

PROJECT MANAGEMENT MATURITY AND PROJECT MANAGEMENT SUCCESS IN DEVELOPING COUNTRIES

S. Pretorius^{1*}, H. Steyn¹ & T.J. Bond-Barnard²

ARTICLE INFO

Article details

Submitted by authors 19 Jul 2022
Accepted for publication 11 Jul 2023
Available online 25 Aug 2023

Contact details

* Corresponding author
suzaan.pretorius@up.ac.za

Author affiliations

1 Department of Engineering and
Technology Management,
University of Pretoria, Pretoria,
South Africa

2 Department of Industrial
Engineering, Stellenbosch
University, Stellenbosch, South
Africa

ORCID® identifiers

S. Pretorius
<https://orcid.org/0000-0003-4612-9558>

H. Steyn
<https://orcid.org/0000-0002-5913-6354>

T.J. Bond-Barnard
<https://orcid.org/0000-0003-0853-4480>

DOI

<http://dx.doi.org/10.7166/34-2-2760>

ABSTRACT

This paper explores whether organisations in a developing country have become more mature over time in their project management practices, and compares the current state to findings from a similar study conducted in 2010. It thus contributes to the scant literature on project management maturity in developing countries. Six hundred responses to a project management maturity questionnaire were used to investigate the perceived project management success of 9 389 projects. The results indicated that the perceived average project management maturity dropped from the 2010 value of 2.88 to 2.64 in 2020. Despite this, most of the projects surveyed were still perceived as successful.

OPSOMMING

Hierdie artikel ondersoek of organisasies in 'n ontwikkelde land meer volwasse geword het in hulle projekbestuurspraktyke, en vergelyk die huidige situasie met bevindings in 'n soortgelyke studie wat in 2010 onderneem is. Dit dra dus by tot die skaars literatuur rakende projekbestuurvolwassenheid in ontwikkelende lande. Seshonderd terugvoere vir 'n projekbestuurvolwassenheid vraelys is gebruik om die projekbestuursukses van 9 389 projekte te ondersoek. Resultate wys dat die gemiddelde waargenome projekbestuurvolwassenheid gedaal het van 2.88 in 2010 tot 2.64 in 2020. Ten spyte hiervan is die meeste projekte steeds as suksesvol beskou.

1. INTRODUCTION

Present-day organisations face challenges caused by innovation, increasing complexity, and the evolving nature of work [1]. In order to remain competitive, companies need to be responsive to these changes [2]. Projects empower a company to adapt to instabilities in the environment. Therefore, several companies have moved in recent years towards 'projectised' structures [3],[4]. There is a general belief that higher project management maturity levels will result in more successful projects [2]. However, there is an ongoing debate among scholars about the influence of project management maturity on project success, if any [2]. The aim of this study is to determine whether organisations in developing countries have become more mature in their project management practices, and to explore the relationship between maturity and perceived project success.

In 2010, Pretorius, Steyn and Jordaan [5] reported on how the project management success of engineering and construction projects in South Africa influenced the project management maturity of the organisations that carried them out. The reasons for revisiting the study of Pretorius *et al.* [5] now include the following:

- Pretorius *et al.* [5] reported that only five of the PMBOK® Guide's [6] project management knowledge areas were positively associated with project management success. This study revisits the impact of project management maturity on project success in all project management knowledge areas, to determine whether the situation has changed over the past decade.
- In 2010 the majority of the respondents perceived their projects as successful. This study assesses whether this situation has changed.

- A decade ago, the average perceived level of project management maturity was 2.88. This study investigates whether and how this level has changed.

Cooke-Davies and Arzymanow [7] state that it seems reasonable to assume that the longer an organisation is exposed to pressures to perform, the more likely it is that its project management processes will become more mature, resulting in a more mature organisation. It is important for an organisation to learn from previous projects in order to achieve a higher level of project management maturity [8]. Developments in information and communication technologies made knowledge transfer - including the easy storage and retrieval of information - possible [8]. Thus over time an organisation should reach a state in which it is more able to manage its projects successfully (i.e., reach a higher level of maturity) [9]. In the past decade South Africa and other developing countries have experienced a high turn-over of professionals, which could have caused problems with knowledge transfer and the loss of 'lessons learned' from previous projects. The value of this study is twofold: it gives an indication of how the 2020 maturity levels in a developing country differ from the 2010 levels; and it provides an understanding of the impact of project management practices, which determine an organisation's maturity, on project success. Moreover, the relationship between project management maturity and project management success may have been different in developing countries in the past decade.

Numerous project management maturity studies have been conducted in developed countries. Countries that have been studied include, but are not limited, to:

- USA [10],[11],[12],[13]
- Canada [14],[15]
- North America [14]
- UK [16]
- Germany [2],[17],[18]
- Sweden [19].

A few studies have been conducted in developing countries, such as:

- South Africa [5],[20]
- Iran [21].

This study makes an important contribution, in that the focus of project management research is shifting to developing countries (or emerging markets), which are steadily becoming the drivers of global growth. Long-term investments in emerging markets have outperformed those in the advanced economies for 15 years [22]. As project management maturity and its effect on project success may differ between developed and developing countries, it is important to study the impact of project management maturity on project management success in developing countries.

Limited studies have been done on project management maturity in African countries. Thus this study contributes by expanding the body of knowledge in this regard. The PMBOK® [6] is still relevant for the practitioner, and it could be stated that a higher organisational project management maturity could make a significant impact on project management success, especially in developing countries, as the systems and infrastructure needed to manage projects successfully are not always in place.

2. LITERATURE REVIEW

2.1. Project management maturity

Project management is intended to make effective and well-organised use of resources to complete a project within time, scope, and cost [23]. Maturity can be defined as "a specific process of explicitly defining, managing, measuring and controlling the evolutionary growth of an entity" [24]. Maturity can also be described as the state in which processes are well-defined, well-managed, fully controlled, and effective [25]. The notion of maturity suggests that there might be an improvement from one level of competency to a higher one [26]. Yazici [10] describes project management maturity as the improved capability to "integrate, assess, and improve project management practices".

It is expected that organisations with higher maturity levels will have a competitive advantage, as they are successful in their project effectiveness and competence [19]. Mature organisational systems and procedures stimulate the realisation of consistent brilliance in project management [21]. Project-based companies need to be agile and flexible in an ever-changing context, and maturation creates an improved understanding of the management, governance, and organising of an organisation over time [27].

2.2. The measurement of project management maturity

The measurement of project management maturity is best illustrated by using the concept of a ladder: an organisation's level of maturity moves higher up the rungs of the ladder as its project management processes and procedures matures over time. It can be measured through certain stages (i.e., measuring a fixed number of KPIs/KPAs), from an initial level (a state of relative uncomplicatedness or 'naivety') up to an ending level (i.e., the 'level of perfection' and of intricacy and thoroughness) [21],[26],[28]. Thus organisations functioning at a low maturity level practise project management in an informal manner, and processes (even though they had been documented) are commonly improvised. Managers at this level (informally referred to as 'firefighters') tend to solve problems straight away, and deadlines and costs are exceeded more often than not [25],[29]. Organisations operating at higher maturity levels have more formal structures and process controls in place [25],[29].

However, it is not essential for every organisation to operate on the 'highest' level of maturity in every project management knowledge area. The notion of an industry-specific 'ideal' level of maturity has been suggested by Christoph and Konrad [29]. From another perspective, it could be said that becoming mature is not an end target that will be reached by everyone; it is a sought-after goal that is constantly moving [30].

Nicholas and Steyn [31] state that maturity models fall into three groups:

- Technical delivery models;
- Project management process models; and
- Total organisation models.

Most project management maturity models use the Software Engineering Institute's 'capability maturity models' (CMMs) as foundation: practices are evaluated against standard measures [32],[33]. These maturity models commonly consist of five linear stages [32]:

Level 1: Initial (ad hoc)

Level 2: Repeatable (planned)

Level 3: Defined (organised)

Level 4: Managed (integrated)

Level 5: Optimised (adaptive, sustained)

Studies show that around two-thirds of organisations are rated at levels 1 or 2 on the project management maturity scale. The petrochemical and defence industries are comparatively more mature than companies in the fields of insurance, finance and health services, pharmaceutical research and development, and telecommunications [31].

In a study that surveyed 75 organisations, Yazici [10] found that their average maturity level was 2.27 (out of a possible 5), and ranging between 1.93 and 2.6. The study found that the project management knowledge areas of cost, risk, and human resources were the critical focus areas that needed attention in respect of standardisation, which would ultimately lead to a higher maturity level. In a study using PM Solutions' project management maturity model, Grant and Pennypacker [13] found a median maturity level of 2 across different industries and companies.

2.3. Maturity models

According to the PMI [34], a maturity model is an organised group of components that define the features of successful processes or products. Maturity models are extensively used in project management to stimulate constant process/system improvement and to calculate an organisation's level of project management maturity - an emerging topic that has been gaining scientific relevance. Reis *et al.* [25], in

their bibliometric analysis of publications relating to maturity models from 2004 to 2014, found that the term ‘maturity model’ is most often used in science-based publications, and mainly in computer science, engineering and business, management, and accounting.

Although the first maturity models were developed in the mid-1990s, the notion of allocating levels of maturity to project management stems from the disciplines of quality and process management and the management of software engineering projects [18]. In 2006, Mullaly [14] estimated that more than 30 project management maturity models were available, while in 2013, Iqbal [35] referred to about 60 different models.

Maturity models include, but are not limited to:

- Capability maturity model (CMM) and capability maturity model integration (CMMI) [33]
- Project management process maturity model [11],[36]
- Portfolio, programme and project management maturity model (P3M3) [37]
- Project management maturity model [38]
- Organisational project management maturity model [39]
- PRINCE2 maturity models [40]
- Prado-PMMM [39] and the project management competence model [41]
- Berkeley PM process maturity model [11],[12]
- PM Solutions project management maturity model [12].

Project management maturity models are usually associated with project management bodies of knowledge, such as *A guide to the project management body of knowledge* (PMBOK®) [34], and the emphasis is on project management knowledge areas [32].

2.4. Project management knowledge areas

The PMBOK® [34] is a widely used and recognised body of knowledge in the South African project environment. Therefore, this study used the PMBOK’s concept of project management knowledge areas. This was also used in the study by Pretorius *et al.* [5] that the current study uses as a point of reference. The PMBOK® [34] defines project management knowledge areas as “fields or areas of specialisation that are commonly employed when using projects”. A project management knowledge area is therefore “a set of processes with a particular topic in project management”.

The questionnaire used to conduct this study mapped the nine project management knowledge areas listed in the 2009 PMBOK® Guide [42] against the five maturity levels given in the Software Engineering Institute’s capability maturity model (CMM). The project management knowledge areas at that time were project integration management, project scope management, project time management, project cost management, project quality management, project human resource management, project communications management, project risk management, and project procurement management.

The authors are aware that the project management knowledge areas have since been extended to ten by adding project stakeholder management; but, in order to ensure comparability with the 2010 study, this paper only reports on the findings that were based on the nine knowledge areas listed above.

Not all of the project management knowledge areas have the same level of maturity in organisations. Besner and Hobbs [43] found that, of the above knowledge areas, risk management seemed to be the most “unattended area in companies”. Busse *et al.* [2] agrees; their findings indicate that risk management is perceived as being the least mature.

Demirkesen and Ozorhon [44] confirm that integration, cost, human resources, communications, risk, and financial management have a positive effect on project performance. A study by Attakora-Amaniampong [45] indicated that project cost, risk, and quality management skills affect project success the most. Chou, Irawan and Pham [46] investigated the influence of project scope, time, quality, human resources, and procurement management on project success using structural equation modelling. Their study found that sound communication management is a critical contributing factor to project success.

2.5. Perceived project management success

Despite the fact that several studies have been conducted on project success factors, many projects are still failing [5],[47],[48],[49],[50],[51],[52]. Success means different things to different people [48]. A person's personal objectives may influence them to judge a project differently from their team member [53]. One person could judge a project as a success, while another might regard it as a failure [54]. In the light of this, this paper refers to the 'perceived' success of a project. Nicholas and Steyn [31] define project success as "hitting a target that floats in a three-dimensional space", with the dimensions being cost, time, and performance. "The purpose of project management is to hit the target" [31]. It could be deduced from this that a project is perceived as successful when the "target has been hit". Several authors realise, however, that the 'iron triangle' (cost, time, and performance) is an over-simplification [47],[55],[56],[57],[58].

Kendra and Taplin [59] say that project management success depends on the following four dimensions:

- "The skills and competencies of the project manager,
- organisational structure,
- measurement systems, and
- management practices that represent an organisation's culture."

For the purposes of this study, project management success was self-defined by the respondents.

3. HYPOTHESES

The hypotheses, with their supporting literature, are presented below:

Project integration management is essential to coordinate all project management knowledge areas in order to ensure progress and to address delays and changes in a timely manner [60]. This leads to H1:

H1: The higher an organisation's level of maturity in project integration management practices, the higher its likelihood of executing more successful projects.

Project scope management is a crucial function that could have an impact on project success, and that is considered one of the most vital functions of a project manager [61]. Therefore, H2 states the following:

H2: The higher an organisation's level of maturity in project scope management practices, the higher its likelihood of executing more successful projects.

Extending the project execution time (i.e., poor project time management) usually leads to cost overruns, mostly for the following reasons: additional expenses on personnel, cost escalations of materials, and paying contract penalties (to name only a few). This very often results in project failures [62]. This leads to H3:

H3: The higher an organisation's level of maturity in project time management practices, the higher its likelihood of executing more successful projects.

The management and control of costs is essential to the success of most projects [63]. Accordingly, H4 states that:

H4: The higher an organisation's level of maturity in project cost management practices, the higher its likelihood of executing more successful projects.

An important outcome of quality control is the acceptance or rejection of a project's milestones or deliverables. ('Acceptance' in this case refers to a successful project phase or 'end product' [64].) This leads to H5:

H5: The higher an organisation's level of maturity in project quality management practices, the higher its likelihood of executing more successful projects.

Despite recent developments in project management methodology, people are still the cornerstone of projects: they determine the success or failure of a project, for they define project goals, they can contribute to problems or constraints, or they can provide solutions and opportunities [64]. This underlies H6:

H6: The higher an organisation's level of maturity in project human resource management practices, the higher its likelihood of executing more successful projects.

Project communication management is one of the most important tasks of a project manager, and is one that largely influences a project's success or failure [65]. This leads to H7:

H7: The higher an organisation's level of maturity in project communication management practices, the higher its likelihood of executing more successful projects.

The management of risk is linked to the attainment of an organisation's objectives and to more projects that tend to stay within budget, achieve schedule milestones, and produce the specified levels of quality [66].

H8: The higher an organisation's level of maturity in project risk management practices, the higher its likelihood of executing more successful projects.

In a project, the management of procured materials and outsourced work is as crucial as the work done internally: procured items that exceed budget or schedule or fail to meet quality requirements can cause cost and schedule overruns, and could ultimately lead to the failure of a project [31]. This leads to H9:

H9: The higher an organisation's level of maturity in project procurement management practices, the higher its likelihood of executing more successful projects.

4. METHODOLOGY

The research was approved by the Ethics Committee of the Faculty of Engineering, the Built Environment and Information Technology at the University of Pretoria. Informed consent was obtained from all participants. Qualtrics XM Platform™ was used to distribute an online, structured, and self-administered survey to respondents. The questionnaire was distributed to project/programme/portfolio managers, project team members, project sponsors/clients, and project stakeholders working in an African project setting (e.g., regulatory authority, subcontractor, and external party). This demographic was chosen to ensure that the respondents understood projects fully and held noteworthy positions in the project environment. In the questionnaire, respondents were asked to base their answers on the outcomes of projects in their organisations, and to scrutinise recent projects in respect of project success. The questionnaire comprised mostly Likert-scale questions. To compare this study with that of Pretorius *et al.* [5], purposive sampling was again used to distribute the survey questionnaire developed by Sonnekus and Marnewick [20].

Although the 2010 study was limited to engineering and construction, a wider population was targeted in order to obtain more data. This did not affect any of the hypotheses, but it did give some indication of how levels of maturity differed between 2010 and 2020.

4.1. Hypothesis testing

As in the case of the 2010 study [5], non-parametric tests were used to test the hypotheses. This was done because parts of the study consisted of small sub-groups.

In order to test the hypotheses, the same statistical measures that were used in the 2010 study [5] were used again. These included the followings tests:

- **Kruskal-Whitney:** This test is designed to assess whether population medians are equal among groups. It is based on ranks rather than means [67].
- **Kolgomorov-Smirnov:** This test compares cumulative distribution functions to test the goodness-of-fit of a given set of data to a theoretical distribution [67].

- Shapiro-Wilk Test: This tests the univariate normality hypothesis [68].

However, the Mann-Whitney tests used in the 2010 study were replaced in the 2020 study by Dunn's non-parametric multiple comparisons for post hoc testing because of advances in the statistical software used for the 2020 study.

4.2. Reliability testing

Cronbach's Alpha measures how well a set of variables measures a single aspect, and it is generally used as a measure of internal consistency and reliability. The reliability of both the 2010 and the 2020 studies was confirmed by the Cronbach's Alpha test (see Table 1). For all of the items, the Alpha was higher than 0.7, indicating that the respondents answered the questions consistently.

5. RESULTS

5.1. Descriptive statistics

As time was of the essence, the authors decided to distribute the questionnaire for a period of 30 days. After this period the survey was stopped, at which point 600 responses had been received. Although the questionnaire was sent out to practitioners working on South African projects, they could also report on projects on which they were working in other parts of Africa.

According to the respondents, the majority of projects were executed in South Africa (52% of all of the projects). Botswana had the second-highest number of projects (8% of all of the projects), with Mozambique and Namibia in third place (each 7% of all of the projects). It should be noted that not all of the responses were complete.

The majority of the respondents came from three industries: engineering, construction, and information and communications technology (see Figure 1).

In order to replicate the 2010 study [5], the authors used their description of the three categories of project outcome in their questionnaire:

- Failed: A project that is never finished or does not meet the needs of the client. It delivers little or no value.
- Challenged: A project that is finalised, but is late, over budget, or does not meet all the needs of the client. It delivers moderate value - less than was anticipated.
- Successful: A project that is delivered on time, within budget, within scope, and that meets all the needs of the client. It delivers the anticipated value.

A comparison between the successful, challenged, and failed projects as perceived by the respondents in 2010 and 2020 respectively is shown in Figure 2. In both studies the majority of projects were perceived as successful. However, in 2020, seven out of ten projects were perceived as successful, compared with only half of all the projects in 2010. In both studies the minority of projects were perceived as failures. In 2020 only 8% of projects failed, and in 2010 it was only 18%. It should be kept in mind that 'success' was self-defined by the respondents. Since 2010 South Africans have increasingly been made aware of a number of gross failures, such as at Eskom, a large South African public electricity utility and the largest producer of electricity in Africa. In comparison with such recently failed projects, even mediocre projects could now be perceived by respondents as successful, which could explain the increase in the number of projects between 2010 and 2020 that were perceived to be successful. Another possible explanation could be self-reporting bias. Project managers are more prone to answer in the affirmative if asked if their project is a success out of fear that it would be a bad reflection on their skills if they said otherwise.

Table 1: Cronbach's Alpha test for the knowledge areas

Knowledge area	No. of items		Cronbach's Alpha	
	2010	2020	2010	2020
1. Project integration management	7	7	0.931	0.939
2. Project scope management	8	7	0.947	0.930
3. Project time management	8	8	0.954	0.942
4. Project cost management	3	3	0.928	0.934
5. Project quality management	3	3	0.952	0.945
6. Project HR management	7	7	0.922	0.951
7. Project communications management	8	8	0.947	0.961
8. Project risk management	11	11	0.975	0.980
9. Project procurement management	7	7	0.948	0.951

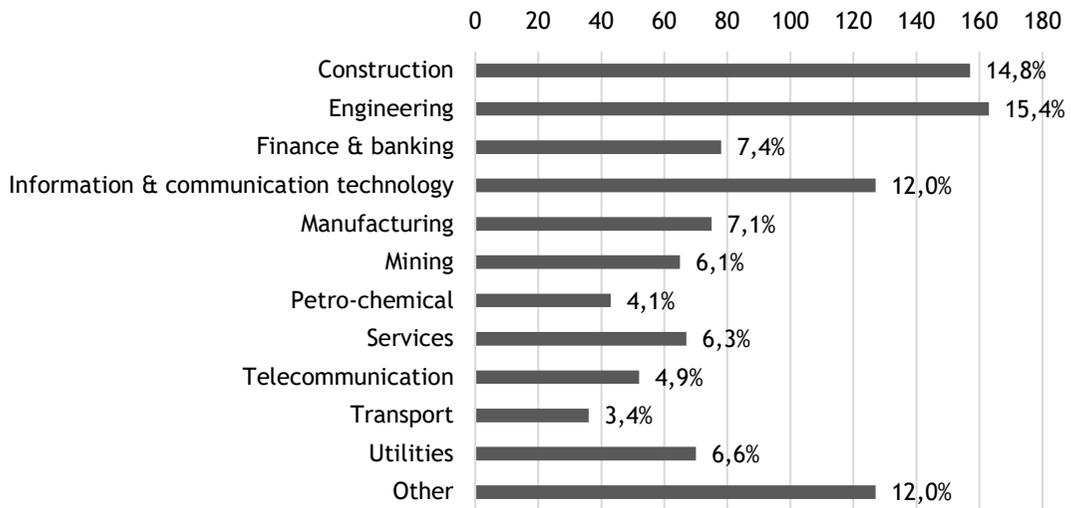


Figure 1: Industries in which respondents have been involved in projects (2020 study)

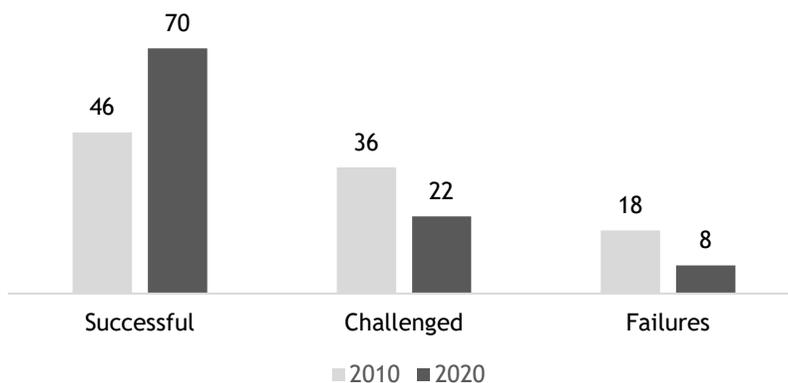


Figure 2: Percentage of projects perceived as successful, challenged, and failed

5.2 The impact of project management knowledge areas on project outcomes

Contrary to the 2010 study [5], we found that all nine PMBOK® knowledge areas [42] correlated positively with project outcomes (see Table 2). The four knowledge areas that Pretorius *et al.* [5] stated did not correlate with project management success were:

- Project quality management,
- Project communication management,
- Project risk management, and
- Project procurement management.

This study confirmed that all of the project management knowledge areas had a significant influence on project management success. Zwikael [69] states that, although the degree of influence may vary according to the type of industry and the stage of a project, the nine PMBOK® knowledge areas have an impact on the outcome of a project.

Table 2: Results of statistical hypothesis testing

Hypothesis	Results	
	2010	2020
H1 The higher an organisation’s level of maturity in project integration management practices, the higher its likelihood of executing more successful projects.	Supported	Supported
H2 The higher an organisation’s level of maturity in project scope management practices, the higher its likelihood of executing more successful projects.	Supported	Supported
H3 The higher an organisation’s level of maturity in project time management practices, the higher its likelihood of executing more successful projects.	Supported	Supported
H4 The higher an organisation’s level of maturity in project cost management practices, the higher its likelihood of executing more successful projects.	Supported	Supported
H5 The higher an organisation’s level of maturity in project quality management practices, the higher its likelihood of executing more successful projects.	Rejected	Supported
H6 The higher an organisation’s level of maturity in project human resource management practices, the higher its likelihood of executing more successful projects.	Supported	Supported
H7 The higher an organisation’s level of maturity in project communication management practices, the higher its likelihood of executing more successful projects.	Rejected	Supported
H8 The higher an organisation’s level of maturity in project risk management practices, the higher its likelihood of executing more successful projects.	Rejected	Supported
H9 The higher an organisation’s level of maturity in project procurement management practices, the higher its likelihood of executing more successful projects.	Rejected	Supported

6. CONCLUSIONS

The average perceived project management maturity level for all received responses was 2.64. This result matches the finding of a recent study conducted among 66 German project managers [2] in which, coincidentally, the project management maturity level was also 2.64. This could be an indication that the average project management maturity of certain developing countries might be comparable with those of developed countries. It should be noted, however, that the majority of respondents in this study worked on projects in South Africa. South Africa may well have more skilled professionals, more standardised systems, and a more stable economy than some other developing countries. This may limit the generalisation of the findings to such countries.

The results indicate a 2010 maturity level of 2.64 that differs from the 2.88 value of the 2010 study. Despite this, most of the surveyed projects were still perceived as successful. A correlation between mature quality, communication, risk, and procurement management practices and the perceived success of projects was found in this study. This finding differs from the 2010 study by Pretorius *et al.* [5]. The reason for this could be that, since 2010, organisations have managed to standardise some of the control processes for the four project management knowledge areas mentioned above. In parastatal organisations specifically, the enforcement of the Public Finance Management Act [70] might have played a role in improving the maturity of procurement processes in these organisations over the last 10 years. These possible reasons could be a theme for further investigation.

7. LIMITATIONS AND RECOMMENDATIONS

This study does not take into consideration the particular development approach of the projects surveyed (i.e., traditional, hybrid, or agile). This aspect of modern projects should be considered in future project management maturity studies.

Project management success was reported on from the respondents' point of view ('success' was self-defined). While stakeholder management was excluded from this study for reasons that were stated earlier, it could be argued that stakeholder management - and especially the client's perception of value and project deliverables that are fit-for-purpose - would be of particular importance in the Fourth Industrial Revolution. This should be addressed in future studies.

Further studies could compare the project management maturity of developing countries with that of developed countries much more comprehensively. Such studies could also study the effects of factors such as organisational culture, diversity, socio-economic status, and leadership on project management maturity; they were not studied in this project, and could be fruitful ground for future studies.

REFERENCES

- [1] Fausing, M.S., Jeppesen, H.J., Jønsson, T.S., Lewandowski, J. & Bligh, M. 2013. Moderators of shared leadership: Work function and team autonomy. *Team Performance Management*, 19(5-6), pp 244-262.
- [2] Busse, R., Zafer, H. & Warner, M. 2020. Rethinking the roles of project management maturity and organisational culture for perceived performance: An empirical study based on German evidence. *European Journal of International Management*, 14(4), pp 730-752.
- [3] Williams, T. 2005. Assessing and building on the underlying theory of project management in the light of badly over-run projects. *IEEE Transactions on Engineering Management*, 52(4), pp 497-2005.
- [4] Shenhar, A.J. 2011. Meeting time, cost, and moneymaking goals with Strategic Project Leadership®. In *PMI Global Congress Proceedings*, Dallas, Texas, pp 1-10.
- [5] Pretorius, S., Steyn, H. & Jordaan, J.C. 2012. Project management maturity and project management success in the engineering and construction industries in Southern Africa. *South African Journal of Industrial Engineering*, 23(3), pp 1-12.
- [6] Project Management Institute. 2008. *A guide to the project management body of knowledge (PMBOK guide)*. Newtown Square, Pennsylvania: Project Management Institute.
- [7] Cooke-Davies, T.J. & Arzymanow, A. 2002. The maturity of project management in different industries: An investigation into variations between project management models. *International Journal of Project Management*, 21, pp 471-478.
- [8] Anantamula, V. & Rad, P. 2018. Role of organizational project management maturity factors on project success. *Engineering Management Journal*, 30(3), pp 165-178.

- [9] Görög, M. 2016. A broader approach to organisational project management maturity assessment. *International Journal of Project Management*, 34(8), pp 1658-1669.
- [10] Yazici, H.J. 2009. The role of project management maturity and organizational culture in perceived performance. *Project Management Journal*, 40(3), pp 14-33.
- [11] Ibbs, C.W. & Kwak, Y.H. 2000. Assessing project management maturity. *Project Management Journal*, 31(1), pp 32-43.
- [12] Pennypacker, J.S. & Grant, K.P. 2003. Project management maturity: An industry benchmark. *Project Management Journal*, 34(1), pp 4-11.
- [13] 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), pp 59-68.
- [14] Mullaly, M. 2006. Longitudinal analysis of project management maturity. *Project Management Journal*, 36(3), pp 62-73.
- [15] Mullaly, M. 2014. If maturity is the answer, then exactly what was the question? *International Journal of Managing Projects in Business*, 7(2), pp 169-185.
- [16] 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), pp 231-246.
- [17] Albrecht, J.C. & Spang, K. 2014. Linking the benefits of project management maturity to project complexity: Insights from a multiple case study. *International Journal of Managing Projects in Business*, 7(2), pp 285-301.
- [18] Albrecht, J.C. & Spang, K. 2016. Disassembling and reassembling project management maturity. *Project Management Journal*, 47(5), pp 18-35.
- [19] Backlund, F., Chronéer, D. & 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.
- [20] Sonnekus, L. & Marnewick, C. 2009. *The Prosperus report 2009: ICT project management maturity versus project management success in South Africa*. Project Management South Africa (PMSA), South Africa.
- [21] Langston, C. & Ghanbaripour, A.N. 2016. A management maturity model (MMM) for project-based organisational performance assessment. *Construction Economics and Building*, 16(4), pp 68-85.
- [22] Bond-Barnard, T. & Steyn, H. 2015. Project management in developing countries: Implications for project trust, collaboration and success. In *3rd IPMA Research Conference*, Stellenbosch, South Africa.
- [23] Anantmula, V. & Rad, P. 2015. Linkages among project management maturity, PMO, and project success. In *2013 International Conference on Engineering, Technology and Innovation, ICE 2013 and IEEE International Technology Management Conference, ITMC 2013*. IEEE, pp 1-12.
- [24] Khoshgoftar, M. & Osman, O. 2009. Comparison of maturity models. In *Proceedings - 2009 2nd IEEE International Conference on Computer Science and Information Technology, ICCSIT 2009*. IEEE, pp 297-301.
- [25] Reis, T.L., Mathias, M.A.S. & De Oliveira, O.J. 2017. Maturity models: Identifying the state-of-the-art and the scientific gaps from a bibliometric study. *Scientometrics*, 110(2), pp 643-672.
- [26] Andersen, E.S. & Jessen, S.A. 2003. Project maturity in organisations. *International Journal of Project Management*, 21, pp 457-461.
- [27] Jerbrant, A. 2014. A maturation model for project-based organisations with uncertainty management as an ever-present multi-project management focus. *South African Journal of Economic and Management Sciences*, 17, pp 33-51.
- [28] Farrokh, J. & Mansur, A.K. 2013. Project management maturity models and organizational project management maturity model (OPM3): A critical morphological evaluation. *World Academy of Science, Engineering and Technology*, 77, pp 60-63.
- [29] Christoph, A.J. & Konrad, S. 2014. Project complexity as an influence factor on the balance of costs and benefits in project management maturity modelling. *Procedia - Social and Behavioral Sciences*, 119, pp 162-171.
- [30] Nesensohn, C., Bryde, D.J., Fearon, D.J. & Ochieng, E.G. 2014. Maturity and maturity models in lean construction. *Australasian Journal of Construction Economics and Building*, 1(14), pp 45-59.
- [31] Nicholas, J.M. & Steyn, H. 2021. *Project management for engineering, business and technology*, 6th ed. New York: Routledge.
- [32] Jugdev, K. & Thomas, J. 2002. 2002 student paper award winner: Project management maturity models: The silver bullets of competitive advantage? *Project Management Journal*, 33(4), pp 4-14.
- [33] Carnegie Mellon University. 2020. *Carnegie Mellon Software Engineering Institute: Capability maturity models*. Available at: <http://www.sei.cmu.edu/cmimi> (Accessed: 7 February 2020).

- [34] PMI. 2021. *A guide to the project management body of knowledge: PMBOK® guide*, 6th ed. Pennsylvania, USA: Project Management Institute.
- [35] Iqbal, S. 2013. Organizational maturity: Managing programs better, in Levin, G. (ed.) *Program management: A life cycle approach*. Boca Raton: CRC Press/Auerbach.
- [36] Kwak, Y.H. & Ibbs, C.W. 2002. Project management process maturity PM2 Model. *Journal of Management in Engineering*, 18(3), pp 1-6.
- [37] Office of Government Commerce. 2009. *Manage successful projects with PRINCE2®*. London: TSO.
- [38] Kerzner, H. 2019. *Using the project management maturity model: Strategic planning for project management*, 3rd ed. Hoboken, New Jersey: John Wiley & Sons.
- [39] PMI. 2008. *Organizational project management maturity model (OPM3)*, 2nd ed. Pennsylvania, USA: Project Management Institute.
- [40] Archibald, R.D. & Prado, D. 2014. Introduction to maturity in project management. *PM World Journal*, 11(1), pp 1-14.
- [41] Gareis, R. & Huemann, M. 2000. Project management competencies in the project-oriented organization, in Turner, J.R. and Simister, S.J. (eds), *The Gower handbook of project management*. Aldershot: Gower, pp 709-721.
- [42] PMI. 2009. *A guide to the project management body of knowledge: PMBOK® guide*, 5th Ed.
- [43] Besner, C. & Hobbs, B. 2008. Project portfolio control and portfolio. *Project Management Journal*, 39(1), pp 16-33.
- [44] Demirkesen, S. & Ozorhon, B. 2017. Measuring project management performance: Case of construction industry. *Engineering Management Journal*, 29(4), pp 258- 277.
- [45] Attakora-Amaniampong, E. 2016. Project management competencies of building construction firms: A structural equation model approach. *Architecture Research*, 6(3), pp 68-79.
- [46] Chou, J.-S., Irawan, N. & Pham, A.-D. 2013. Project management knowledge of construction professionals: Cross-country study of effects on project success. *Journal of Construction Engineering and Management*, 139(11), pp 47-67.
- [47] Baccarini, D. 1999. The logical framework method for defining project success. *Project Management Journal*, 30(4), pp 25-32.
- [48] Shenhar, A.J., Dvir, D., Levy, O. & Maltz, C. 2001. Project success: A multidimensional strategic concept. *Long Range Planning*, 34(6), pp 699-725.
- [49] Jugdev, K. & Müller, R. 2005. A retrospective look at our evolving understanding of project success. *Project Management Journal*, 36(4), pp 19-31.
- [50] Yu, A.G., Flett, P.D. & Bowers, J.A. 2005. Developing a value-centred proposal for assessing project success. *International Journal of Project Management*, 23(6), pp 428-436.
- [51] Todorović, M.L., Petrović, D.C., Mihić, M.M., Obradović, V.L. & Bushuyev, S.D. 2015. Project success analysis framework: A knowledge-based approach in project management. *International Journal of Project Management*, 33(4), pp 772-783.
- [52] Northouse, P.G. 2016. *Leadership*. Thousand Oaks, California: Sage Publications.
- [53] Ika, L.A. 2009. Project success as a topic in project management journals. *Project Management Journal*, 40(4), pp 6-19.
- [54] Müller, R. & Turner, R. 2007. The influence of project managers on project success criteria and project success by type of project. *European Management Journal*, 25(4), pp 298-309.
- [55] De Wit, A. 1988. Measurement of project success. *International Journal of Project Management*, 6(3), pp 164-170.
- [56] Shenhar, A.J., Dvir, D. & Levy, O. 1997. Mapping the dimensions of project success. *Project Management Journal*, 28(2), pp 5-13.
- [57] Atkinson, R. 1999. Project management: Cost, time and quality, two best guesses and a phenomenon, it's time to accept other success criteria. *International Journal of Project Management*, 17(6), pp 337-342.
- [58] Jha, K.N. & Iyer, K.C. 2007. Commitment, coordination, competence and the iron triangle. *International Journal of Project Management*, 25, pp 527-540.
- [59] Kendra, K. & Taplin, L.J. 2004. Project success: A cultural framework. *Project Management Journal*, 35(1), pp 30-45.
- [60] Pheng, L.S. 2018. Project integration management, in: *Project management for the built environment (Management in the built environment)*, pp. 47-61. Singapore: Springer.
- [61] Khan, H. 2010. Project scope management. *Organisational Project Management*, 45(6), pp 83-84.
- [62] Solís-Carcaño, R.G., Corona-Suárez, G.A. & Garzía-Ibarra, A.J. 2015. The use of project time management processes and the schedule performance of construction projects in Mexico. *Journal of Construction Engineering*, 2015, pp 1-9.
- [63] Smith, P. 2014. Project cost management – Global issues and challenges. *Procedia -Social and Behavioral Sciences*, 119(2014), pp 485-494.

- [64] Steyn, H., Carruthers, M., Dekker, A., Du Plessis, Y., Kruger, D., Kuschke, B., Sparrius, A., Van Eck, S. & Visser, K. 2016. *Project management: A multi-disciplinary approach*, 4th ed. Pretoria: Funda Project Management.
- [65] Samáková, J., Babčanová, D., Hrablíkchovanová, H., Mesárošová, J. & Šujanová, J. 2017. Using the communication methods, tools and support during management of project communication in industrial manufacturing enterprises. *Research Papers Faculty of Materials, Science and Technology Slovak University of Technology*, 25(41), pp 51-62.
- [66] Cooper, D., Bosnich, P., Grey, S., Purdy, G., Raymond, G., Walker, P. & Wood, M. 2014. *Project risk management guidelines: Managing risk with ISO 31000 and IEC 62198*. Chichester: John Wiley & Sons.
- [67] Berger, V.W. & Zhou, Y.Y. 2014. Kolmogorov test: Overview. In *Wiley StatsRef: Statistics Reference Online*. New York: John Wiley & Sons.
- [68] Villasenor, J.A. & Estrada, E.G. 2009. A generalization of Shapiro-Wilk's test for multivariate normality. *Communications in Statistics - Theory and Methods*, 38(11), pp 1870- 1883.
- [69] Zwikael, O. 2009. The relative importance of the PMBOK® Guide's nine knowledge areas during project planning. *Project Management Journal*, 40(4), pp 94-103.
- [70] South African Government. 1999. *Public Finance Management Act Number 1 of 1999*. Pretoria: Government Printing Works.