacity	3	3	3	1	3	9	9	204	0.30

Performance Level = Maturity Level x (0.40) + Capacity x (0.30) + Capability x (0.30)

= 40% x (0.40) + 46% x (0.30) + 80% x (0.30) = 50%

3.4.4 Case Study 4 - The City of El Paso (TX) – International Airport

A. Staff Profile

Table 3.13 describes the staff profile in the International Airport Department.

Table 3.13 Staff Profile – El Paso International Airport

Project Manager	Experience (Years)	License	PMI Certification	Workload / Project Manager	Typical Project Value
11	6-10	None	None	10-15 Projects	$2 M - $5 M

B. Knowledge and Skills Profile

Table 3.14 describes the profile of project management knowledge and skills in three essential talents, as well as the project manager development plan.

Table 3.14 Knowledge, Skills, and Development Profile – El Paso International Airport

Technical Project Management	Leadership	Strategic and Business Management	Project Manager Development Plan	Training Budget (Annual)
70%	50%	50%	None	$6 K - $10 K

- *Technical Project Management is the technical aspect that is required to perform the role of a project manager (Scale from 0 – 100%).*
- *Leadership is the skills to guide, motivate, and direct a team to help an organization achieve its business goals (Scale from 0-100%).*
- *Strategic and Business Management is the skill required to enhance an organization's performance and better deliver business outcomes (Scale from 0-100%).*

C. Project Management Best Management Practice

Project managers rely on their experience and judgment in performing the work. This department utilized the same project delivery manual that was introduced by the Capital Improvement Department.

D. Performance Level Determination

Table 3.15 presents calculated performance factors. The maturity level is the average of the knowledge area of project management processes that was equal to two. The capacity value is the average workload of thirteen projects per project manager (Table 3.13), and capability value is the average of PMI's talent triangle (Table 3.14, columns 1, 2, and 3).

Table 3.15 Performance Factors – El Paso International Airport

Maturity Level	Capacity	Capability
40%	46%	57%

Table 3.16 shows the weighted factors obtained using the prioritization matrix.

Table 3.16 Weighted Factor Matrix – El Paso International Airport

Performance Factors	Improvement Cost	Complexity	Development time	Best Management Practices	# of Project Manager	Project Manager Experience	Training Budget	Total	Weighted Factor
Importance Score	*8*	*8*	*7*	*6*	*7*	*8*	*6*		
Maturity Level	9	3	3	9	3	9	3	282	0.38
Capability	3	3	3	1	3	9	9	222	0.31
Capacity	3	3	3	1	3	9	9	222	0.31

Performance Level (%) = Maturity Level x (0.38) + Capacity x (0.31) + Capability x (0.31)

= 40% x (0.38) + 46% x (0.31) + 57% x (0.31) = 47%

3.5 Interpretation of Results

This section discusses the critical components that affect the project management performance level. Table 3.17 shows the project manager profiles, including the expected composition of the number of project managers in a local government agency. It is prevalent for a project manager in a small city to hold multiple functions, as seen in the City of Sunland Park, with only one project manager. For the City of Sunland Park, one project manager may be sufficient to meet the City's needs. This condition shows that small local agencies rely heavily upon their project-manager for management-related functions.

Table 3.17 Project Manager Profiles

Local Government	Project Manager	Experience (Year)	Licenses	PMI Certificate	Workload / PM	Typ. Construction Value
City of Sunland Park	1	6-10	None	None	6-10	≤$500,000
County of El Paso	5	6-10	1 PE	None	6-10	≤$500,000
City of El Paso – CID	22	6-15	5 PE	None	10-15	$5M - $10M
El Paso – Int. Airport	11	6-10	None	None	10-15	$2M - $5M

The project manager's workload for the City of Sunland Park and the County of El Paso averages eight projects per project manager, where the City of El Paso – CID and the Airport is on the average of thirteen projects. For a local government agency with no documented project management standard process in place, its performance relies on the project manager's ability. Therefore, the workload to project manager ratio is critical to the agency's performance, reflecting the agency's capacity level. Other factors that might affect the agency's performance are the project manager's work experience and training. As shown in Table 3.17, these project managers have been in the present position for six to ten years on average. However, none of them have attained qualified project management training. This condition may negatively affect the project manager’s capability and thereby reduce the project management performance level.

The Project Management Institute (PMI) described the talent triangle (PMBOK, 2017, p.57) that should be possessed by a project manager. Table 3.18 shows the participant's talent triangle that consists of technical project management, leadership, and strategic and business management. The table showed the talent of a project manager representing each of the local governments. The average talent level distribution between the participants indicates that a large city with more project managers does not necessarily correlate with more talent than a small city. Furthermore, it also indicates that a project manager's talent is more critical in small local agencies.

Table 3.18 Knowledge and Skills Profile

Local Government	Technical Project Management	Leadership	Strategic and Business Management	Average Talent Level
City of Sunland Park	60%	60%	80%	67%
County of El Paso	40%	63%	60%	53%
City of El Paso - CID	80%	80%	80%	80%
City of El Paso - Airport	70%	50%	50%	57%

Table 3.19 shows the commitment of leadership to develop the project manager's talent. As shown in the table, all participants reported that they do not have a development plan. The ratio of annual training budget for a project manager to the construction ranges from 0.2 % to 1% t for the City of Sunland Park and the County of El Paso; 0.06% to 0.20% for the City of El Paso – CID; and 0.12% to 0.50% for the City of El Paso - Airport. As compared to the City of Sunland Park and the County of El Paso, the City of El Paso – CID budget is lower, yet the construction value is ten to twenty times higher. The City of El Paso – Airport, with an average construction budget of approximately half of the CID's construction budget, roughly doubles that of the CID's training budget.

Table 3.19 Project Manager Development

Local Government	Project Manager	PM Development Plan	Typ. Constructio n Value	Training Budget (Annual)	Training to Construction Value
City of Sunland Park	1	None	≤$500,000	$1K - $5K	0.20% - 1%
County of El Paso	5	None	≤$500,000	$1K - $5K	0.20% - 1%
City of El Paso - CID	22	None	$5M - $10M	$1K - $5K	0.06% - 0.20%
City of El Paso - Airport	11	None	$2M - $5M	$6K - $10K	0.12% - 0.50%

As shown in Table 3.19, project manager development was not a priority for the three local agencies, and the level of commitment varies from department to department.

Table 3.20 summarizes the performance factors and performance levels of the participants. The performance level differences are small, indicating that an agency's size does not necessarily affect the performance level. Additionally, the low maturity level for the City of Sunland Park and the County of El Paso is compensated with a high capacity level. The smaller capacity levels of the City of El Paso's departments are caused by the heavy workload assigned to the project managers.

Table 3.20 Summary of Performance Components and Levels

Agency	# Project Manger	BMP	Maturity Level	Maturity Weighted Factor	Capacity	Capacity Weighted Factor	Capability	Capability Weighted Factor	Performance Level
City of Sunland Park	1	None	20%	0.40	75%	0.30	67%	0.30	51%
County of El Paso	5	None	20%	0.38	75%	0.31	53%	0.31	47%
City of El Paso - CID	22	None	40%	0.40	46%	0.30	80%	0.30	50%
City of El Paso - Arpt	11	None	40%	0.38	46%	0.31	57%	0.31	47%

BMP = Best Management Practices

The weighted factor calculation results for all the participants were similar and indicated all participants assigned a similar level of importance for the performance factors. A local agency should create its specific criteria to establish weighted factors based on their own goals and priorities. As an example, the City of Sunland Park, at present, prefers to invest in the development of project-manager abilities rather than improving the project management processes; thereby, the City assigns criteria that emphasize the development of the project-manager ability. Similarly, the City of El Paso prefers to improve its project management processes and assigns criteria that emphasize project management processes.

None of the participants have defined and documented the project management processes following standards, or the implementation is limited to top-priority projects.

3.6 Conclusions

Many local government agencies have implemented project management practices to execute public works projects, and traditional performance factors, including scope, budget, and schedule, have been used as project success indicators. These three indicators, although critical, do not measure the department's project-management performance in delivering projects. There is currently a gap in the project management area with no consensus on a performance measure methodology. The Project Management Institute provides a guide that can be utilized as the standard; the Guide to the Project Management Body of Knowledge (PMBOK Guide) was developed based on the Standard for Project Management, the Approved American National Standard (ANSI).

This study addressed the need for a performance measure methodology to identify critical performance factors, establish weighting factors, and determine the performance level using an equation to assess the maturity of the agency's process, capacity, and capability. The performance level equation components capture the critical factors in the project management processes and project-manager ability. Furthermore, a weighting factor broadens each of the performance level components to reflect the agency's goals and priorities.

3.7 Recommendation for future research

Future research should expand the survey questionnaire to capture, in more detail, the project-manager skills and knowledge of the project management processes. Increasing the number of participants in the survey study may provide additional insights. Examining the performance level equation is highly recommended when more data are available. It could include an assessment of the actual workload of a project manager to better estimate the capacity. Also, future research should include an impact assessment of training on capability.

3.8 Contribution to Local Government Agencies

- This study introduces local governments to a project-management performance measure approach that serves as a framework for the standardization of their processes.
- This study fosters leadership involvement to monitor performance and the development of project managers' abilities.
- This study emphasizes the importance of monitoring the project management processes, project managers' capacity, and capability as the main performance factors that influence the agency's project management performance.

3.9 Limitations

- The survey results in the case study represent the response of one representative, a project manager from each local government.
- The traditional design-bid-build project delivery process is considered in the survey, and no other project delivery methods are addressed in the study.
- The scope of this study is limited to the construction phase of the project life cycle.

Reference

Abdul Rasid, S. Z., Wan Ismail, W. K., Mohammad, N. H., & Long, C. S. (2014). Assessing the adoption of project management knowledge areas and maturity level: A case study of a public agency in Malaysia. *Journal of Management in Engineering*, *30*(2), 264–271.

Alipour, F., Idrisb, K., Ismailc, I. A., Ulid, J. A., & Karimi, R. (2012). The Relationship between Human Capital and Organizational Performance: Mediating Effect of Intrapreneurship. *Archives Des Sciences*, *65*(5), 377–393.

Armstrong, M. (2009). *Armstrong's handbook of performance management: An evidence-based guide to delivering high performance*. Kogan Page Publishers.

Auger, D. A. (2019). Public management of privatization and contracting. In *Public productivity handbook* (pp. 155–188). CRC Press.

Bassioni, H. A., Price, A. D. F., & Hassan, T. M. (2004). Performance measurement in construction. *Journal of Management in Engineering*, *20*(2), 42–50.

Behn, R. D. (2003). Why measure performance? Different purposes require different measures. *Public Administration Review*, *63*(5), 586–606.

Bernstein, D. J. (2000). *Local government performance measurement use: Assessing system quality and effects*. George Washington University.

Bontis, N., Bart, C., Isaac, R. G., Herremans, I. M., & Kline, T. J. B. (2009). Intellectual capital management: pathways to wealth creation. *Journal of Intellectual Capital*.

Chmielewski, T. L., & Phillips, J. J. (2002). Measuring Return-on-Investment in Government: Issues and Procedures. *Public Personnel Management*, *31*(2), 225–237. https://doi.org/10.1177/009102600203100208

Chou, J.-S., Irawan, N., & Pham, A.-D. (2013). Project management knowledge of construction professionals: A cross-country study of effects on project success. *Journal of Construction Engineering and Management*, *139*(11), 4013015.

Cooke-Davies, T. J., Schlichter, J., & Bredillet, C. (2001). Beyond the PMBOK guide. *Proceedings of the 32nd Annual Project Management Institute 2001 Seminars and Symposium, Nashville, TN*.

Cooke-Davies, T. (2004). Project management maturity models. *The Wiley Guide to Managing Projects*, 1234–1255.

De Lancer Julnes, P. (2004). The utilization of performance measurement information: Adopting, implementing, and sustaining. *Public Administration and Public Policy-New York-*, *107*, 353–376.

Defeo, J. A., & Juran, J. M. (2010). *Juran's Quality Handbook: The Complete Guide to Performance Excellence 6/e*. McGraw Hill Professional.

Demir, C., & Kocabaş, İ. (2010). Project management maturity model (PMMM) in educational organizations. *Procedia-Social and Behavioral Sciences*, *9*, 1641–1645.

Demirkesen, S., & Ozorhon, B. (2017). Impact of integration management on construction project management performance. *International Journal of Project Management*, *35*(8), 1639–1654.

Demirkesen, S., & Ozorhon, B. (2017). Measuring project management performance: a case of the construction industry. *Engineering Management Journal*, *29*(4), 258–277.

Eastham, J., Tucker, D. J., Varma, S., & Sutton, S. M. (2014). PLM software selection model for project management using hierarchical decision modeling with criteria from PMBOK® knowledge areas. *Engineering Management Journal*, *26*(3), 13–24.

Ford, D. N., Lyneis, J. M., & Taylor, T. (2007). Project controls to minimize cost and schedule overruns: A model, research agenda, and initial results. *2007 International System Dynamics Conference*, 23–27.

Gargan, J. J. (1981). Consideration of local government capacity. *Public Administration Review*, *41*(6), 649–658.

Grafton, J., Lillis, A. M., & Widener, S. K. (2010). The role of performance measurement and evaluation in building organizational capabilities and performance. *Accounting, Organizations, and Society*, *35*(7), 689–706.

Guide, P. (2017). A guide to the project management body of knowledge. Sixth Edit. *Project Management Institute, Inc*, 2–111.

Halman, J. I. M., & Voordijk, J. T. (2012). Balanced framework for measuring the performance of supply chains in house building. *Journal of Construction Engineering and Management*, *138*(12), 1444–1450.

Hou, Y., Moynihan, D. P., & Ingraham, P. W. (2003). Capacity, management, and performance: Exploring the links. *The American Review of Public Administration*, *33*(3), 295–315.

Hughes, S. W., Tippett, D. D., & Thomas, W. K. (2004). Measuring project success in the construction industry. *Engineering Management Journal*, *16*(3), 31–37.

Jin, Y., Kunz, J., Levitt, R., Ramsey, M., Rivero, C., & Thaeler, C. (2009). *Project management system and method*. Google Patents.

Julnes, P. de L., & Holzer, M. (2001). Promoting the Utilization of Performance Measures in Public Organizations: An Empirical Study of Factors Affecting Adoption and Implementation. *Public Administration Review*, *61*(6), 693–708. https://doi.org/10.1111/0033-3352.00140

Kagioglou, M., Cooper, R., & Aouad, G. (2001). Performance management in construction: a conceptual framework. *Construction Management and Economics*, *19*(1), 85–95.

Kemp, R. (2004). Fundamentals of project performance measurements. *Hampton, VA: Humphreys*.

Kerzner, H. (2003). *Advanced project management: Best practices on implementation*. John Wiley & Sons.

Kravchuk, R. S., & Schack, R. W. (1996). Designing effective performance-measurement systems under the Government Performance and Results Act of 1993. *Public Administration Review*, 348–358.

Krishnaswamy, N., & Selvarasu, A. (2016). Exploring interrelationship between three performance indicators with PMI's Nine Knowledge Areas for successful Project Management. *Int. J Latest Trends Fin. Eco. Sc. Vol*, *6*(3), 1162.

Kwak, Y. H., & Ibbs, C. W. (2000). Calculating project management's return on investment. *Project Management Journal*, *31*(2), 38–47.

Makau, L. (2017). Effect of Performance Management and Capacity Building on Employee Performance in Madison Insurance Company Kenya Limited. *Journal of Entrepreneurship & Project Management*, *1*(1), 34–45.

Mark Mullaly, P. M. P., & Thomas, J. (2008). *Researching the value of project management*.

Miller, K. (2014). *Extreme Government Makeover: Increasing Our Capacity to Do More Good*. Governing Books.

Milosevic, D., & Patanakul, P. (2005). Standardized project management may increase the development project's success. *International Journal of Project Management*, *23*(3), 181–192.

Munteanu, I., & Newcomer, K. (2020). Leading and Learning through Dynamic Performance Management in Government. *Public Administration Review*, *80*(2), 316–325. https://doi.org/10.1111/puar.13126

Nassar, N., & AbouRizk, S. (2014). Practical application for integrated performance measurement of construction projects. *Journal of Management in Engineering*, *30*(6), 4014027.

Ngacho, C., & Das, D. (2014). A performance evaluation framework of development projects: An empirical study of Constituency Development Fund (CDF) construction projects in Kenya. *International Journal of Project Management*, *32*(3), 492–507.

Nicholson-Crotty, S., Theobald, N. A., & Nicholson-Crotty, J. (2006). Disparate measures: Public managers and performance-measurement strategies. *Public Administration Review*, *66*(1), 101–113.

Nitzl, C., Sicilia, M., & Steccolini, I. (2019). Exploring the links between different performance information uses, NPM cultural orientation, and organizational performance in the public sector. *Public Management Review*, *21*(5), 686–710. https://doi.org/10.1080/14719037.2018.1508609

Plant, T., & Agocs, C. (2000). *From measuring to managing performance: recent trends in the development of municipal public sector accountability*. Institute of Public Administration of Canada.

Propper, C., & Wilson, D. (2003). The use and usefulness of performance measures in the public sector. *Oxford Review of Economic Policy*, *19*(2), 250–267.

Robbins, S. (n.d.). *P.(1997), Essentials of Organizational Behaviour*. Prentice Hall International, Inc., New Jersey.

Robinson, H. S., Carrillo, P. M., Anumba, C. J., & Al-Ghassani, A. M. (2005). Knowledge management practices in large construction organizations. *Engineering, Construction, and Architectural Management*.

Rubenstein, R., Schwartz, A. E., & Stiefel, L. (2003). Better than raw: A guide to measuring organizational performance with adjusted performance measures. *Public Administration Review*, *63*(5), 607–615.

Simeone, R., Carnevale, J., & Millar, A. (2005). A Systems Approach to Performance-Based Management: The National Drug Control Strategy. *Public Administration Review*, *65*(2), 191–202.

Sodade, B. A. A. (2011). Project management complexities in municipal projects, (p. 1-80)-PhD-Diss. *University of Calgary, Canada*.

Tahir, N., Yousafzai, I. K., Jan, S., & Hashim, M. (2014). The Impact of Training and Development on Employees Performance and Productivity A case study of United Bank Limited Peshawar City, KPK, Pakistan. *International Journal of Academic Research in Business and Social Sciences*, *4*(4), 86.

Tang, Y. H., & Ogunlana, S. O. (2003). Modeling the dynamic performance of a construction organization. *Construction Management & Economics*, *21*(2), 127–136.

Tarnow, T. A. (2003). *Project management techniques that contribute to information technology project success in the finance industry*.

Thompson, D. G. (2009). *The impact of organizational performance measures on Project Management Institute's nine knowledge areas: An exploratory study of project managers' perceptions*. Capella University.

Wang, X., & Berman, E. (2001). Hypotheses about performance measurement in counties: Findings from a survey. *Journal of Public Administration Research and Theory*, *11*(3), 403–428.

Ward, S. C., Curtis, B., & Chapman, C. B. (1991). Objectives and performance in construction projects. *Construction Management and Economics*, *9*(4), 343–353.

Winter, M., & Smith, C. (2006). Rethinking project management. *Final Rep*.

Zhu, J., & Mostafavi, A. (2017). Discovering complexity and emergent properties in project systems: A new approach to understanding project performance. *International Journal of Project Management*, *35*(1), 1–12.

Chapter 4

A System Dynamics Method to Measure Project Management Performance

Abstract

Project management has grown increasingly sophisticated and complex since World War II because of organization and technological complexity. However, project management performance is still being assessed with a traditional approach using a conventional budget and schedule tracking tools. Measuring project management performance is complex and requires tools to capture the dynamic nature of the processes involved. Since the conception of system dynamics in the 1950s, the method has been used to solve many complex projects. Project management possesses dynamic characteristics that involve planning, human resources, implementation, and control elements; thereby, using system dynamics to measure project management performance method is a more realistic approach.

The study aims to use system dynamics to develop project management performance measures to capture project management's complexity in local government agencies. The approach conceives measuring the agency's project management performance as a holistic system influenced by leadership involvement, project management processes, and project manager's ability.

The Zachman architectural framework is used to develop the project-management performance system's ontology as the system dynamics model's foundation. A case study was conducted in three local government agencies: The City of Sunland Park, the County of El Paso, and the City of El Paso, to better understand the model and the performance of its components over time.

The case study results conclude that the system dynamics method is a feasible tool to measure project management performance at local government agencies.

Keywords: project management, performance measure, system dynamic model

4.1 Introduction

Project management has been adopted by local government agencies, with varying degrees of expertise, to deliver public works projects efficiently. To evaluate the project management practices' performance, the agencies utilize traditional budget and schedule tracking tools. Since World War II, project management processes have grown increasingly sophisticated, and these traditional tools are no longer sufficient to evaluate project management performance (Baccarini, 1996). Baccarini further explained project complexity elements, including organizational complexity and technological complexity, and other sub-elements such as workforce complexity. Nonetheless, traditional measurement tools are still used nowadays to measure project management performance. One possible reason is that local government agencies may not be aware of other methods to measure performance.

A comprehensive literature study showed a gap in performance measurement methods in the project management area (Thompson, 2009), and there is no consensus on how to assess project management performance in construction projects (Demikersen and Ozohan, 2017). This study provides a method to measure project-management performance using system dynamics to capture the complexity of the project management processes. The study approach focuses on leadership involvement, project management processes, and project-manager ability. This study is organized into five sections: introduction, background, the systems dynamics method to measure project performance, case study, and conclusions. The introduction describes the study's purpose. The background summarizes the literature review, and the methodology explains the approach to developing the method to measure project management performance. A case study demonstrates the method's application in three local government agencies, and the conclusions summarize the findings with recommendations for future research.

4.2. Background

Performance measurements in construction are critical because of its global economic impact; therefore, achieving a high-performance construction level requires effective project management (Demirkesen and Ozorhon, 2017). Many studies with different approaches have been conducted to improve the performance of project management practices. However, most of these studies were intended for private sector usage and may not be suitable for local agencies. Research studies focused on project management performance measures for local agencies are limited. Considerable research studies have been done in the private sector with the primary goal of creating value for stakeholders aim at profitability and sustainable competitive advantage (Winter et al., 2006). This goal is not aligned with local government entities. Furthermore, there is no consensus on the best way to assess project management performance in construction (Demikersen and Ozorhon, 2017).

It is critical to select performance measurements that best fit local agencies ' management practices. Formulating a performance measure begins with the definition of its purpose. Only then can performance measures be selected or developed with the characteristics required to achieve the agency's objectives (Behn, 2003).

With the progress of time, project management has grown in sophistication and complexity. The project management process is complex because it possesses many components interacting with each other. Baccarini, 1996, explained that project complexity is due to interrelated parts with differentiation and interdependency. Moreover, complexity can change over a project life cycle, and as projects continue to reduce project timelines for execution, they become even more complex (Williams, 1999). The traditional approach that relies on budget and schedule tracking tools is no longer sufficient to assess project management's performance because of its complexity as a system (Lyneis et al., 2001).

As a complex system, project management possesses dynamic characteristics that consist of planning, human resources, implementation, and control elements; thereby, a system dynamics method provides a more realistic approach to capture this complexity. (Anderson, 1999).

4.2.1 System Dynamics

The concept of system dynamics was first introduced by Jay Forrester of Sloan School of Management, MIT. The system dynamics concept is used to simplify a complex system based on the cause and effect relationship. Moreover, the human brain's limited capability enables the system dynamics to provide valuable assistance to develop project performance measures. Project management is a complex social system because it involves individuals interacting with each other, working as a unit in a network to serve a common purpose.

People could not adequately understand how social systems behave due to the presence of multiple non-linear feedback mechanisms; social networks are complex and challenging to comprehend (Forrester, 1971). Furthermore, every person uses mental models based on assumptions and relationships as decision-making tools, and these models may be “incomplete” due to the complexity of the processes.

System dynamics have been used in project design, construction, and project management. For example, system dynamics was used to study the delay and disruption of engineering projects; the research focused on the delay in approving the design changes. The study results showed a significant benefit of system dynamics in revealing patterns and behavior and incorporating project management decisions into solving the problems (Williams et al. (1995). System dynamics helped to improve the understanding of the complex nature of project management performance; it identifies common problem sources and the cause-effect "path" by which they affect projects (K.G. Cooper (1997).

A system dynamic method was also used to analyze the behavior and operation of an engineering service department. In this study, a system dynamics model was developed to analyze system behavior's information-feedback and formulate mathematical models of dynamic interrelationships in the engineering service department. The results indicated a need for a strategic change to establish a new culture and operation structure in the department; it provided a valuable understanding of the targeted area of improvements for managers to increase efficiency (Lai, Ip, and Lee, 2001).

System dynamics was used to review project management's dynamic characteristics that consist of planning, human resources, implementation, and control elements. Moreover, it provided a comparison between traditional approaches and system dynamics. The study noted that traditional methods are linear and assume the sum of the parts provides an estimate of the total project. The study concluded that project management performance benefits from combining traditional approaches and system dynamics methods. Furthermore, the use of system dynamics offers a complete view of the project as a whole to enhance the traditional method by incorporating more subjective factors such as the client's behavior and the interaction on the project outcomes (Rodrigues and Bowers, 1996).

System dynamics provides a holistic approach to develop performance measures for local agencies. It addresses shortcomings of the linear approach followed by the traditional project management methods; furthermore, it affords an understanding of the implemented effects of alternative responses' actions; therefore, it offers the most feasible venue to develop the project management performance measure.

4.3 Methodology to Develop Project Management Performance Metrics using System Dynamics

This section describes the approach and methods in developing project management performance measures using the system dynamics model. This study's approach looks at the project management practices of delivering projects as a system, a holistic concept to simplify complex interactions between various project management elements. By definition, a system is a group of devices or artificial objects or an organization forming a network distributing something or serving a common purpose. Additionally, this study is focused primarily on the engineering system, which is a collection of artificial objects or parts designed to act together to perform a specific function or a set of features (Cha et al., 2000).

The study's approach considers leadership involvement, project management processes, and project-manager ability as critical factors in a local agency's project management execution. These critical factors influence the project management performance level, measured by the local agency's maturity, capacity, and capability. These performance management components are used in the development of the system dynamics performance model.

The Project Management Body of Knowledge (PMBOK) guidelines, combined with the quality management principle and the Project Management Maturity Model (PMMM), were utilized to develop the performance level equation and assess project management maturity level for the system dynamics model. In developing the model, the Zachman architectural framework was used to define system components (artifacts) and boundaries. The system dynamics software Vensim was instrumental in developing the model, and survey software, Question-Pro, was used to collect field data.

4.3.1 Survey

Three local governments participated in this study: The City of Sunland Park, the County of El Paso, and the City of El Paso. Question-Pro web-based survey tools were used to collect information about project management practices. The survey questionnaire consisted of nineteen questions pertaining to the agency's organization and composition and thirty maturity level assessment questions. The maturity level assessment questionnaires covered selected project management processes and knowledge areas, as described in the Guide to the Project Management Body of Knowledge (PMBOK, 6th ed., 2017). The Project Management Maturity Model (PMMM) was adapted to create the questionnaire to determine the project management processes' maturity. The PMMM is an adaption of the Capability Maturity Model (CMM) for software development by the Software Engineering Institute (Paulk, 1991). The PMMM provided a five-level maturity grade system parallel to those of the CMM, with level one as the lowest level and five as the highest.

4.3.2 Project Management Measuring Model

In developing the system dynamics model, the first step is defining the system ontology, and the second step is developing the system dynamics performance model. These steps are described as follows:

A. Performance Measure System Ontology

The first step is to identify system components and boundaries. Enterprise architectural framework methodologies were reviewed, and one of the architectural frameworks was selected to identify the system components and boundaries. Enterprise architecture is a construction structure and a framework of a human endeavor. It is a holistic approach to the management and evolution of the enterprise. Several architectural frameworks exist today, such as the Open Group Architectural Framework (TOGAF), Model-Driven Architecture (OMG), and Department of Defense Architectural Framework (DoDAF). However, their application is limited and may not capture some types of system development. On the other hand, Zachman's architectural framework is very flexible, thereby, has a very wide application. Therefore, this study selected the Zachman architectural framework.

Zachman Architectural Framework (ZAF) is an enterprise framework invented by John Zachman in 1980 created for IBM, and it is in the public domain. The ZAF is used by Information Technology (IT) system developers to describe the IT system's architecture. The ZAF is used to identify the needed components (artifacts) for architecture and how they relate to each other. The ZAF is an ontology, a theory of the existence of a structured set of essential elements of an object for which explicit expressions are necessary and perhaps even mandatory for creating, operating, and changing the "object." The "object" could be an enterprise or a department, a value chain, a "sliver," a solution, a project, an airplane, a building, a product, a profession, or other subjects. According to Zachman, this ontology is derived from analogous structures found in the older disciplines of Architecture/Construction and Engineering/Manufacturing that classify and organize the design artifacts created to design and produce complex physical products (e.g., buildings or airplanes).

The ZAF uses a two-dimensional classification model based on six basic interrogatives and six distinct perspectives. The six interrogatives are what, how, where, who, when, and why. The six perspectives are planner, owner, designer, builder, implementer, and worker. These perspectives are related to stakeholder groups. The intersecting cells of the framework correspond to models that can provide a holistic view of the enterprise if documented.

In the development of the system ontology, not all rows or columns need to be filled, as they are related to the system to be created. ZAF provides a view of the required essential components to construct a performance measuring system and how each component correlate to each other. Table 4.1 depicts the ontology of the project-management performance measurement system using the Zachman architectural framework. The first three rows describe the system from three perspectives: planner, owner, and designer; the last row describes the final product, the working system. These are shown in the last column in Table 4.1.

Table 4.1 Zachman Architecture Framework (ZAF) System Ontology Matrix For Project-Management Performance Measures (Zachman, 1987)

	What	How	Where	Who	When	Why	
Project Management Perspective	Project management performance level	Periodic performance measure of project management practice	Local government area of jurisdiction	Stakeholders: Citizen, City Council, City Manager	Annually or as needed	Improve credibility, performance reporting, transparancy, accountability	Scope / Planner
Investment	Performance level data, staff utilization, and development	Evaluation of Performance, resource allocation, and investment	Department	Leadership (Department Head), Division manager	Annually or as needed	To standarize processes and establish policy	Requirements / Owner
Process Improvement	Maturity level, capability level, capacity level, resource management, system dynamic evaluation	Perform assessment survey, interview, observation , evaluation	Division	Division manager, project manager	Annually or as needed	Assessment of standard and policy implementations	Design / Designer
Implementation	Performance Measure Methodology	Continous data collection and monitoring	Department and divisions	Division manager, project manager	Annually or as needed	Process performance monitoring and improvement	Working System / Final Product
	Data	Process	Network	Organization	Timing	Motivation	

The intersecting cells of the framework correspond to the elements of the performance system. Each row of Table 4.1 represents a perspective. The descriptive representation of the performance measurement system from each perspective is described as follows:

Artifacts of the performance model.

1. The first row is the scope of the system from the project management perspective. This row also describes the boundary of the performance measurement system:
    - What: the subject matter of the system, the project-management performance level.
    - How: the process to determine the project-management performance level. The process consists of periodic performance evaluations conducted annually or as desired by the leadership.
    - Where: the location or the network where the project management activities are conducted. In this case, it is within the local government area of jurisdiction.
    - Who: the stakeholder or the system's owner: citizen, city council, and city's upper management.
    - When: the performance level information is needed for strategic planning.
    - Why: the motivation behind the need to measure the performance of project management practices. The motivation is to improve credibility by improving reporting tools, transparency, and accountability of the organization.
2. The second row is the perspective of the owner regarding the descriptive representation of the performance measurement system. It describes the investment requirements for the system.

- What: input data needed for the performance system. The information is performance level data (existing or expected performance level), staff utilization, and staff development program.
- How: the process to collect the data, in this case, through evaluating project management performance evaluation of resource distribution, and allocated investment for staff development.
- Where: the location or network. The location is in the Public Works Department or Engineering Department.
- Who: the stakeholder from the perspective of the owner is the user-department. They are the department head and division manager.
- When: Annual strategic planning or scheduled project-management performance evaluation.
- Why: the motivation is to standardize the project management processes or establish a policy.

3. The third row is the descriptive representation of the project management measurement system from the system designer's perspective.
    - What: the required data to perform the performance measurement. The data are the maturity level, the project manager's capability, the project manager's capacity, the system dynamic computer model, and resource management.
    - How: the data is collected through the assessment survey, interviews, observations, and periodic evaluation of the project management performance.
    - Where: the location is within the Public Works Department or Engineering Department

- Who: the stakeholders are the division manager and the project manager.
- When: Annually at the strategic planning session or as needed.
- Why: the motivation is to assess the implementation of standards or policy.

4. The fourth row is the descriptive representation of the final product or the working system.
    - What: the project-management performance measure methodology for local government agencies.
    - How: the process consists of continuous data collection and performance monitoring.
    - Where: Location is at the Public Works Department or Engineering Department.
    - Who: the stakeholders involved are the division manager and the project manager.
    - When: Annually or as needed by the leadership or upper management.
    - Why: the motivation is performance improvement.

Summary of the project-management performance measuring system

The project-management performance measurement system is based on the continuous collection of data for performance monitoring through assessment surveys, interviews, and observations. The data consists of the project-management process maturity level, project-manager capability, project-manager capacity, and resource management; furthermore, a system dynamics computer model is created and used to conduct the performance evaluation. Leadership commitment is measured through investment in staff development and utilization. A project manager conducts the performance evaluation activities under the supervision of a division manager. Finally, the performance evaluation is conducted on an annual basis or as requested by the leadership. The primary motivation for implementing the performance measurement system is to improve credibility by improving performance reporting tools, transparency, and accountability.

The system dynamics model was developed based on these characteristics, and it is discussed in the following section.

B. System Dynamics Performance Measurement Model

The ZAF provides a view of the required essential components to construct a performance measuring system and how each component correlate to each other. The ZAF is incorporated into the system dynamics model to map the system's decision-making process's overall scope and context. These two techniques allow an enhanced comprehension of diagnosis processes and improvement (Dantu and Smith, 2011).

System dynamics is used to develop a project-management performance measuring model and to further identified components that impact the system's performance. The fundamental objective of using system dynamics is to gain an understanding of the structural system's behavior. Each element's behavior in the system is essential in assessing how different actions on different parts of the system accentuate or attenuate its behavioral tendency (Garcia, 2019). It shall not be construed that this model is in the final form; modification of the performance components may be necessary as more data becomes available. The system dynamics model to measure project-management performance is depicted in Figure 4.1.

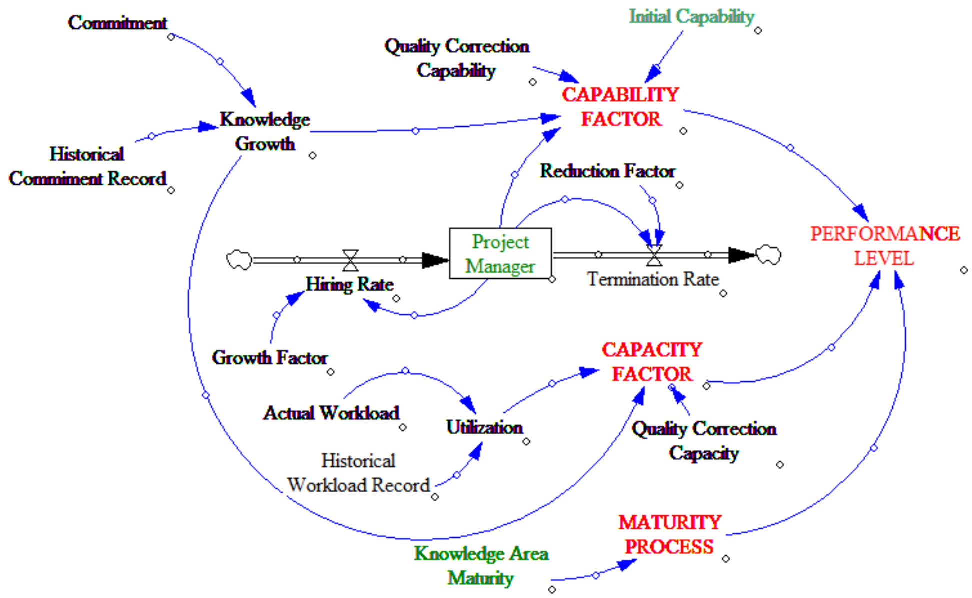

Figure 4.1 System Dynamic Model to Measure Project Management Performance

A system dynamic computer software tool, Vensim, is used to develop the project-management performance system model. The model variables are estimated based on the theoretical interpretation and commonly accepted values in the construction industry. The success of the model is based on whether or not the model can imitate the real-life event. Staff turnover is the primary contributing factor in any organization's performance; therefore, staff retention should be the primary focus of leadership to improve performance levels. The real-life event considered in this model is the leadership (upper management) commitment to staff and project managers' retention. The behavior of leadership commitment over time is reflected in both capability and capacity factors. The following are the variables included in the model:

- **Project Manager**

The project manager is the central focus of this performance model to measure project management practices; consequently, the project manager's longevity in the organization strongly influences the organization's performance. An organization with a high staff turnover rate struggles to successfully develop performance improvement programs because it must train new employees. Additionally, the organization's level of intellectual property may not be maintained or improved. For each project manager, the employment duration (turnover rate) is assumed two years; thereby, the termination rate was one project manager every two years. The hiring rate is assumed as one project manager annually, which is the typical hiring process rate for a local government agency. Whether an agency has one or more project managers, the model looked at it as one organizational unit and used the project managers' average values.

- **Quality Correction Factors**

The concept of managing performance cannot be separated from the concept of quality management. The concept of quality management or managing for quality means to ensure product or service conformance to requirements (Juran, 2010). Managing performance parallels to managing quality. Both performance and quality tie to the staff's or project manager's capacity and capability. Research indicated that 15% - 25% of all work performed consists of redoing prior work because products and processes were not perfect (Juran et al., 2010). In the construction industry, commonly accepted construction change order and time extension could vary between 15% to 25%. These are human errors that could reduce the effectiveness and efficiency of an organization. Quality correction factors for effectiveness and efficiency are applied to the capacity and capability factors in calculating the performance level to account for the errors. The correction factors for capability are estimated at 0.85 and for capacity is 0.90.

- **Utilization**

Utilization is obtained by dividing the ideal workload, as a number of daily projects, over the actual workload carries by project managers, and it is reported in percentage. The ideal workload is determined by estimating that project activities consume approximately 1.3 hours of the project manager's time daily for each project. The estimation is based on observation. In a regular 8 hours working day, a project manager ideally manages about six projects. The actual workload is obtained from the project management survey indicate that a project manager manages between six to fifteen projects per day. Figure 4.2 is used as a mockup representation of historical workload data to develop a utilization curve as a function of the number of projects. The utilization ratio is also an indication of the leadership's commitment to staff retention.

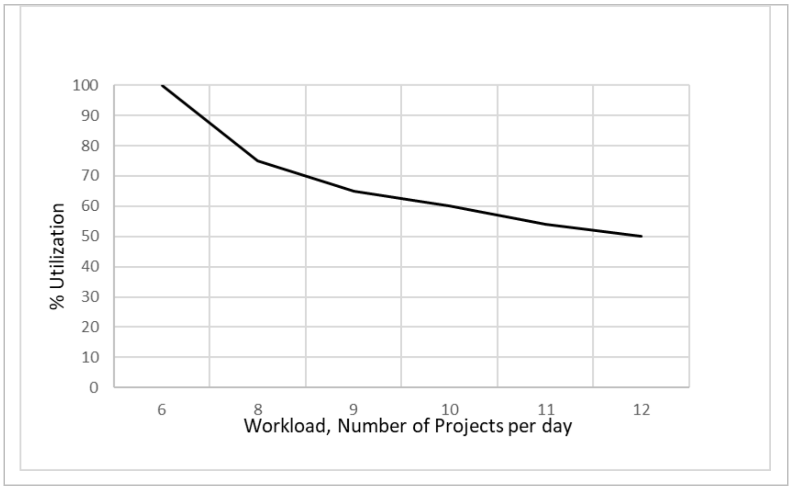

Figure 4.2 Mockup Historical Workload Record

- **Knowledge Growth**

Knowledge growth represents the commitment of the leadership to invest in the development of project-manager ability. To determine the knowledge growth caused by investment is difficult. One method to measure knowledge growth is through surveying at the end of a structured training program. However, an in-depth study to measure knowledge growth is not part of this study. Figure 4.3 is a mocked representation of historical investment data to estimate the knowledge growth as a function of investment to facilitate the simulation process.

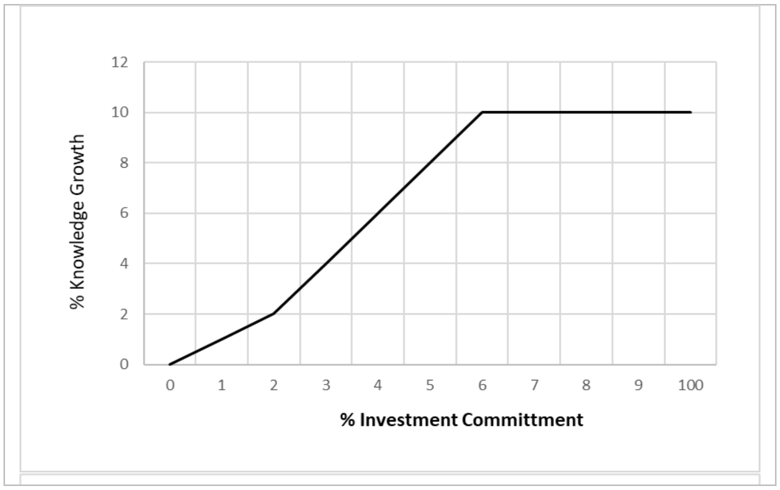

Figure 4.3 Mock-up Historical Investment Record

- **Capability Factor**

The capability factor is loosely estimated by adding the initial capability, knowledge growth, and project manager, and then the result is multiplied by the quality correction capability.

Capability Factor (%) = (Initial Capability (%) + Knowledge Growth (%) + Project Manager) x Quality Correction Capability Factor

Initial Capability = Survey data of the average value of project manager knowledge of the Talent Triangle describes in the PMBOK

- **Capacity Factor**

The capacity factor is loosely estimated by adding the value of the ratio of ideal workload over the actual workload (Figure 4.2) and knowledge growth (Figure 4.3). Then, the result is multiplied by the correction capacity factor.

Capacity Factor (%) = (Knowledge Growth (%) + Utilization (%)) x Quality Correction Capacity Factor

- **Project Management Maturity Process**

The maturity level of the project management process is obtained from the survey's responses. It is a value of the knowledge area maturity level of the project management process.

The maturity level is based on the PMMM five-level maturity scale (PMI, 1980). The maturity level is then expressed as a percentage that ranges from 0 to 100.

- **Project Management Performance Level**

Many earlier studies have shown that employee performance determines organizational performance; improved performance is achieved through the organization's employee (Armstrong, 2009); thereby, the organization's project-management performance level was developed utilizing PMBOK and quality management principles. The performance level metric was established by establishing an equation to capture the relationship between project management and quality management perspectives.

Performance Level (%) = Maturity (%) (wf1) + Capacity (%) (wf2) + Capability (%) (wf3) (Makahaube, J.S., 2020. *A Systematic Approach to Determine the Project Management Performance Level at Local Governments*. Doctoral Dissertation University of Texas at El Paso)

Maturity = Survey data of knowledge area maturity level of project management processes.

Capacity = Number of projects that a project manager is capable of conducting over a given time

Capability = The ability of a project manager to complete the tasks.

wf = weight factor

In this simulation, the weight factors (wf) are 0.50, 0.25, 0.25 for maturity, capacity, and capability components, consecutively. Weight factors vary for each agency or organization, and the weight factor's determination is the subject of further research.

4.4 Case Study

A case study illustrates the applicability of the system dynamics method as a tool to measure the performance of project management practices at local government agencies. The behavior of each performance system component is studied by comparing the simulation results. The simulation scenario for the case study is described as follows.

Simulation Scenario

To improve the chances of becoming a stimulus recipient, a local government agency adopts a plan to enhance its project management performance. The city council asked the public works department to submit a funding request to enhance the department's project management performance and to meet federal requirements. The director of the public works department needs to assess the current performance level of the department.

Also, the director would like to conduct a ten-year performance analysis for the department. For the last couple of years, the director faces the challenge of losing a project manager every two years; this condition will hamper the director's effort to improve the department's performance. Therefore, to anticipate a reduction in the workforce, the director intends to hire a project manager every year. The director requests that staff knowledge development and utilization be addressed in the report to improve employee retention levels.

4.4.1 Project Management Performance Simulations

Table 4.2 shows the initial input variables from the survey's responses to four local government agencies.

Table 4.2 Performance Model Input Variables

Input Variables	City of Sunland Park	County of El Paso	City of El Paso - CID	City of El Paso – Airport
Initial Capability	67%	53%	80%	57%
# Project Manager	1	5	22	11
Maturity Process	20%	20%	40%	40%

The results showed that the City of Sunland Park and the County of El Paso perform at maturity level one, which is equivalent to 20%; the City of El Paso CID and Airport perform at maturity level two or 40%. These results are similar to the results of the study conducted by Grant and Pennypacker (2006). The result indicated that 67% of the participants performed at maturity levels one or two. The maturity level remained constant in the simulations due to the lack of historical data. The most reliable method to assess the maturity level for a process is through a survey.

The results of the simulations are presented in figures 4.4 through 4.8. These figures are mockup examples to help illustrate the performance's behavior and its associated components. Figure 4.4 shows the behavior of the performance level, capability, and capacity overtime for the City of Sunland Park. Figure 4.5 depicted the results for the County of El Paso. Although the City of Sunland Park is a smaller agency, it has a higher performance level than the County of El Paso.

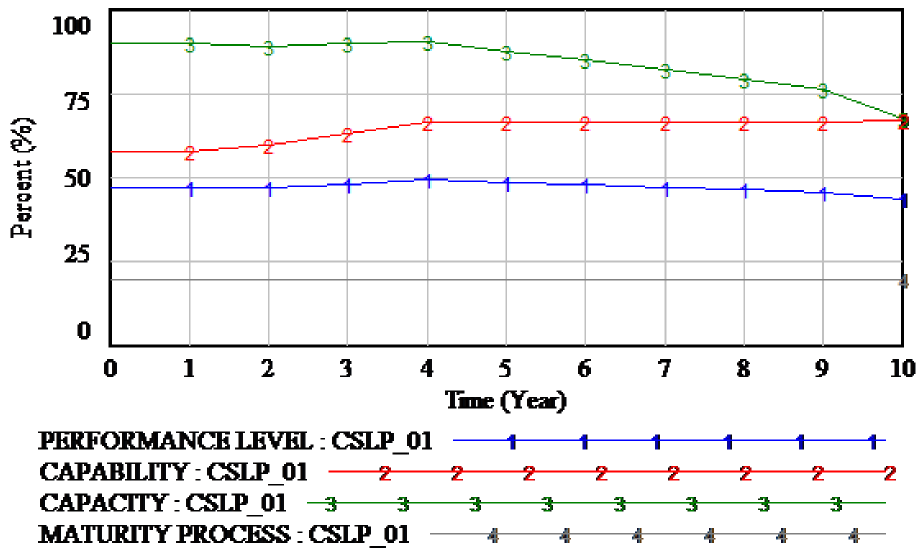

Figure 4.4 Performance vs. Capability vs. Capacity

City of Sunland Park

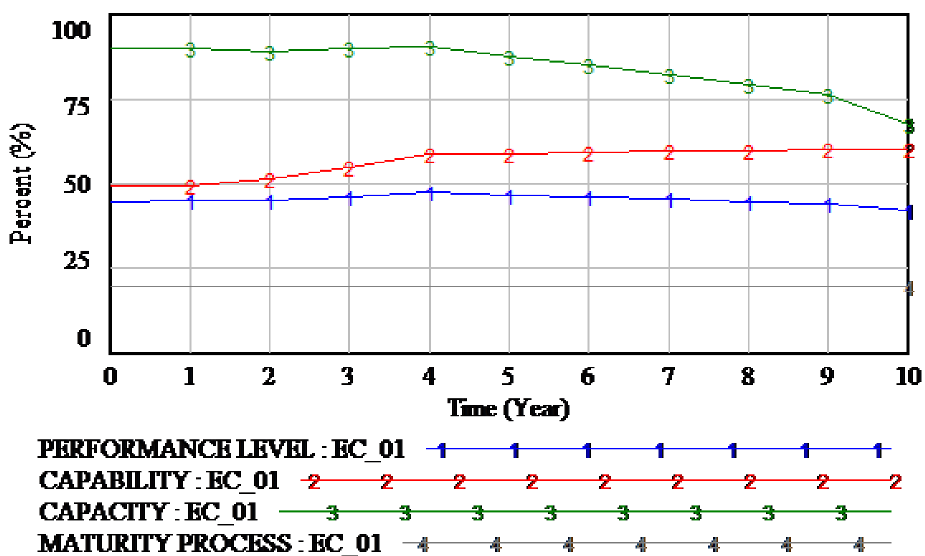

Figure 4.5 Performance vs. Capability vs. Capacity

County of El Paso

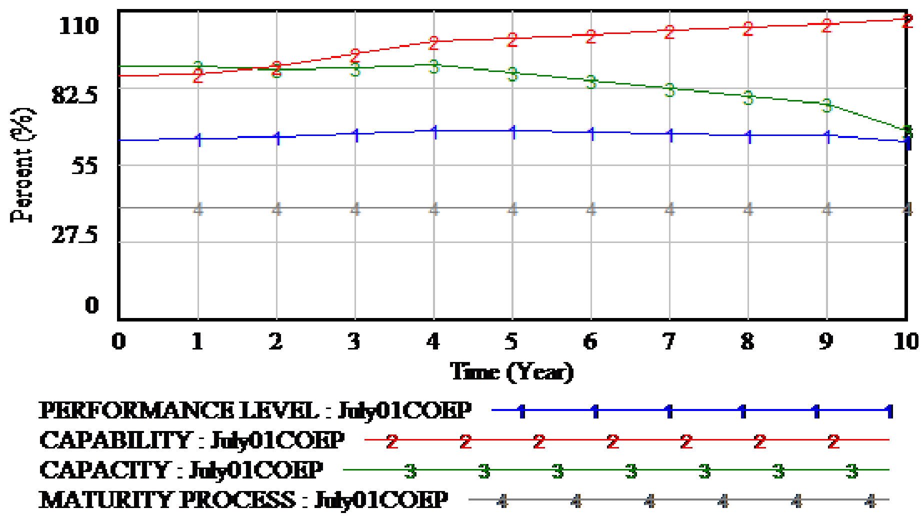

Figure 4.6 Performance vs. Capability vs. Capacity

City of El Paso – Capital Improvement Department

Figure 4.6 depicts the performance level as compared to the capability and capacity of the City of El Paso – CID. Figure 4.7 depicts the performance level of the International Airport. The performance level of CID is higher than the Airport.

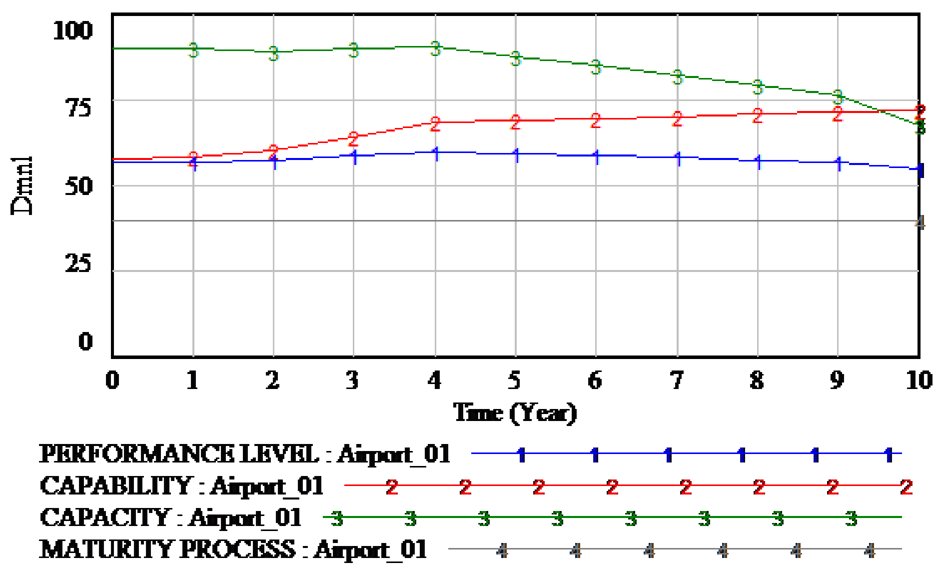

Figure 4.7 Performance vs. Capability vs. Capacity

City of El Paso – International Airport

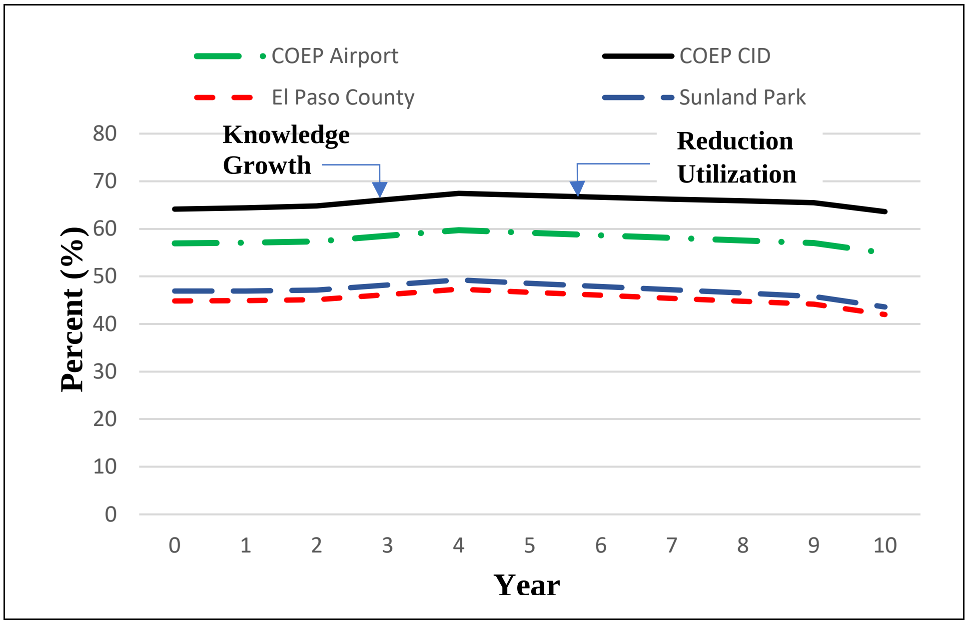

Figure 4.8 Performance Level Comparison

Figure 4.8 shows the evolution of the performance level of the City of Sunland Park, the County of El Paso, and the City of El Paso CID and Airport. The results show that the performance level differences are proportioned to the project manager's initial capability and the project-management maturity level. The project management processes for both the City of Sunland Park and the County of El Paso are at the initial level; therefore, the performance levels primarily reflect the project manager's ability.

The performance level upward tendency, from the beginning to the 4^{th} year, is caused by the increased capability of the project manager. The increased capability is caused by knowledge growth; the leadership commitment fostered the growth in knowledge of the project manager. The knowledge growth decreases in the 4^{th} year, even though leadership commitment continued. The downward tendency of the performance level after the 4^{th} year was caused by the reduction of capacity. Increased workload caused a reduction in the utilization of working hours that ultimately results in a reduction of capacity.

The increase in the number of project managers has a minimum impact on the performance level. However, an increase in workload directly impacts the capacity; consequently, it also impacts the agency's performance level. This behavior mimics real-life cases where the hiring of a project manager is based on the target workload. If the workload continues to increase, the effective utilization of working hours decreases due to labor time available to manage the projects.

4.4.2 Performance Contributing Factors

Table 4.3 shows the contributing factors, identified by the system dynamics model, that affect the local agency's project performance level. The primary factors directly affect the performance level, and the secondary factors indirectly affect the performance level.

Table 4.3 Project Management Performance Contributing Factors

Primary Factors	Secondary Factors
Number of Project Managers	Utilization
Capability	Knowledge Growth
Capacity	Investment for Project Manager Development
Process Maturity Level	Project Manager Retention

It is critical to recognize the different levels of leadership or upper management involvement in these factors. In the primary factors, leadership may delegate the decision-making process to lower management levels because it does not involve a financial investment. In secondary factors, the leadership's direct involvement is necessary to decide the amount of investment committed to utilization, knowledge growth, project management development, and retention strategies. It is required to determine the initial state of these parameters as input parameters when performing the simulation.

4.5 Conclusions

The following conclusions are the results of the simulation analysis:

- The system dynamic performance model captured the three critical performance factors: leadership commitment, project manager ability, and project management processes. Furthermore, the performance factors' behavior over time can analyze an agency's future performance.
- Eight contributing factors that affect the organization's project performance level are identified in this study. These contributing factors are categorized into primary and secondary factors. The primary factors directly affecting the performance level are the number of project managers, capability, capacity, and maturity level of the project management process. The secondary factors indirectly affecting the performance level are the project's working-hours utilization, knowledge growth, investment for project manager development, and project manager retention. It is critical to recognize the need for leadership commitment in these factors. In the primary factors, the leadership has indirect involvement in the decision-making process, wherein leadership has direct involvement in the secondary factors.
- It shall not be construed that the developed model is in the final form; further development may be necessary as data pertaining to the knowledge growth and investment areas becomes available.

4.6 Recommendations for future research

Examining the methodology to measure project management performance is highly recommended when more data becomes available. Future research can be performed by expanding the methodology to assess public agencies' performance contributing factors that serve larger communities. Additionally, establishing a relationship between the investment for the project manager’s development and the project manager’s knowledge growth is necessary to estimate the capability better. Moreover, it is also critical to analyze the relationship between the project manager's workload and utilization level to better estimate the organization's overall capacity. Finding these relationships implies conducting more surveys and using statistical tools for the analyses.

4.7 Contribution to Local Government Agencies

The following are contributions of this research to local government agencies.

- This study provides a framework for analyzing project management performance in local government agencies.
- This study describes a method for assessing the project management performance at local government agencies instead of investing in an over-the-shelf system that may not be applicable.
- The methodology can also assist in the strategic planning process by identifying investment priorities required to enhance project management performance.

4.8 Limitations

- The performance variable values for knowledge growth and utilization are estimated based on observations and experiences due to the lack of historical data.
- The process-maturity value overtime was not analyzed in this study due to the lack of historical data.
- The proposed system dynamic model is constructed using Vensim software; a different model structure model may require a different software tool.

Reference

Abdul Rasid, S. Z., Wan Ismail, W. K., Mohammad, N. H., & Long, C. S. (2014). Assessing the adoption of project management knowledge areas and maturity level: A case study of a public agency in Malaysia. *Journal of Management in Engineering*, *30*(2), 264–271.

Anderson, P. (1999). Perspective: Complexity theory and organization science. *Organization Science*, *10*(3), 216–232.

Anderson, P., Meyer, A., Eisenhardt, K., Carley, K., & Pettigrew, A. (1999). Introduction to the special issue: Applications of complexity theory to organization science. *Organization Science*, *10*(3), 233–236.

Baccarini, D. (1996). The concept of project complexity—a review. *International Journal of Project Management*, *14*(4), 201–204.

Bontis, N., Bart, C., Isaac, R. G., Herremans, I. M., & Kline, T. J. B. (2009). Intellectual capital management: pathways to wealth creation. *Journal of Intellectual Capital*.

Breuner, E. F. (1995). *Complexity and organizational structure*. Masters Dissertation MIT Sloan School of Management.

Cantwell, P. R. (2013). The Use of System Dynamics to Understand the Consequences of Project Controls with Dynamic Performance Measures in DoD Project Management. *ProQuest Dissertations and Theses*, *August 2008*, 164. http://ezproxy.um.edu.my:2048/login?url=http://search.proquest.com/docview/1343507549?accountid=28930

Chang, C. L., Ogunlana, S., & Saeed, K. (1991). Construction Project Management: A system dynamics approach. *9th International Conference of the System Dynamics Society, Bangkok, Thailand*.

Chapman, R. J. (1998). The role of system dynamics in understanding the impact of changes to key project personnel on design production within construction projects. *International Journal of Project Management*, *16*(4), 235–247.

Chou, J.-S., Irawan, N., & Pham, A.-D. (2013). Project management knowledge of construction professionals: A cross-country study of effects on project success. *Journal of Construction Engineering and Management*, *139*(11), 4013015.

Cooke-Davies, T. J., Schlichter, J., & Bredillet, C. (2001). Beyond the PMBOK guide. *Proceedings of the 32nd Annual Project Management Institute 2001 Seminars and Symposium, Nashville, TN*.

Cooper, K. G. (1997). System dynamics methods in complex project management. *Managing and Modelling Complex Projects* (pp. 89–108). Springer.

Dantu, B., & Smith, E. (2011). Diagnostic modeling for medical decision making. *IIE Annual Conference. Proceedings*. 1.

Dantu, B., & Smith, E. (2011). Medical process modeling with a hybrid system dynamics Zachman Framework. *Procedia Computer Science*, *6*, 76–81.

Demirkesen, S., & Ozorhon, B. (2017). Impact of integration management on construction project management performance. *International Journal of Project Management*, *35*(8), 1639–1654.

Demirkesen, S., & Ozorhon, B. (2017). Measuring project management performance: the case of the construction industry. *Engineering Management Journal*, *29*(4), 258–277.

Eastham, J., Tucker, D. J., Varma, S., & Sutton, S. M. (2014). PLM software selection model for project management using hierarchical decision modeling with criteria from PMBOK® knowledge areas. *Engineering Management Journal*, *26*(3), 13–24.

Eden, C., Williams, T., Ackermann, F., & Howick, S. (2000). The role of feedback dynamics in disruption and delay on the nature of disruption and delay (D&D) in major projects. *Journal of the Operational Research Society*, *51*(3), 291–300.

Ford, D. N., Lyneis, J. M., & Taylor, T. (2007). Project controls to minimize cost and schedule overruns: A model, research agenda, and initial results. *2007 International System Dynamics Conference*, 23–27.

Ford, D. N., Lyneis, J. M., Taylor, T., Cooper, K. G., Lyneis, J. M., Cooper, K. G., Els, S. A., Rodrigues, A., Bowers, J., Sterman, J. D., & Forrester, J. W. (2001). System dynamics modeling for project management. *California Management Review*, *10*(4), 245–256.

Forrester, J. W. (1971). *World dynamics*. Wright-Allen Press.

Forrester, J. W. (1971). Counterintuitive behavior of social systems. *Theory and Decision*, *2*(2), 109–140.

Guide, P. (2017). A guide to the project management body of knowledge. Sixth Edit. *Project Management Institute, Inc*, 2–111.

Hashim, E. M. M. (2016). *Project managers knowledge management and competency model for construction in Malaysia*.

Hillson, D. (2003). Assessing organizational project management capability. *Journal of Facilities Management*, *2*(3), 298–311.

Ivory, C., & Alderman, N. (2005). Can project management learn anything from studies of failure in complex systems? *Project Management Journal*, *36*(3), 5–16.

Jin, Y., Kunz, J., Levitt, R., Ramsey, M., Rivero, C., & Thaeler, C. (2009). *Project management system and method*. Google Patents.

Kerzner, H. (2003). *Advanced project management: Best practices on implementation*. John Wiley & Sons.

Kwak, Y. H., & Ibbs, C. W. (2000). Calculating project management's return on investment. *Project Management Journal*, *31*(2), 38–47.

Lai, C. L., Ip, W. H., & Lee, W. B. (2001). The system dynamics model for engineering services. *Managing Service Quality: An International Journal*.

Lyneis, J. M., & Ford, D. N. (2007). System dynamics applied to project management: a survey, assessment, and directions for future research. *System Dynamics Review: The Journal of the System Dynamics Society*, *23*(2-3), 157–189.

Mark Mullaly, P. M. P., & Thomas, J. (2008). *Researching the value of project management*.

Milosevic, D., & Patanakul, P. (2005). Standardized project management may increase development projects' success. *International Journal of Project Management*, *23*(3), 181–192.

Ogunlana, S. O., Li, H., & Sukhera, F. A. (2003). System dynamics approach to exploring performance enhancement in a construction organization. *Journal of Construction Engineering and Management*, *129*(5), 528–536.

Pereira, C. M., & Sousa, P. (2004). A method to define an Enterprise Architecture using the Zachman Framework. *Proceedings of the 2004 ACM Symposium on Applied Computing*, 1366–1371.

Pundir, A. K., Pundir, A., Ganapathy, G., & Sambandam, N. (2007). Towards a complexity framework for managing projects. *Emergence: Complexity & Organization*, *9*(4).

Robbins, S. (n.d.). *P (1997), Essentials of Organizational Behaviors*. Prentice Hall International, Inc., New Jersey.

Robinson, H. S., Carrillo, P. M., Anumba, C. J., & Al-Ghassani, A. M. (2005). Knowledge management practices in large construction organizations. *Engineering, Construction, and Architectural Management*.

Rodrigues, A. G., & Williams, T. M. (1998). System dynamics in project management: assessing the impacts of client behavior on project performance. *Journal of the Operational Research Society*, *49*(1), 2–15.

Rodrigues, A., & Bowers, J. (1996). The role of system dynamics in project management. *International Journal of Project Management*, *14*(4), 213–220.

Rodrigues, A., & Bowers, J. (1996). System dynamics in project management: a comparative analysis with traditional methods. *System Dynamics Review: The Journal of the System Dynamics Society*, *12*(2), 121–139.

Sodade, B. A. A. (2011). Project management complexities in municipal projects, (p. 1-80)-PhD-Diss. *University of Calgary, Canada*.

Tang, Y. H., & Ogunlana, S. O. (2003). Modeling the dynamic performance of a construction organization. *Construction Management & Economics*, *21*(2), 127–136.

Tarnow, T. A. (2003). *Project management techniques that contribute to information technology project success in the finance industry*.

Thompson, D. G. (2009). *The impact of organizational performance measures on Project Management Institute's nine knowledge areas: An exploratory study of project managers' perceptions*. Capella University.

Whitty, S. J., & Maylor, H. (2007). And then came complex project management. *Proceedings of the 21st IPMA World Congress on Project Management*, 371–376.

Whitty, S. J., & Maylor, H. (2009). And then came complex project management (revised). *International Journal of Project Management*, *27*(3), 304–310.

Williams, T. M. (2013). *Managing and modeling complex projects* (Vol. 17). Springer.

Williams, T. M. (1999). The need for new paradigms for complex projects. *International Journal of Project Management*, *17*(5), 269–273.

Williams, T., Ackermann, F., & Eden, C. (2003). Structuring a delay and disruption claim: An application of cause-mapping and system dynamics. *European Journal of Operational Research*, *148*(1), 192–204.

Winter, M., & Smith, C. (2006). Rethinking project management. *Final Rep*.

Zachman, J. A. (1996). Concepts of the framework for enterprise architecture. *Los Angeles, CA*.

Zachman, J. A. (2003). The Zachman framework for enterprise. *Zachman International*, 38.

Zachman, J. A. (2008). John Zachman's concise definition of the Zachman framework. *Zachman International*.

Appendix

The University of Texas at El Paso
Project Management Maturity Assessment Survey

- ○ ***Select only one choice***
- ☐ ***May select >1 choice***

Part 1: About Yourself

1 Please indicate your highest degree received
- ○ Bachelor's degree
- ○ Master's degree
- ○ Doctoral Degree
- ○ Other, please describe ____

2 In what discipline is your degree? (please described below)

____

3 What is your current position title? (please described below)

____

4 How long have you been working in the department?
- ○ Less than one year
- ○ 1 – 5 years
- ○ 6 – 10 years
- ○ 11 – 15 years
- ○ More than 15 years

5 Do you retain certification from Project Management Institute (PMI) (You may select more than one answer)
- ☐ None
- ☐ PMP (Project Management Professional)
- ☐ PgMP (Program Management Professional)
- ☐ PfMP (Portfolio Management Professional)
- ☐ CAPM (Certified Associate in Project Management)
- ☐ PMI-PBA (PMI Professional in Business Analysis)
- ☐ PMI-ACP (Agile Certified Practitioner)
- ☐ PMI-RMP (PMI Risk Management Professional)
- ☐ PMI-SP (PMI Scheduling Professional)
- ☐ Others, please describe ____

6 Do you retain the following certification or license?
- ○ Engineer-in-Training
- ○ Professional Engineer

Part 2: Project Manager & Workload

7 How many project managers you have in your department? Please describe below.

____

8 What is the average experience a project manager has in the department?

- ○ 1 – 5 years
- ○ 6 – 10 years
- ○ 11 – 15 years
- ○ More than 15 years

9 How many projects is a project manager managing?

- ○ 1 – 5 projects
- ○ 6 – 10 projects
- ○ 11 – 15 projects
- ○ 16 – 20 projects

10 What is the total project value typically assign to a project manager?

- ○ Less than $500,000.00
- ○ $500,000 - $2,000,000
- ○ $2,000,000 - $5,000,000
- ○ $5,000,000 - $10,000,000
- ○ $11,000,000 - $15,000,000
- ○ $16,000,000 - $20,000,000
- ○ $21,000,000 - $25,000,000
- ○ Greater than $25,000,000

Part 3: Knowledge of Project Management Processes

11 Is a project manager (employee) development plan exist and being implemented?

- ○ Yes
- ○ No

12 Is the budget for knowledge & skill development allocated every year?

- ○ Yes
- ○ No

13 What is the estimated annual budget for knowledge and skill development in your department?

- ○ $1,000 - $5,000
- ○ $6,000 - $10,000
- ○ $11,000 - $15,000
- ○ $16,000 - $20,000
- ○ Greater than $20,000
- ○ None

14 Technical project management skills are defined as the skills to effectively apply project management knowledge to deliver the desired outcomes for projects or programs.
On a scale of 0 – 100, how would you rate the project manager's knowledge of these skills? (Please mark below)

Scale 0----10----20----30----40----50----60----70----80----90----100

15 Strategic and business management skills involve seeing the organization's high-level overview, effectively negotiating, and implementing decisions and actions that support strategic alignment and innovation.

On a scale of 0 – 100, how would you rate the project manager's knowledge of these skills? (Please mark below)

Scale 0----10----20----30----40----50----60----70----80----90----100

16 Leadership is the knowledge, skills, and behaviors needed to guide, motivate, and direct a team to help an organization achieve its business goals.

On a scale of 0 – 100, how would you rate the project manager's knowledge of these skills? (Please mark below)

Scale 0----10----20----30----40----50----60----70----80----90----100

17 Is a project management best practice developed by your department and available to the project manager? Please describe below.

____

Part 4: Organization Structure

18 What is the type of department organizational structure?
- o Vertical
- o Horizontal
- o Divisional
- o Matrix
- o Others, please describe _______________________________________

19 Select all divisions/sections that are part of the project delivery process WITHIN your department. Please check all that apply (you may select more than one answer)
- ☐ Planning division
- ☐ Design division
- ☐ Construction bidding division
- ☐ Procurement division
- ☐ Contract compliance division
- ☐ Construction management division

- ☐ Construction inspection division
- ☐ Project management division
- ☐ Transportation planning division
- ☐ Scheduling division
- ☐ Cost estimation division
- ☐ Others, please specify ____

20 Select all divisions/sections that are part of the project delivery process OUTSIDE your department. Please check all that apply.

- ☐ Procurement/Bidding division
- ☐ Planning division
- ☐ Building Permit division
- ☐ Construction Code Compliance Inspection division
- ☐ Others, please specify ____

Part 5: Maturity Assessment Questionnaire
(see next pages)

MATURITY ASSESSMENT QUESTIONNAIRE

KA = Knowledge Area

PMP = Project Management Process

ML = Maturity Level

IM = Integration Mgmt.; SM = Scope Mgmt.; TM = Time Mgmt.; BM = Budget Mgmt.; QM = Quality Mgmt.; HRM = Human Resource Mgmt.; CM = Communication Mgmt.; Risk Mgmt.; PRM = Procurement Mgmt.

#	KA	PMP	ML	Code	Questions	Check
1	**Project Plan Development (PPD) process is the development of a document that guides the execution, monitoring, and controlling of the project.** **** Please select one of the five statements below to describe the existing process.***					
	IM	PPD	1	IPD1	There is no defined PPD and process in place	
	IM	PPD	2	IPD2	PPD is defined and its implemented and documented ONLY for the selected project	
	IM	PPD	3	IPD3	PPD is standardized and documented for all projects	
	IM	PPD	4	IPD4	PPD process is integrated into other business processes and practices	
	IM	PPD	5	IPD5	A program in place to continuously collect & analyze process performance data & use it to improve the process	
2	**Project Plan Execution (PPE) process involves the entire project team in coordination and performance against the project work plan.** **** Please select one of the five statements below to describe the existing process.***					
	IM	PPE	1	IPE1	There is no defined PPE and process in place	
	IM	PPE	2	IPE2	PPE is defined and its implemented and documented ONLY for the selected project	
	IM	PPE	3	IPE3	PPE is standardized and documented for all projects	
	IM	PPE	4	IPE4	PPE process is integrated into other business processes and practices	
	IM	PPE	5	IPE5	A program in place to continuously collect & analyze process performance data & use it to improve the process	
3	**Integrated Change Control (ICC) is the process to receive change, assess the project plan's impact, act on the change, and revise the project plan accordingly.** **** Please select one of the five statements below to describe the existing process.***					
	IM	ICC	1	ICC1	There is no defined ICC and process in place	

MATURITY ASSESSMENT QUESTIONNAIRE

KA = Knowledge Area

PMP = Project Management Process

ML = Maturity Level

IM = Integration Mgmt.; SM = Scope Mgmt.; TM = Time Mgmt.; BM = Budget Mgmt.; QM = Quality Mgmt.; HRM = Human Resource Mgmt.; CM = Communication Mgmt.; Risk Mgmt.; PRM = Procurement Mgmt.

#	KA	PMP	ML	Code	Questions	Check
	IM	ICC	2	ICC2	ICC is defined and its implemented and documented ONLY for the selected project	
	IM	ICC	3	ICC3	ICC is standardized and documented for all projects	
	IM	ICC	4	ICC4	ICC process is integrated into other business processes and practices	
	IM	ICC	5	ICC5	A program in place to continuously collect & analyze process performance data & use it to improve the process	
4	**Initiation (IN) process is the formal authorization to proceed with the project or take the project to the next phase.** **** Please select one of the five statements below to describe the existing process.***					
	SM	IN	1	SIN1	There is no defined IN and process in place	
	SM	IN	2	SIN2	IN is defined and its implemented and documented ONLY for the selected project	
	SM	IN	3	SIN3	IN is standardized and documented for all projects	
	SM	IN	4	SIN4	IN process is integrated into other business processes and practices	
	SM	IN	5	SIN5	A program in place to continuously collect & analyze process performance data & use it to improve the process	
5	**Scope Planning (SP) process involves the creation of a detailed scope statement agreed by the customer and the project manager.** **** Please select one of the five statements below to describe the existing process.***					
	SM	SP	1	SSP1	There is no defined SP and process in place	
	SM	SP	2	SSP2	SP is defined and its implemented and documented ONLY for the selected project	
	SM	SP	3	SSP3	SP is standardized and documented for all projects	
	SM	SP	4	SSP4	SP process is integrated into other business processes and practices	
	SM	SP	5	SSP5	A program in place to continuously collect & analyze process performance data & use it to improve the process	

MATURITY ASSESSMENT QUESTIONNAIRE

KA = Knowledge Area

PMP = Project Management Process

ML = Maturity Level

IM = Integration Mgmt.; SM = Scope Mgmt.; TM = Time Mgmt.; BM = Budget Mgmt.; QM = Quality Mgmt.; HRM = Human Resource Mgmt.; CM = Communication Mgmt.; Risk Mgmt.; PRM = Procurement Mgmt.

#	KA	PMP	ML	Code	Questions	Check
6	**Scope Definition (SD) further defines the scope of the project by decomposing the scope and producing the work base schedule (WBS).** **** Please select one of the five statements below to describe the existing process.***					
	SM	SD	1	SSD1	There is no defined SD and process in place	
	SM	SD	2	SSD2	SD is defined and its implemented and documented ONLY for the selected project	
	SM	SD	3	SSD3	SD is standardized and documented for all projects	
	SM	SD	4	SSD4	SD process is integrated into other business processes and practices	
	SM	SD	5	SSD5	A program in place to continuously collect & analyze process performance data & use it to improve the process	
7	**Scope Verification (SV) is the formal acceptance process by the project sponsor and client that the work results were as agreed to in the scope statement, the work base schedule (WBS), and the project plan.** **** Please select one of the five statements below to describe the existing process.***					
	SM	SV	1	SSV1	There is no defined SV and process in place	
	SM	SV	2	SSV1	SV is defined and its implemented and documented ONLY for the selected project	
	SM	SV	3	SSV1	SV is standardized and documented for all projects	
	SM	SV	4	SSV1	SV process is integrated into other business processes and practices	
	SM	SV	5	SSV1	A program in place to continuously collect & analyze process performance data & use it to improve the process	
8	**Scope Change Control (SCC) is the process of receiving change and change requests, evaluating the impact on the work base schedule (WBS) and project plan, and acting on the modification.** **** Please select one of the five statements below to describe the existing process.***					
	SM	SCC	1	SSC1	There is no defined SCC and process in place	

MATURITY ASSESSMENT QUESTIONNAIRE

KA = Knowledge Area

PMP = Project Management Process

ML = Maturity Level

IM = Integration Mgmt.; SM = Scope Mgmt.; TM = Time Mgmt.; BM = Budget Mgmt.; QM = Quality Mgmt.; HRM = Human Resource Mgmt.; CM = Communication Mgmt.; Risk Mgmt.; PRM = Procurement Mgmt.

#	KA	PMP	ML	Code	Questions	Check
	SM	SCC	2	SSC2	SCC is defined and its implemented and documented ONLY for the selected project	
	SM	SCC	3	SSC3	SCC is standardized and documented for all projects	
	SM	SCC	4	SSC4	SCC process is integrated into other business processes and practices	
	SM	SCC	5	SSC5	A program in place to continuously collect & analyze process performance data & use it to improve the process	
9	**Activity Definition (AD) process involves a further decomposition of the work base schedule (WBS) from the format of deliverable to the work that must be done to produce the deliverables identified in the WBS and scope statement. ** Please select one of the five statements below to describe the existing process.***					
	TM	AD	1	TAD1	There is no defined AD and process in place	
	TM	AD	2	TAD2	AD is defined and its implemented and documented ONLY for the selected project	
	TM	AD	3	TAD3	AD is standardized and documented for all projects	
	TM	AD	4	TAD4	AD process is integrated into other business processes and practices	
	TM	AD	5	TAD5	A program in place to continuously collect & analyze process performance data & use it to improve the process	
10	**Activity Sequencing (AS) process is the beginning step in creating a project schedule by laying out a work sequence. ** Please select one of the five statements below to describe the existing process.***					
	TM	AS	1	TAS1	There is no defined AS and process in place	
	TM	AS	2	TAS2	AS is defined and its implemented and documented ONLY for the selected project	
	TM	AS	3	TAS3	AS is standardized and documented for all projects	
	TM	AS	4	TAS4	AS process is integrated into other business processes and practices	
	TM	AS	5	TAS5	A program in place to continuously collect & analyze process performance data & use it to improve the process	

MATURITY ASSESSMENT QUESTIONNAIRE

KA = Knowledge Area

PMP = Project Management Process

ML = Maturity Level

IM = Integration Mgmt.; SM = Scope Mgmt.; TM = Time Mgmt.; BM = Budget Mgmt.; QM = Quality Mgmt.; HRM = Human Resource Mgmt.; CM = Communication Mgmt.; Risk Mgmt.; PRM = Procurement Mgmt.

#	KA	PMP	ML	Code	Questions	Check
11	**Activity Duration Estimate (ADE) process produces an estimated duration of work activity that will provide all or some part of a deliverable.** **** Please select one of the five statements below to describe the existing process.***					
	TM	ADE	1	ADE1	There is no defined ADE and process in place	
	TM	ADE	2	ADE2	ADE is defined and its implemented and documented ONLY for the selected project	
	TM	ADE	3	ADE3	ADE is standardized and documented for all projects	
	TM	ADE	4	ADE4	ADE process is integrated into other business processes and practices	
	TM	ADE	5	ADE5	A program in place to continuously collect & analyze process performance data & use it to improve the process	
12	**Schedule Development (SD) process develops the estimated start and end dates for every work activity to produce the deliverables identified in the work base schedule (WBS).** **** Please select one of the five statements below to describe the existing process.***					
	TM	SD	1	TSD1	There is no defined SD and process in place	
	TM	SD	2	TSD2	SD is defined and its implemented and documented ONLY for the selected project	
	TM	SD	3	TSD3	SD is standardized and documented for all projects	
	TM	SD	4	TSD4	SD process is integrated into other business processes and practices	
	TM	SD	5	TSD5	A program in place to continuously collect & analyze process performance data & use it to improve the process	
13	**Schedule Control (SC) process manages all schedule changes and integrates the changes into other processes.** **** Please select one of the five statements below to describe the existing process.***					
	TM	SC	1	TSC1	There is no defined SC and process in place	
	TM	SC	2	TSC2	SC is defined and its implemented, and documented ONLY for the selected project	

MATURITY ASSESSMENT QUESTIONNAIRE

KA = Knowledge Area

PMP = Project Management Process

ML = Maturity Level

IM = Integration Mgmt.; SM = Scope Mgmt.; TM = Time Mgmt.; BM = Budget Mgmt.; QM = Quality Mgmt.; HRM = Human Resource Mgmt.; CM = Communication Mgmt.; Risk Mgmt.; PRM = Procurement Mgmt.

#	KA	PMP	ML	Code	Questions	Check
	TM	SC	3	TSC3	SC is standardized and documented for all projects	
	TM	SC	4	TSC4	SC process is integrated into other business processes and practices	
	TM	SC	5	TSC5	A program in place to continuously collect & analyze process performance data & use it to improve the process	
14	**Resource Planning (RP) is the process of identifying resources to complete the project that may include people, materials, and equipment.** **** Please select one of the five statements below to describe the existing process.***					
	BM	RP	1	BRP1	There is no defined RP and process in place	
	BM	RP	2	BRP2	RP is defined and its implemented, and documented ONLY for the selected project	
	BM	RP	3	BRP3	RP is standardized and documented for all projects	
	BM	RP	4	BRP4	RP process is integrated into other business processes and practices	
	BM	RP	5	BRP5	A program in place to continuously collect & analyze process performance data & use it to improve the process	
15	**Cost Estimating (CE) is the process of generating estimates of cost.** **** Please select one of the five statements below to describe the existing process.***					
	BM	CE	1	BCE1	There is no defined CE and process in place	
	BM	CE	2	BCE2	CE is defined and its implemented, and documented ONLY for the selected project	
	BM	CE	3	BCE3	CE is standardized and documented for all projects	
	BM	CE	4	BCE4	CE process is integrated into other business processes and practices	
	BM	CE	5	BCE5	A program in place to continuously collect & analyze process performance data & use it to improve the process	

MATURITY ASSESSMENT QUESTIONNAIRE

KA = Knowledge Area

PMP = Project Management Process

ML = Maturity Level

IM = Integration Mgmt.; SM = Scope Mgmt.; TM = Time Mgmt.; BM = Budget Mgmt.; QM = Quality Mgmt.; HRM = Human Resource Mgmt.; CM = Communication Mgmt.; Risk Mgmt.; PRM = Procurement Mgmt.

#	KA	PMP	ML	Code	Questions	Check
16	**Cost Budgeting (CB) is the process of allocating funding or budget to complete the project.** **** Please select one of the five statements below to describe the existing process.***					
	BM	CB	1	BCB1	There is no defined CB and process in place	
	BM	CB	2	BCB2	CB is defined and its implemented, and documented ONLY for the selected project	
	BM	CB	3	BCB3	CB is standardized and documented for all projects	
	BM	CB	4	BCB4	CB process is integrated into other business processes and practices	
	BM	CB	5	BCB5	A program in place to continuously collect & analyze process performance data & use it to improve the process	
17	**Cost Control (CC) is the process of managing cost changes throughout the life cycle of the project.** **** Please select one of the five statements below to describe the existing process.***					
	BM	CC	1	BCC1	There is no defined CC and process in place	
	BM	CC	2	BCC2	CC is defined and its implemented, and documented ONLY for the selected project	
	BM	CC	3	BCC3	CC is standardized and documented for all projects	
	BM	CC	4	BCC4	CC process is integrated into other business processes and practices	
	BM	CC	5	BCC5	A program in place to continuously collect & analyze process performance data & use it to improve the process	
18	**Quality Planning (QP) process determines the required quality standard for a project and how to meet the required standard.** **** Please select one of the five statements below to describe the existing process.***					
	QM	QP	1	QQP1	There is no defined QP and process in place	
	QM	QP	2	QQP2	QP is defined and its implemented, and documented ONLY for the selected project	
	QM	QP	3	QQP3	QP is standardized and documented for all projects	

MATURITY ASSESSMENT QUESTIONNAIRE

KA = Knowledge Area

PMP = Project Management Process

ML = Maturity Level

IM = Integration Mgmt.; SM = Scope Mgmt.; TM = Time Mgmt.; BM = Budget Mgmt.; QM = Quality Mgmt.; HRM = Human Resource Mgmt.; CM = Communication Mgmt.; Risk Mgmt.; PRM = Procurement Mgmt.

#	KA	PMP	ML	Code	Questions	Check
	QM	QP	4	QQP4	QP process is integrated into other business processes and practices	
	QM	QP	5	QQP5	A program in place to continuously collect & analyze process performance data & use it to improve the process	
19	**Quality Assurance (QA) consists of the processes and procedures performed to assure that the work meets the relevant quality standard.** **** Please select one of the five statements below to describe the existing process.***					
	QM	QA	1	QQA1	There is no defined QA and process in place	
	QM	QA	2	QQA2	QA is defined and its implemented, and documented ONLY for the selected project	
	QM	QA	3	QQA3	QA is standardized and documented for all projects	
	QM	QA	4	QQA4	QA process is integrated into other business processes and practices	
	QM	QA	5	QQA5	A program in place to continuously collect & analyze process performance data & use it to improve the process	
20	**Quality Control (QC) process monitors project deliverables and management to determine compliance with project quality requirements.** **** Please select one of the five statements below to describe the existing process.***					
	QM	QC	1	QQC1	There is no defined QC and process in place	
	QM	QC	2	QQC2	QC is defined and its implemented, and documented ONLY for the selected project	
	QM	QC	3	QQC3	QC is standardized and documented for all projects	
	QM	QC	4	QQC4	QC process is integrated into other business processes and practices	
	QM	QC	5	QQC5	A program in place to continuously collect & analyze process performance data & use it to improve the process	

MATURITY ASSESSMENT QUESTIONNAIRE

KA = Knowledge Area

PMP = Project Management Process

ML = Maturity Level

IM = Integration Mgmt.; SM = Scope Mgmt.; TM = Time Mgmt.; BM = Budget Mgmt.; QM = Quality Mgmt.; HRM = Human Resource Mgmt.; CM = Communication Mgmt.; Risk Mgmt.; PRM = Procurement Mgmt.

#	KA	PMP	ML	Code	Questions	Check
21	**Communication Planning (CP) process focuses on defining project stakeholders, information sharing and frequency, and information format throughout the life cycle of the project.** **** Please select one of the five statements below to describe the existing process.***					
	CM	CP	1	CCP1	There is no defined CP and process in place	
	CM	CP	2	CCP2	CP is defined and its implemented, and documented ONLY for the selected project	
	CM	CP	3	CCP3	CP is standardized and documented for all projects	
	CM	CP	4	CCP4	CP process is integrated into other business processes and practices	
	CM	CP	5	CCP5	A program in place to continuously collect & analyze process performance data & use it to improve the process	
22	**Information Distribution (ID) process implements a communication plan and addresses any information requests.** **** Please select one of the five statements below to describe the existing process.***					
	CM	ID	1	CID1	There is no defined ID and process in place	
	CM	ID	2	CID2	ID is defined and its implemented, and documented ONLY for the selected project	
	CM	ID	3	CID3	ID is standardized and documented for all projects	
	CM	ID	4	CID4	ID process is integrated into other business processes and practices	
	CM	ID	5	CID5	A program in place to continuously collect & analyze process performance data & use it to improve the process	
23	**Performance Reporting (PR) process collects and disseminates project performance data to include analyses of resources usage, budget, and time spent to achieve project objectives.** **** Please select one of the five statements below to describe the existing process.***					
	CM	PR	1	CPR1	There is no defined PR and process in place	
	CM	PR	2	CPR2	PR is defined and its implemented, and documented ONLY for the selected project	

MATURITY ASSESSMENT QUESTIONNAIRE

KA = Knowledge Area

PMP = Project Management Process

ML = Maturity Level

IM = Integration Mgmt.; SM = Scope Mgmt.; TM = Time Mgmt.; BM = Budget Mgmt.; QM = Quality Mgmt.; HRM = Human Resource Mgmt.; CM = Communication Mgmt.; Risk Mgmt.; PRM = Procurement Mgmt.

#	KA	PMP	ML	Code	Questions	Check
	CM	PR	3	CPR3	PR is standardized and documented for all projects	
	CM	PR	4	CPR4	PR process is integrated into other business processes and practices	
	CM	PR	5	CPR5	A program in place to continuously collect & analyze process performance data & use it to improve the process	
24	**Administration Closure (AC) process includes project final reporting, accumulation and distribution of lessons learned, final project results, and information archiving.** **** Please select one of the five statements below to describe the existing process.***					
	CM	AC	1	CAC1	There is no defined AC and process in place	
	CM	AC	2	CAC2	AC is defined and its implemented, and documented ONLY for the selected project	
	CM	AC	3	CAC3	AC is standardized and documented for all projects	
	CM	AC	4	CAC4	AC process is integrated into other business processes and practices	
	CM	AC	5	CAC5	A program in place to continuously collect & analyze process performance data & use it to improve the process	
25	**Risk Management Planning (RMP) process focuses on the planning approach to the risk management process.** **** Please select one of the five statements below to describe the existing process.***					
	RM	RMP	1	RMP1	There is no defined RMP and process in place	
	RM	RMP	2	RMP2	RMP is defined and its implemented, and documented ONLY for the selected project	
	RM	RMP	3	RMP3	RMP is standardized and documented for all projects	
	RM	RMP	4	RMP4	RMP process is integrated into other business processes and practices	
	RM	RMP	5	RMP5	A program in place to continuously collect & analyze process performance data & use it to improve the process	

MATURITY ASSESSMENT QUESTIONNAIRE

KA = Knowledge Area

PMP = Project Management Process

ML = Maturity Level

IM = Integration Mgmt.; SM = Scope Mgmt.; TM = Time Mgmt.; BM = Budget Mgmt.; QM = Quality Mgmt.; HRM = Human Resource Mgmt.; CM = Communication Mgmt.; Risk Mgmt.; PRM = Procurement Mgmt.

#	KA	PMP	ML	Code	Questions	Check
26	**Risk Identification (RI) process identifies all events that may potentially impact the project's ability to achieve performance or capability outcome goals.** **** Please select one of the five statements below to describe the existing process.***					
	RM	RI	1	RRI1	There is no defined RI and process in place	
	RM	RI	2	RRI2	RI is defined and its implemented, and documented ONLY for the selected project	
	RM	RI	3	RRI3	RI is standardized and documented for all projects	
	RM	RI	4	RRI4	RI process is integrated into other business processes and practices	
	RM	RI	5	RRI5	A program in place to continuously collect & analyze process performance data & use it to improve the process	
27	**Qualitative Risk Analysis (QlRA) process focuses on prioritizing the identified risks and assessing their potential impact on the project and the likelihood to materialize.** **** Please select one of the five statements below to describe the existing process.***					
	RM	QlRA	1	RlR1	There is no defined QlRA and process in place	
	RM	QlRA	2	RlR2	QlRA is defined and its implemented, and documented ONLY for the selected project	
	RM	QlRA	3	RlR3	QlRA is standardized and documented for all projects	
	RM	QlRA	4	RlR4	QlRA process is integrated into other business processes and practices	
	RM	QlRA	5	RlR5	A program in place to continuously collect & analyze process performance data & use it to improve the process	
28	**Quantitative Risk Analysis (QnRA) process analyses the probability of risk occurrence and the cost to the project; it provides an assessment of the priorities of each risk as related to their impact on project success.** **** Please select one of the five statements below to describe the existing process.***					
	RM	QnRA	1	RnR1	There is no defined QnRA and process in place	

MATURITY ASSESSMENT QUESTIONNAIRE

KA = Knowledge Area

PMP = Project Management Process

ML = Maturity Level

IM = Integration Mgmt.; SM = Scope Mgmt.; TM = Time Mgmt.; BM = Budget Mgmt.; QM = Quality Mgmt.; HRM = Human Resource Mgmt.; CM = Communication Mgmt.; Risk Mgmt.; PRM = Procurement Mgmt.

#	KA	PMP	ML	Code	Questions	Check
	RM	QnRA	2	RnR2	QnRA is defined and its implemented, and documented ONLY for the selected project	
	RM	QnRA	3	RnR3	QnRA is standardized and documented for all projects	
	RM	QnRA	4	RnR4	QnRA process is integrated into other business processes and practices	
	RM	QnRA	5	RnR5	A program in place to continuously collect & analyze process performance data & use it to improve the process	
29	**Risk Response Planning (RRP) process focuses on reducing the likelihood of adverse effects on the project by identifying appropriate actions for each risk that warrant a response.** **** Please select one of the five statements below to describe the existing process.***					
	RM	RRP	1	RRP1	There is no defined RRP and process in place	
	RM	RRP	2	RRP2	RRP is defined and its implemented, and documented ONLY for the selected project	
	RM	RRP	3	RRP3	RRP is standardized and documented for all projects	
	RM	RRP	4	RRP4	RRP process is integrated into other business processes and practices	
	RM	RRP	5	RRP5	A program in place to continuously collect & analyze process performance data & use it to improve the process	
30	**Risk Monitoring & Control (RMC) process maintains the risk management plan throughout the project life cycle; risk change, new risks, and other risks that become inoperative as the project commences. Also includes a monitoring function to assess risk reduction effectiveness.** **** Please select one of the five statements below to describe the existing process.***					
	RM	RM	1	RMC1	There is no defined RMC and process in place	
	RM	RM	2	RMC2	RMC is defined and its implemented, and documented ONLY for the selected project	
	RM	RM	3	RMC3	RMC is standardized and documented for all projects	
	RM	RM	4	RMC4	RMC process is integrated into other business processes and practices	

MATURITY ASSESSMENT QUESTIONNAIRE

KA = Knowledge Area

PMP = Project Management Process

ML = Maturity Level

IM = Integration Mgmt.; SM = Scope Mgmt.; TM = Time Mgmt.; BM = Budget Mgmt.; QM = Quality Mgmt.; HRM = Human Resource Mgmt.; CM = Communication Mgmt.; Risk Mgmt.; PRM = Procurement Mgmt.

#	KA	PMP	ML	Code	Questions	Check
	RM	RM	5	RMC5	A program in place to continuously collect & analyze process performance data & use it to improve the process	

Curriculum Vitae

Johanes Sombo Makahaube earned a bachelor's degree in Civil Engineering from the Universitas Kristen Indonesia, Jakarta, in 1989. He pursued a Master of Science Degree in Civil Engineering at the University of Texas at El Paso (UTEP) and graduated in 1993. After graduation, Johanes worked for private firms and the City of El Paso for twenty-five years. While working, he obtained a Master of Business Administration Degree from the University of Phoenix in 2004. Johanes joined the Doctoral Program in Civil Engineering at the University of Texas at El Paso under the mentoring of Dr. Carlos M. Chang. He continues working full time as a Division Manager at the Engineering Department in the City of El Paso while pursuing the Doctoral degree and graduated in Fall 2020. Johanes believes in lifelong learning and has a strong interest in teaching, research, and service. His main objective and motivation for conducting doctoral studies are to become a Professor to transfer his knowledge and professional experiences to new generations.

He can be reached at *makahaubejs@gmail.com*.