International Journal of Construction Project Management ISSN: 1944-1436
Volume 12, Number 1

USING THE PROJECT MANAGEMENT MATURITY MODELS TO EVALUATE ORGANIZATIONAL IMPLEMENTATION IN JORDAN: A CASE STUDY

Muhammad T. Hatamleh[1,*], Gary P. Moynihan[2,†], M. Ammar Alzarrad[3,‡], and Robert G. Batson[4,§]

[1]Ph.D. Candidate, Department of Civil, Construction, and Environmental Engineering, The University of Alabama, Tuscaloosa, AL, USA
[2]Professor, Department of Civil, Construction, and Environmental Engineering, The University of Alabama, Tuscaloosa, AL, USA
[3]Assistant Professor, Department of Civil Engineering and Construction, Bradley University; Peoria, IL, USA
[4]Professor, Department of Civil, Construction, and Environmental Engineering, The University of Alabama, Tuscaloosa, AL, USA

ABSTRACT

The success of construction projects in developing countries is often uncertain due to planning and operating in an unpredictable and poorly resourced environment. In this research, the Project Management Maturity Models have been utilized to evaluate the organization's capabilities in implementing project management. The maturity was assessed by using 103 measurement instruments derived from the literature. Quantitative scores were collected by using a closed-ended interview with a group of experts. The results show a significant difference between the contractor's and consultant's maturity levels. Finally, a comparison of the maturity scores was highlighted and recommendations were made to enhance the maturity levels and improve the organization's management proficiencies.

Keywords*:* project management, project management maturity, maturity models, closed-ended interview, developing countries

* Corresponding Author's Email: mthatamleh@crimson.ua.edu
† Corresponding Author's Email: gmoynihan@eng.ua.edu
‡Corresponding Author's Email: malzarrad@fsmail.bradley.edu
§ Corresponding Author's Email: rbatson@eng.ua.edu

INTRODUCTION

In developing countries, construction activities account for about 80% of the total capital assets, 10% of their Gross Domestic Product (GDP), and more than 50% of the wealth invested in fixed assets (Jekale, 2004). Further, they provide high employment opportunities (Ofori, 2007). Despite the construction industry's essential role in those countries, it fails to achieve the expectations and requirements of governments, customers, and society (Ofori, 2007). In fact, many construction projects in developing countries facing massive time and cost overruns, fail to achieve their intended benefit, and may even be terminated or abandoned before completion (Idoko, 2008).

The economy in Jordan is growing rapidly due to all the changes in the region. Several large projects are being proposed and implemented. However, there is a lack of modern tools, methods, and techniques necessary to achieve the desired goals within time, cost, and standards (Abbasi and Al-Mharmah 2000). The construction industry provided employment to approximately 624,000 Jordanian nationals in 2015; equal to 5.8% of total population employment. Thus, the construction industry in Jordan is one of the main pillars of the country's economy (Trading Economics 2018).

The construction industry is a highly competitive industry, characterized by high levels of risk and low-profit margins (Enshassi et al. 2013). In such a competitive environment, in which the construction companies operate, the failure or success of a single project may affect the sustainability of the company. Therefore, performance enhancement is of utmost importance to maintaining the construction company's sustainability and competitive advantage.

The construction industry in developing countries frequently operates in a harsh environment (Gould and Joyce, 2009). Continuous enhancement of the regulations, to match the ones found in the developed countries, lead to a variety of laws and regulations that are intended to ensure safety and minimize the environmental impacts of the construction projects add more to the harsh environment of the industry (Bennett, 2003).

Based on the significant role that the construction industry plays in Jordan, and the poor level of performance of the industry, improving the performance of the construction project should be a priority. This could be achieved by enhancing the project management process. Formal principles of project management are being adopted by most private and public organizations in order to develop and deliver new or improved products, services and organizational process changes (Enshassi et al. 2013). Therefore, many researchers investigate ways to develop and enhance the organization's project management practices such as training, evaluating, monitoring, the use of new tools and techniques, and the use of maturity model (Cooke-Davies 2004).

By the end of the 1990s, several researchers were studying the maturity concepts (Hartman and Skulmoski 1998). Cooke-Davies (2004) noted that the use of project management maturity models provide a clear scope of work for the progressive development of project management and achieving successful projects. In addition, PM3 helps an organization to measure to what extent it is executing project management against the practice of its peers in the industry, as well as determine how mature its project management practice is (Man, 2007).

Essentially, maturity models are designed to provide a framework that an organization needs to develop its capabilities, in order to deliver projects successfully in the long term (Backlund et al. 2014). Therefore, understanding the maturity concept will allow the organizations to improve the organization's management proficiencies which will lead to overcome the past management malpractices and achieve a better project performance (Malik et al. 2018).

For the sake of this research, a closed-ended interview was conducted with a group of experts currently working in the construction industry in Jordan to assess their organizational management processes and practices, the interview was designed based on the literature to cover as many aspects to help in the evaluation process.

LITERATURE REVIEW

Due to the wide project failure rates in the past few years, either related to cost overruns or delays, more companies have started focusing on approaches that may help to improve their project management practices (Jugdev and Thomas 2002, Hatamleh et al. 2018). However, the top managers consider the project management practices as a tactical but not strategic asset for the organization. This has resulted in adding more pressure on management by having trouble convincing them that PM investment results in financial and organizational benefits (Kwak and William 2000).

By the end of the 1990s, many models for project management have appeared and formulated the process of building the maturity concept (Hartman and Skulmoski 1998). The SEI Capability Maturity Model (SEI CMM) was the origin of all the models that followed. In other words, most of the models were inspired by it, but one significant criticism that targeted this model is that the organization will tend to avoid risky projects in order to get a better CMM rating (Backlund et al. 2014, Hartman and Skulmoski 1998).

According to Hartman and Skulmoski (1998), the next model was a PMBOK–based model, Project Management Process Maturity Model (PM2), which was formulated after a study that was intended to identify the organizational and financial benefits of project management. Therefore, the PM2 model breaks PM processes and practices into nine PM knowledge areas and five PM processes based on the PMBOK. The PM2 becomes an evaluation technique used by consultant companies to evaluate an organization’s current PM maturity level. Hence, in PM2 there is a series of steps that help the organization to improve its overall PM effectiveness and to check where it stands (Backlund et al. 2014, Kwak, and Ibbs 2002).

The Project Management Maturity Model (PM3) differs from the other models since it doesn’t recommend particularly that all of the organizations must be at the top level of maturity. Instead, it suggests that the organization should achieve a balance that best suits its business objectives, where an organization can have several different levels of maturity, and still be effective. Also, this model recognizes that effective project management is an evolving interaction of processes, systems, and culture (Hartman and Skulmoski 1998). However, the contribution of PM3 to organizational improvement and development is somewhat unclear yet. Therefore, a literature review highlights different aspects regarding PM3 models, specifically their purpose, strengths, and weaknesses (Backlund et al. 2014).

According to Görög (2016) and Malik et al. (2018), there are more than 30 maturity models developed, and that can be used to assess project management maturity. However, Malik et al. (2018) suggested that three models were attracting much more attention and were used to achieve the objectives of this study: The Project Management Maturity Model, by PM solutions (Crawford, 2014), has become one of the industry standards in measuring project management maturity, Organizational Project Management Maturity Model by PMI (Fahrenkrog et al, 2003), and Project Management Maturity Model by Kerzner (2002) represent the other models evaluated. There is a common ground for these three models, these models are adopting PM knowledge areas that are extracted from the Project Management Body of Knowledge (PMBOK) of PMI's standard as a guide for the project management processes and practices implementation.

There is an agreement between researchers that the maturity models are comprised of five levels. These models also support that there are five levels of maturity and that any organization shall fall into one of these levels. Each level represents a different degree of maturity in project management (Mullaly 2006, Yazici 2009, Kerzner 2017). These levels are Level 1: initial processor or common language, Level 2: structured process and standards or common processes, Level 3: organizational standards and institutionalized process or singular methodology, Level 4: managed process or benchmarking, and Level 5: optimizing process or continuous improvement. Several researchers explained each level thoroughly while indicating the differences between them (Fahrenkrog et al, 2003, Mullaly 2006, Yazici 2009, Crawford, 2014, Kerzner 2017).

Each level of maturity has processes. These processes help the organization to achieve a better understanding of each level of maturity and help the organization to assess and keep track of their improvement (Cooke-Davies, 2004). Kerzner (2017) suggests that these levels allow the organization to evaluate their relative strengths and weaknesses against a range of practices, and to identify their specific project management goals. Also, these levels can overlap depending on the amount of risk that the organization is willing to take.

PMI introduced in the latest edition of the PMBOK, the 6th edition, ten knowledge areas: project integration management, project scope management, project schedule management, project cost management, project quality management, project resource management, project communication management, project risk management, project procurement management, and project stakeholder management (Project Management Institute 2018).

Regarding the maturity models and these knowledge areas, each knowledge area has a set of measurement instruments\ processes that can indicate the level of the maturity of the organization in specific area by assessing to what extent each instrument is used in the construction project's life (Abdul Rasid et al. 2014; Malik et al. 2018). Also, since there is a general acceptance of the PMBOK by both scholars and practitioners; the maturity models that are derived from it are widely used (Abdul Rasid et al. 2014). Several researchers defined the processes that need to be covered in each knowledge area and these processes based on the PMBOK with some modification related to the project complexity, stakeholder challenges, and geographical and cultural differences between projects. (Ibbs & Kwak, 2000; Grant & Pennypacker, 2006; Yimam, 2011; Malik, et al. 2018; Project Management Institute 2018). Table 1 illustrates the literature that was used to generate the measurement instruments used in this study.

Table 1. Number of the processes within each knowledge area to assess the maturity level

Knowledge area	Grant and Pennypacker (2006).	Yimam (2011)	PMI (2017)	Malik et al. (2018)	This study
Project Integration Management	5	7	7	6	6
Project Scope Management	6	9	6	6	7
Project Schedule Management	5	17	6	7	11
Project Cost Management	5	19	4	4	11
Project Quality Management	4	26	3	3	11
Project Resource Management	4	37	6	4	19
Project Communication Management	4	16	3	3	6
Project Risk Management	5	18	7	6	14
Project Procurement Management	4	15	3	4	10
Project Stakeholder Management	0	0	4	4	8
Total Processes	42	164	49	47	103

In Cooke-Davies (2004), the author concludes that if the PM3 was applied within an organization, that it would help to add a competitive advantage for the company. Hence, the PM3 concept tries to alter the idea of managing one project toward managing several projects. By applying PM3, the field of quality management was enhanced in a noticeable way among the practitioners. However, PM3 needs total organizational commitment. If the organization had the assumption that there is an ideal path to achieve the maturity regardless of challenges (i.e., the market environment, the type of projects at the time, and the competitive strategy of the company), this might work against the organization goals and improvement (Cooke-Davies 2004).

On the other hand, Brookes et al. (2014) studied the impact of PM3 on improving project performance. Throughout the study, the authors emphasize the lack of empirical evidence that links higher levels of project maturity to higher levels of project performance. However, project management maturity was measured using a survey instrument that was created based on PMI's nine knowledge areas and five maturity levels (Ibbs and Kwak, 2000, Pennypacker and Grant 2003, Grant and Pennypacker 2006, and Yazici 2009). Brookes et al. (2014) went a little further by adding the aggregate levels of project management maturity in each of the nine knowledge areas. After comparing the results between 7 organizations in the UK, they suggested that in order to improve the performance of organizations with low levels of project management maturity they should focus on the formal project management process rather than the weaknesses identified by PM3. On the contrary, the companies with higher levels of maturity should be aware of the model (or framework) that they will implement since it will affect the performance improvement.

Mullaly (2014) noticed that the main short-term objectives and outcomes require minimal maturity to be realized and achieved, while those with a longer-term and more specific seem to be more a product of increased maturity. Therefore, the organization should determine in advance the reasons for adopting one of the maturity models in advance to achieve maximum benefits out of it.

Yazici (2009) conducted research by distributing a survey and he got 86 responses from project managers. In the study, the author notices that there is a great opportunity to improve

project management practice in order to enhance the maturity level of American construction companies since most of the companies that participated in his study did not fully achieve Level 3 of maturity. However, the author concludes that PM3 is significantly related to the company's business performance. Also, the author added that an increase in the project maturity level of an organization along with a suitable organization culture will ensure cost savings and improve the organization's competitive advantage.

RESEARCH METHODOLOGY AND DATA ANALYSIS

The main objective of this study is to assess and evaluate the maturity of the organization in Jordan. In order to do that, an interview with twelve experts was conducted to gather the primary data of this study. The conclusion and recommendations were given to enhance the maturity level in each of the knowledge areas as needed to improve the organization's management proficiencies in Jordan.

This study offers an in-depth understanding of the maturity concept which allows the organizations in the industry to improve the organization's management practices to overcome the past management malpractices and achieve a better project performance. In addition, this study helps the organizations to measure to what extent it is executing project management against the practice of its peers in the industry, as well as determine how mature its project management practice is.

According to the United Nations in its Human Development Index (HDI), countries with an HDI score of 0.800 or higher are considered developed countries. Jordan has a score of 0.741 which means it is still considered by the United Nations as a developing country (Roser, 2018). The data and studies done within this transition phase can be used as a benchmark for future studies in the region and all around the world.

The closed-ended interview was designed as a structured checkbox grid of questions. Participants were asked to choose one of the answers illustrating to what extent each practice/process was used by the participant's organization by using a Behaviorally Anchored Response Scale (BARS) scale. The BARS scale allows the experts to determine the organization's maturity in an easier and more comfortable way (Malik et al. 2018). According to Denscombe (2014), sets of standards should be followed in order to construct an effective interview such as using simple and obvious words, avoid asking sensitive questions, depending on the logical flow of questions, assuming that former questions do not influence the answer of latter questions, and selecting questions related to the topic. Hence, all of these standards were used in order to design the closed-ended interview for this study.

A comprehensive list of Project Management Maturity Model (PM3) measurement instruments was selected to assess and evaluate the maturity of the organization of the experts and to link the knowledge areas together. These instruments were selected from four main sources: Grant and Pennypacker (2006), Yimam (2011), Project Management Institute (2017), and Malik et al. (2018) to cover each knowledge area within the PM3. This research doesn't aim to develop a new maturity model but it aims to utilize the three maturity models mentioned in the literature section to achieve this study's objectives. For the sake of the interview, a list of processes (measurement instruments) was selected as shown in Table 1.

The interviews were conducted with twelve experts. Frequencies and percentages are shown in Table 2 in order to describe the profile information of the experts.

Table 2. Demographic description

Respondents' Information	Frequency	Percent
Type of your participation in construction project implementation		
Consultant: (Planner, Designer, Environmental, or HR).	5	41.67%
Contractor: (Prime contractor or Subcontractor).	7	58.33%
Current position		
Project Manager	2	16.67%
Construction Manager or Superintendent	3	25.00%
Assistant Project Manager (e.g., schedule, material, quality, safety, subcontractor control)	6	50.00%
Regional manager/project manager/IM manager &coordinator	1	8.33%
Type of projects		
Residential buildings	5	41.67%
Commercial buildings	6	50.00%
Mixed/PPP/WASH/Energy	1	8.33%
Working experience in the Construction Industry		
5 – 10 years	3	25.00%
10 - 15 years	4	33.33%
>15 years	5	41.67%

Table 3. Case processing summary

		N	%
Cases	Valid	12	100.0
	Excluded	0	.0
	Total	12	100.0

Table 4. Reliability statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.986	.986	103

According to Malik et al. (2018), each knowledge area has its own maturity level and that could be decided by pointing out the lowest level of maturity between the measurement instruments assigned for each area. The maturity level was assigned by calculating the values of median and mode for each measurement instrument to reflect a better understanding. However, the maturity level for each knowledge area was assigned by selecting the lowest level within the instruments related to it. Hence, the experts' responses for both groups separately are available upon request from the corresponding author.

The first step to start the data analysis for this part is to check the reliability and it was assessed using internal consistency. Internal consistency provides an estimate of the equivalence of items that exist in the same test and assumes that items measuring the same variable should be correlated (Kimberlin and Winterstein, 2008). The most popular method for testing the internal consistency in behavioral sciences is Cronbach's alpha coefficient (Drost, 2011). Cronbach's alpha computed values range between 1 (perfect internal reliability) and 0 (no internal reliability) (Bryman and Bell, 2015). Table 3 illustrate the case

processing summary from the SPSS software, which suggests that all of the twelve samples were included in the analysis.

In order to determine how reliable the measures used in the study are, Hair et al. (2010) suggested that the minimum acceptable level of Cronbach's alpha for considering a study's instrument reliable should be 0.60. Hence, Table 4 shows the Cronbach's alpha value for this study which is 0.986 for the total number of 103 indicators and that suggests strong internal reliability.

The second step in the data analysis for this part is to check if there is an agreement between contractors' and consultants' responses. The Mann-Whitney test (U) was investigated for potential application, but the sample size is small (Mann-Whitney test (U) results gives an agreement between the variables for sample size less than 30), therefore Kendall's tau_b test was conducted (Sheskin 2003). The following hypothesis was used to check the agreement between the contractor's and the consultant's responses: H01: There is no statistically significant relationship between the contractor responses and the consultant responses. The results of Kendall's tau_b test shown in Table 5 suggest Kendall's tau_b correlation coefficient equal 0.205 which means accepting the hypothesis. Hence, if the value equals 1 that means having a strong agreement between the variables. Therefore, there is no statistically significant relationship between the contractor responses and the consultant responses. Therefore, there is a need to study the responses of each group separately.

Table 5. Kendall's tau_b correlation coefficient

Correlations			Cont.	Cons
Kendall's tau_b	Cont.	Correlation Coefficient	1.000	.205
		Sig. (2-tailed)		.002
		N	103	103
	Cons.	Correlation Coefficient	.205	1.000
		Sig. (2-tailed)	.002	
		N	103	103

Finally, content validity was employed in this study to check the validity of the study instrument. Content validity relates to the assessment of whether the variables used to represent certain concepts do in fact reflect the content and definition of that concept (Bryman and Bell, 2015). To examine this type of validity, it is advised to seek feedback from experts on the concepts being explored (Hair et al., 2010). Therefore, to ensure that the instrument developed for this research is valid the feedback provided by the experts from the closed-ended interview was reflected in the final interview questions. Hence, the revised measurement instruments that formulated the interview questions along with the experts' responses for both groups separately are available upon request from the corresponding author.

CONTRACTORS AND CONSULTANTS' INTERVIEW RESULTS

According to Malik et al. (2018), each knowledge area has its own maturity level assigned by the lowest level of maturity between the measurement instruments. Table 6

illustrates the results from the contractor's perspective and it was assigned in the mentioned methodology. For instance, the maturity level based on the contractors' responses for the project integration management is at Level 2 (taking in consideration that this is the lowest level for this knowledge are and extracted from instrument number three which was used to relate to the project executing process and instrument number five which was used to relate to integrated change control). Hence, the same process was implemented for the rest of the results and summarized in Table 6 contractor's responses. On the other hand, Table 6 consultants' responses illustrate the results from the consultant's perspective. For instance, the maturity level based on the consultants' responses for the project resource management is at Level 1 (taking in consideration that this is the lowest level for this knowledge are and extracted from instrument number six which was used to relate to the project resource management planning and instrument number fourteen which was used to relate to project resource acquisition).

Table 6. Summary of maturity level based on the contractors' responses

Knowledge Areas	Maturity Level Contractors' responses	Maturity Level Consultants' responses
Project Integration Management:	2	2
Project Scope Management	3	3
Project Schedule Management	2	4
Project Cost Management	2	2
Project Quality Management	1	2
Project Resource Management	2	1
Project Communication Management	3	2
Project Risk Management	2	1
Project Procurement Management	3	1
Project Stakeholder Management	2	2

COMPARISON AND CONCLUSION

Both contractors and consultants exhibited the same maturity levels in the following areas: integration, scope, cost, and stakeholder management. The rest of the areas had different maturity levels. Table 6 shows that the contractors have only one area with a maturity level of 1 (the project quality management) while the consultants had three areas with maturity level 1 (resource, risk, and procurement management).

Contractors should set a standards management approach to long-term success through customer satisfaction, where all members of the company participate in improving processes, products, services, and the culture in which they work. The consultant should focus on having an equipment policy that guides acquisition, use, and replacement decision, having an effective risk response strategy and managing the delivery dates of procures items as implied on the contract.

The contractors achieved Level 2 of maturity in Project Integration, Schedule, Cost, Resource, Risk, and Stakeholder Management. This implies that the contractors have a structured process that has been applied for each project separately. Therefore, this might affect the organization's performance as a whole since the projects that an organization execute

simultaneously have to align towered achieving the organization goals rather than each individual project goals at a time. On the other hand, the consultant's firms have the same maturity level for Project Integration, Cost, Quality, Communication, and Stakeholder Management.

The participants showed that the majority of the Jordanian contractors take in their consideration a contingency time in the project schedule for potential risk impact. As well as, reserving a contingency budget for covering the potential risk cost impact. This practice is built-in within their policies and standards which allow them to handle risk to a certain extent. However, they are facing a challenge in identifying the potential problems and risks that they might encounter during the project life span. Therefore, following a well-structured practice like Risk Breakdown Structure (RBS), would help them to identify the amount of contingency needed for the project.

The results also show that the consulting companies in Jordan have a good understanding of Project Schedule Management, they tend to use network scheduling methods such as the Critical Path Method (CPM) and Project Evaluation and Review Technique (PERT) along with computer tools such as Microsoft Project, Primavera, and Excel for scheduling. Hence, the majority of the consultants achieved Level 5 of maturity in these two practices.

Finally, the organizations in Jordan have achieved maturity ranging between Levels 1 to 4 in the different knowledge areas with a majority at Level 2. These results were in line with the Mullaly (2006) study since the author concluded that the majority of international organizations implement project management processes under this maturity level. However, both contractors and consultants had achieved maturity of Level 4 and 5 on several processes. The contractors achieved Level 4 of maturity on 38 processes out of 103 with one process at Level 5, while the consultants achieved Level 4 on 37 with 4 processes at Level 5. These maturity levels still need enhancement in order to get closer to the best practice condition in project management processes. This indicates inefficiency in the current project management system in Jordanian organizations.

Organizations in the region could use the results of this study to better understand their current capabilities, weaknesses, and strengths in handling future projects to ensure better organization management proficiencies. Hence, enhancing the maturity in the lowest mature areas would lead to improving the organization's management proficiencies which can be applied throughout the industry.

ETHICAL COMPLIANCE

The authors have stated all possible conflicts of interest for this work and all sources of funding for this work, if any.

REFERENCES

Abbasi, G. Y., & Al-Mharmah, H. (2000). Project Management Practice by the Public Sector in a Developing Country. *International Journal of Project Management, 18(2),* 105-109.

Abdul Rasid, S. Z., Wan Ismail, W. K., Mohammad, N. H., & Long, C. S. (2014). Assessing 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.

Backlund, F., Chronéer, D. and Sundqvist, E., (2014). Project Management Maturity Models – A Critical Review: A Case Study within Swedish Engineering and Construction Organizations. *Procedia-Social and Behavioral Sciences, 119,* pp.837-846.

Bennett, F. L. (2003). *The Management of Construction: A Project Life Cycle Approach.* Waltham, MA, USA: Butterworth- Heinemann.

Bryman, A. and Bell, E. (2015). *Business Research Methods* (4th Edition). Oxford, England: Oxford University Press.

Cooke-Davies, T. (2004). *Project Management Maturity Models: The Wiley Guide to Managing Projects,* 1234-1255. Hoboken, NJ, USA: Wiley & Sons, Inc.

Crawford, J. K. (2014). *Project Management Maturity Model* (3rd Edition). Boca Raton, FL, USA: CRC Press, Taylor & Francis Group; Auerbach Publications.

Denscombe, M. (2014). *The Good Research Guide: For Small-Scale Social Research Projects.* London, England: McGraw-Hill Education.

Drost, E. A. (2011). Validity and Reliability in Social Science Research. *Education Research Perspectives, 38 (1),* 105-123.

Enshassi, A., Mohamed, S., & Abdel-Hadi, M. (2013). Factors Affecting the Accuracy of Pre-Tender Cost Estimates in the Gaza Strip. *Construction in Developing Countries, 18(1),* 73-94.

Fahrenkrog, S. L., Haeck, W., Abrams, F., & Whelbourn, D. (2003). 'PMI's Organizational Project Management Maturity Model. *Paper presented at PMI® Global Congress 2003,* North America. Baltimore, MD. Newtown Square, PA: Project Management Institute.

Grant, K. P., & Pennypacker, J. S. (2006). project Management Maturity: An Assessment of Project Management Capabilities among and between Selected Industries. *IEEE Transactions on Engineering Management, 53(1),* 59-68.

Gould, F. E., & Joyce, N. E. (2009). Construction Project Management (3rd Edition). Upper Saddle River, NJ, USA. Prentice-Hall.

Görög, M. (2016). A Broader Approach to Organizational Project Management Maturity Assessment. *International Journal of Project Management, 34(8),* 1658–1669.

Hair, J. F., Black, W. C., Babin, B. J. and Anderson, R. E. (2010). *Multivariate Data Analysis* (7th Edition). Upper Saddle River, NJ, USA: Pearson Education, Inc.

Hatamleh, M. T., Hiyassat, M., Sweis, G. J., & Sweis, R. J. (2018). Factors Affecting The Accuracy Of Cost Estimate: Case of Jordan. *Engineering, Construction and Architectural Management, 25(1),* 113-131.

Hartman, F. T., & Skulmoski, G. (1998). Project Management Maturity. *Project Management Journal, 4(1),* 74-78.

Ibbs, C. W., & Kwak, Y. H. (2000). Assessing Project Management Maturity. *Project Management Journal, 31(1),* 32-43.

Idoko, L. A. (2008). Developing local capacity for project management - Key to social and business transformation in developing countries. *PMI Global Congress 2008. Project Management Institute.*

Jekale, W. (2004). *Performance for Public Construction Projects in Developing Countries: Federal Road and Educational Building Projects in Ethiopia.* Norwegian University of Science & Technology.

Jugdev, K., & Thomas, J. (2002). Project Management Maturity Models: The Silver Bullets of Competitive Advantage. *2002 Student Paper Award Winner: Project management journal, 33(4*), 4-14.

Kerzner, H. (2002). *Strategic Planning for Project Management Using a Project Management Maturity Model.* Hoboken, NJ, USA. John Wiley & Sons Inc.

Kerzner, H. (2017). *Project Management: A Systems Approach to Planning, Scheduling, and Controlling.* Hoboken, NJ, USA. John Wiley & Sons Inc.

Kimberlin, C. L., and Winterstein, A. G. (2008). Validity and Reliability of Measurement Instruments Used in Research. *American Journal of Health-System Pharmacy, 65*, 2276-2284.

Kwak, Y. H., & Ibbs, C. W. (2002). Project Management Process Maturity PM 2 Model. *Journal of Management in Engineering, 18(3*), 150-155.

Kwak, Y. H., & William, C. (2000). The Berkeley Project Management Process Maturity Model: Measuring The Value of Project Management. *In Engineering Management Society, 2000. Proceedings of the 2000 IEEE* (pp. 1-5). IEEE.

Malik, V., Haryono, I, & Pratami, D. (2018). The Utilization of Project Management Maturity Models in Enhancing Project Management Capabilities: Case Study of a Project-Based Organization in Indonesia. *The 2nd International Conference on Family Business & Entrepreneurship (2nd to 4th May 2018).* Bali, Indonesia

Man, T. (2007). *A Framework for Comparison of Maturity Models for Project-Based Management.* Utrecht, Netherlands: Utrecht University.

Mullaly, M. (2006). Longitudinal Analysis of Project Management Maturity. *Project Management Journal, 37(3),* 62-73.

Mullaly, M. (2014). 'f Maturity Is The Answer, Then Exactly What Was The Question. *International Journal of Managing Projects in Business, 7(2),* 169-185.

Ofori, G. (2007). Procurement reform: A research agenda for construction in developing countries. *In Proceeding of CIB World Building Congress,* Cape Town, South Africa. 1949-1963

Pennypacker, J. S., & Grant, K. P. (2003). Project Management Maturity: An Industry Benchmark. *Project Management Journal, 34(1),* 4-11.

Project Management Institute (2017). *A Guide to the Project Management Body of Knowledge PMBOK® Guide* (Sixth Edition). Newtown Square, PA, USA: Project Management Institute, Inc.

Project Management Institute (2018). *A Guide to the Project Management Body of Knowledge (PMBOK® Guide).* Newtown Square, PA, USA: *Project Management Institute, Inc.*

Roser, M. (2018). Human Development Index (HDI). Our World in Data, Published online at OurWorldInData.org. Retrieved from: https://ourworldindata.org/human-development-index.

Sheskin, D. J. (2003). *Handbook of Parametric and Nonparametric Statistical Procedures.* Boca Raton, FL, USA: CRC Press.

Trading Economics (2018). Jordan GDP from Construction Industry. Retrieved from: https://tradingeconomics.com/jordan/gdp-from-construction.

Yazici, H. J. (2009). The Role of Project Management Maturity and Organizational Culture in Perceived Performance. *Project Management Journal, 40(3),* 14-33.

Yimam, A. H. (2011). *Project Management Maturity in the Construction Industry of Developing Countries (The Case of Ethiopian Contractors).* Doctoral dissertation. College Park, Maryland: Faculty of the Graduate School of the University of Maryland.

BIOGRAPHICAL DETAILS

Muhammad T. Hatamleh, Ph.D. Candidate

BIOGRAPHY

Muhammad T. Hatamleh is a Ph.D. candidate at the Department of Civil, Construction and Environmental Engineering at The University of Alabama. He graduated with a Bachelor's degree in Civil Engineering from the Hashemite University, Jordan. He received his Master's degree in Project Management Engineering, Construction Management from The University of Jordan, Jordan. Before assuming his current position, he worked as a project coordinator at HILTI Company, Jordan branch. He is a graduate assistant at the Department of Civil, Construction and Environmental Engineering at The University of Alabama. His research interests include but not limited to the accuracy of cost estimate; Fuzzy Logic techniques and Intelligent Decision Support System (IDSS); economic analysis; project management; project risk management; quality and reliability engineering; safety engineering; sustainability and sustainable infrastructure.

Dr. Gary P. Moynihan, Professor, Associate Department Head of Civil, Construction and Environmental Engineering

BIOGRAPHY

Dr. Moynihan's primary areas of research specialization are information systems development, including management information systems, decision support systems, and expert systems; economic analysis; project management; and operations analysis. He has served as principal or co-principal investigator on research grants and contracts that have

been funded by NASA, the U.S. Army Aviation and Missile Command, the Federal Aviation Administration, BellSouth Telecommunications, Mercedes-Benz, and the foundry industry. Moynihan co-founded and served as assistant director for the Alabama Industrial Assessment Center, which is a Department of Energy-funded center dedicated to assisting manufacturing facilities in energy cost reduction, productivity improvement, waste minimization, and pollution prevention. He has published more than 100 articles in books, journals and conference proceedings, and has five software copyrights. Prior to joining The University of Alabama, Moynihan was employed for 10 years by Martin Marietta Orlando Aerospace, where he was a manufacturing engineer, industrial engineer, and a systems analyst for a variety of company programs, including missile defense and fixed-wing/rotorcraft avionics. He has also held production supervisor positions in the computer and chemical processing industries.

Dr. M. Ammar Alzarrad, Assistant Professor

BIOGRAPHY

Dr. Ammar Alzarrad is a LEED Accredited Professional. He graduated with dual bachelor's degrees in Civil Engineering and Business Administration from the University of South Alabama. He received his M.Sc. and Ph.D. in Civil Engineering from The University of Alabama (UA). He is an Assistant Professor at the Department of Civil Engineering and Construction at Bradley University. Before assuming his current position, he was a Virtual Design & Construction (VDC) manager at an engineering design firm in Chicago where he managed multi-million projects (i.e., Wrigley Field restoration and expansion project). Dr. Alzarrad is an independent consultant, and he provides his services to different companies in the Chicago area and Peoria city. Dr. Alzarrad is a recipient of several awards including The UA College of Engineering's Outstanding Teaching Award and The UA Civil Engineering's Department Outstanding Research Award for the years of 2017 and 2019 respectively. Dr. Alzarrad's research interests include but not limited to Fuzzy Logic techniques and Intelligent Decision Support System (IDSS), Building Information Modeling, Machine Learning, and Deep Learning applications in construction, 3D printing and automation in construction, sustainability and sustainable infrastructure. He published his research outputs in top-tier peer-reviewed journals and presented some of his research findings at different international conferences.

Dr. Robert G. Batson, Professor

BIOGRAPHY

Dr. Robert Batson has research interests in engineering and quality management, project risk management, supplier and supply chain management, quality and reliability engineering, and safety engineering. Since joining UA in 1984, he has been awarded 52 contracts and grants worth more than $2.3 million with organizations such as Mercedes-Benz, American Cast Iron Pipe Co., BellSouth, National Science Foundation, NASA, the Federal Aviation Administration, and the Army Aviation and Missile Command. A number of these dealt with materials processing, fabrication, and assembly, or safety of operations. He and his students recently completed a contract to improve the accuracy and usability of the ALDOT software to predict queue formation and growth/dissipation at interstate highway work zones. He has authored a Handbook of Project Risk Management for NASA in 1987 and a Wiley textbook entitled Applied Integer Programming in 2010, along with 75 refereed articles or book chapters. Bob is a registered P.E. in California.