

PROJECT MANAGEMENT MATURITY MODELS

LITERATURE REVIEW AND NEW DEVELOPMENTS

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Capability; Project Portfolio

Abstract: The purpose of this paper is to analyze the different Project Management Maturity Models (PMMM) and give suggestions on how to select or develop a model to assess the Project Management Maturity of an organization. While it seems consolidated to classify PMMM into 5 levels, it would be useful to evaluate separately as “determinants of maturity”: a. the individuals (project managers and team members), b. the projects and how they are managed (with extension to portfolio and programs too), and c. the organization as a whole and its capacity to deploy and apply Project Management. This paper is the most recent, complete review on PMMM.

1. Introduction

The success of any kind of association, whether it is a small private company or public management company, depends on how successful their projects are.

Regrettably, the data of a new questionnaire 2019 Pulse of the Profession® show that enterprises have wasted 12% of the money invested in last's year projects caused by an unprofessional service. These data have been almost steady in the last 5 years. Even though many efforts have been made, implementation of work has not been improved (Project Management Institute, 2019).

Managing the projects competently is not an instinctive talent or a skill that a company can acquire by just carrying out a few projects with whatever results. It is based on the level of its organizational maturity (Tonchia, 2018).

Over this century, we have been well aware that the competence of handling projects is a concrete clue of organizational project management maturity (Andersen and Jessen, 2003).

Being aware of a company's proficiency in organizational project management and their individual strengths and weaknesses from different points of view allows the company to create needed processes for heightened project management efficiency. (Spalek, 2015).

The essential strategy to develop a management project competency is to understand and determine company's level of organizational maturity (Project Management Institute, 2013).

A lot has been studied on this subject to improve systems and techniques to boost the effectiveness of organizational projects (Nenni et al., 2014).

The Project Management Maturity Model (PMMM) is defined as “a formal tool used to assess, measure and compare an organization's own practices against best practices or those employed by competitors, with the intention to map out a structured path to improvement” (Grant and Pennypacker, 2006).

The PMMM defines a collection of project manager' best practices and the best ways to improve this field. (Pasian, 2011).

Nowadays, it is quite an interesting and often common subject to discuss with very positive reactions of experts' because the awareness of maturity can provide lots of advantages too (Görög, 2016).

On the one hand, understanding the level of maturity helps to come up with methods and right way to develop maturity expertise. On the other, it helps to measure betterment internally as well as in compared to other enterprises. (Pennypacker and Grant, 2003). Besides, the recognized worldwide and verifiable maturity model helps to have better business. The last but not least, it helps secure better partnerships and contracts.

However, the PMMM has had also some provocative objections in literature, many have shown disbelief at the narrow view towards the procedures and mechanistic way of the model, missing a wider perspective on the

organizational model determinants and their contextual factors which also form management maturity. Besides, models are excessively elaborate, need a lot of additional information without rigorous protocols to conclude the evaluation of maturity (Brookes and Clark, 2009). Since the 1990s the world has seen a broad range of maturity models architected with a concrete area of organizational tasks ranging from operational and strategic procedure to staff's involvement and management operations.

Even though varieties of the models are numerous, what maturity models have in common are the following three points:

- 1.Appraisal: the results of this procedure are an assessment of the organizational project management capabilities and of the advantages and disadvantages of the project management model (Backlund et al., 2014).
- 2.Body of knowledge and evolution: capabilities and competencies related to various stages of maturity levels, as well as performance-based indicators.
- 3.Improvement: related to the appraisal results and the capabilities list. The improvement function of the model provides the most important actions and shows the way to betterment.

So that maturity models find the way to establish long-lasting organizational plans.

The body of the knowledge of the models is very alike. Every maturity stage has a list of the best practices adopted for which prerequisite capabilities are also required. By achieving these capabilities leads to betterment which can be proven through the results expressed in terms of key performance indicators (KPI). (Kwak et al., 2015).

The aim of this paper is to analyze the different existing PMMM derived from an extensive literature review, to compare them, to give some indications and suggestions in order to select and/or construct a model to assess the project management maturity of an organization, and to discuss future directions and developments of this kind of assessment.

2. Literature Review: Method and Data

Collection

To answer the research questions, we firstly conducted a systematic literature review of the academic research on PMMM.

In order to progress with the literature review, a keyword search was done on the two largest electronic databases of peer-reviewed literature: Scopus and Web of Science. We decided to include in the research: Articles, Reviews and Book Chapters (excluding Conference Proceedings, believing that the best articles would have become journal papers). The keyword searched on the database includes the following terms:

- “Capability Maturity Model Integration”.
- “Project Management Maturity Model”.
- “PM Maturity Models”.
- “PM and Maturity Models”.
- “Organizational Project Management Maturity Model”.
- “Portfolio, Programme and Project Management Maturity Model”.

Overall, the search was restricted to the last 11 years (2009 to 2019) and selected, at May 29 2019, a total of 199 Academic Articles, Reviews and Book Chapters on Scopus, and a total of 97 Academic Articles, Reviews and Book Chapters on Web of Science, as reported in detail on **Table 1**

Keywords	Scopus N°	Web of Science N°
1 “Capability Maturity Model Integration”	129	80
2 “Project Management Maturity Model”	45	13
3 “PM Maturity Models”	13	1
4 “PM and Maturity Models”	0	0
5 “Organizational Project Management Maturity Model”	11	3
6 “Portfolio, Programme and Project Management Maturity Model”	1	0
<i>Total of Academic Articles, Reviews and Book Chapter</i>	199	97

Table 1. Selected Academic Articles, Reviews and Book Chapter and Proceeding papers on Web of Science and Scopus divided by keywords.

We then decided to choose articles with significant and relevant contributions, based on the journal's ranking, article's citation index and range of its application. **Table 2** provides a summary of the selected publications.

Keywords	Scopus N°	Web of Science N°
1 “Capability Maturity Model Integration”	129	80
2 “Project Management Maturity Model”	45	13
3 “PM Maturity Models”	13	1
4 “PM and Maturity Models”	0	0
5 “Organizational Project Management Maturity Model”	11	3
6 “Portfolio, Programme and Project Management Maturity Model”	1	0
<i>Total of Academic Articles, Reviews and Book Chapter</i>	199	97

Table 2. Selected publications on Scopus and Web of Science. (continue...)

Scopus				
Keyword: “Capability Maturity Model Integration”: 16 documents selected				
Title	Author/s	Journal	Year	Document Type
A Delphi-based expert judgment method applied to the validation of a mature Agile framework for Web development projects	Torreçilla-Salinas, C.J., De Troyer, O., Escalona, M.J. and Mejias, M.	Information Technology and Management	2019	Article
CMMI-DEV implementation simplified: A spiral software model	Ayyagari, R. M. and Atoum, I.	International Journal of Advanced Computer Science and Applications	2019	Article
Exploring the determinants of software process improvement success: A dynamic capability view	Lee, J.-C. and Chen, C.-Y.	Information Development	2019	Article
Exploring capability maturity models and relevant practices as solutions addressing information technology service offshoring project issues	Salman, R., Daim, T., Raffo, D. and Dabic, M.	International Journal of Management Science and Engineering Management,	2018	Article
Analysing software quality using CMMI-2 with agile-scrum framework	Krishna, B., Srinath, A., Bhavani, N. and Sai, G.	International Journal of Engineering and Technology	2018	Article
Predictability with agility: Achieving excellence in software delivery through SPEED	Sreenivasan, S. and Kothandaraman, K.	Global Business and Organizational Excellence	2017	Article
A new maturity model for the implementation of software process improvement in web-based projects	Al-Rousan, T. and Al-Shargabi, B.	Journal of Digital Information Management	2017	Article
Capability maturity model integration with approach of agile Six Sigma	Safaie, M.	International Journal of Agile Systems and Management	2017	Article
Agile, Web Engineering and Capability Maturity Model Integration: A systematic literature review	Torreçilla-Salinas, C.J., Sedeño, J., Escalona, M.J. and Mejias, M.	Information and Software Technology	2016	Article
Risk, process maturity, and project performance: An empirical analysis of US federal government technology projects	Mishra, A., Das, S.R. and Murray, J.J.	Production and Operations Management	2016	Article
Understanding the conceptual value in adopting CMMI process maturity framework	Vince R.S., Srinath, M.V. and Shareef, P.M.	International Journal of Applied Engineering Research	2015	Article
Using CMMI together with agile software development: A systematic review	Selleri S. F., Soares, F.S.F., Peres, A.L., Azevedo, L.M.D., Vasconcelos, A.P.L.F., Kamei, F.K. and Meira, S.R.D.L.	Information and Software Technology	2015	Review
Achieving and maintaining CMMI maturity level 5 in a small organization	Falesi, D., Shaw, M. and Mullen, K.	IEEE Software	2014	Article
A systematic review of software process improvement by CMM	Dhankhar, P. and Mishra, A.K.	International Journal of Software Engineering and its Applications	2014	Article
A CMMI-based approach for medical software project life cycle study	Chen, J. J., Su, W.C., Wang, P.-W. and Yen, H.C.	SpringerPlus	2013	Article
A systematic study of change management during CMMI implementation: A modified activity theory perspective	Shih, SP., Shaw, R.S., Fu, T.Y. and Cheng, C.P.	Project Management Journal	2013	Article
Keyword: “Project Management Maturity Model”: 16 documents selected				
Exploring the impact of knowledge management (KM) best practices for project management maturity models on the project management capability of organizations	Jaleel, F., Daim, T. and Giadedi, A.	International Journal of Management Science and Engineering Management	2019	Article
National project management maturity: A conceptual framework	Seelhofer, D. and Graf, C.O.	Central European Business Review	2018	Article
An assessment for IT project maturity level	Bolat, B., Kuşdemir, A., Uslu, İ.C. and Temur, G.T.	International Journal of Information Technology Project Management	2017	Article

Why it is important to build an innovation strategy through the project management maturity model	De Fazio, E.	IEEE Aerospace and Electronic Systems Magazine	2017	Article
Strengthening the connections between strategy and organizational project management	Jugdev, K.	Cambridge Handbook of Organizational Project Management	2017	Book Chapter
A broader approach to organisational project management maturity assessment	Görög, M.	International Journal of Project Management	2006	Article
Disassembling and Reassembling Project Management Maturity	Albrecht, J.C. and Spang, K.	Project Management Journal	2016	Article
Evolution of project-based organization: A case study	Kwak, Y.H., Sadatsafavi, H., Walewski, J., and Williams, N.L.	International Journal of Project Management	2015	Article
Developing a maturity model for assessing sustainable project management	Silvius, A.J.G. and Schipper, R.	Journal of Modern Project Management	2015	Article
If maturity is the answer, then exactly what was the question?	Mullaly, M.	International Journal of Managing Projects in Business	2014	Article
Linking the benefits of project management maturity to project complexity: Insights from a multiple case study	Albrecht, J. C. and Spang, K.	International Journal of Managing Projects in Business	2014	Article
The use of maturity models in improving project management performance: An empirical investigation	Brookes, N., Butler, M., Dey, P. and Clark, R.	International Journal of Managing Projects in Business	2014	Article
Extending the concept and modularization of project management maturity with adaptable, human and customer factors	Pasian, B.	International Journal of Managing Projects in Business	2014	Article
Project, programme and portfolio maturity: a case study of Australian Federal Government	Young, M., Young, R. and Romero Zapata, J.	International Journal of Managing Projects in Business	2014	Article
How to increase the value of the project management maturity model as a business-oriented framework	Nenni, M.E., Arnone, V., Boccardelli, P. and Napolitano, I.	International Journal of Engineering Business Management	2014	Article
Project management maturity: a critical analysis of existing and emergent factors	Pasian, B., Sankaran, S. and Boydell, S.	International Journal of Managing Projects in Business	2012	Article
4. Keyword “PM Maturity Models”: 11 documents selected				
Project-based organizational maturity in architecture, engineering, and construction: A theoretical premise for practical purposes	Johnson, R.D., Adkins, J. and Pepper, D.	Developing Organizational Maturity for Effective Project Management	2018	Book Chapter
National project management maturity: A conceptual framework	Seelhofer, D. and Graf, C.O.	Central European Business Review	2018	Article
An assessment for IT project maturity level	Bolat, B., Kuşdemir, A., Uslu, İ.C. and Temur, G.T.	International Journal of Information Technology Project Management	2017	Article
A broader approach to organisational project management maturity assessment	Görög, M.	International Journal of Project Management	2016	Article
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Evolution of project-based organization: A case study	Kwak, Y.H., Sadatsafavi, H., Walewski, J. and Williams, N.L.	International Journal of Project Management,	2015	Article
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The use of maturity models in improving project management performance: An empirical investigation	Brookes, N., Butler, M., Dey, P. and Clark, R.	International Journal of Managing Projects in Business	2014	Article
Project, programme and portfolio maturity: a case study of Australian Federal Government	Young, M., Young, R. and Romero Zapata, J.	International Journal of Managing Projects in Business	2014	Article
Extending the concept and modularization of project management maturity with adaptable, human and	Pasian, B.	International Journal of Managing Projects in Business	2014	Article

customer factors					
<i>Keyword "Organizational Project Management Maturity Model": 1 document selected</i>					
Strengthening the connections between strategy and organizational project management	Jugdev, K.	Cambridge Handbook of Organizational Project Management	2017	Book Chapter	
<i>Keyword "Portfolio, Programme and Project Management Maturity Model": 1 document selected</i>					
Project, programme and portfolio maturity: a case study of Australian Federal Government	Young, M., Young, R. and Romero Zapata, J.	International Journal of Managing Projects in Business	2014	Article	
<i>Web of Science</i>					
<i>Keyword "Capability Maturity Model Integration": 4 documents selected</i>					
Agile, Web Engineering and Capability Maturity Model Integration: systematic literature review	Torrecilla-Salinas, C.J., Sedeno, J., Escalona, M.J. and Mejias, M.	Information and software technology	2016	Systematic literature review	
Implementing Project Management Category Process Areas of CMMI Version 1.3 Using Scrum Practices, and Assets	Farid, A., Abdelghany A., and Helmy, Y.		2016	Article	
Risk, Process Maturity, and Project Performance: An Empirical Analysis of US Federal Government Technology Projects	Mishra, A. Das, S.R. and Murray, J.J.	Production and operations management	2016	Article	
Using CMMI together with agile software development: A systematic review	Selleri, S. F., Soares, F.S.F., Peres, A.L., Monteiro de Azevedo, I., Vasconcelos, A.P.L.F., Kamei, F. K., and Meira, S.R.D.	Information and Software Technology	2015	Systematic Review	
<i>Keyword "Project Management Maturity Model": 3 documents selected</i>					
Project Management in Public Administration. TPM – Total Project Management Maturity Model. The Case of Slovenian Public Administration	Zurga G.	Transylvanian Review of Administrative Sciences	2018	Article	
Organizational project management maturity	Derenskaya Y.	Baltic Journal of Economic Studies	2017	Article	
OPM3-based internal control of an accounting information system in cloud computing	Liu, X., Xia, X. and Zhou, L.	Agro food industry hi-tech	2017	Article	
<i>Keyword "Organizational Project Management Maturity Model": 1 document selected</i>					
Organizational project management maturity	Derenskaya, Y.	Baltic Journal of Economic Studies	2017	Article	
<i>Keyword "Portfolio, Programme and Project Management Maturity Model": 1 article selected</i>					
OPM3-based internal control of an accounting information system in cloud computing	Liu, X., Xia, X. and Zhou, L.	Agro food industry hi-tech	2017	Article	

Table 2. Selected publications on Scopus and Web of Science.

3. Focus on the main Project Management Maturity Models (PMMM)

Following the extensive literature review we realized that many models are different from each other in terms of structure, types, characteristics, features, applicability and usage (Table 3). Some of them are named with identical or similar acronyms (e.g. P2MM and PM2; KPMMM, PMMM, P2M3 and MMM).

After analyzing in-depth, the relative publications, we ranked them into three groups:

- Maturity Models of the leading PM Organizations – these models are: OPM3 (from the PMI), IPMA Delta (from IPMA), P3M3 - P2MM (from Axelos/PRINCE2).
- Most cited and validated historical Maturity Models – these models are: CMMI, Berkley/PM2, Kerzner's KPMMM, PMMM (from Project Management Solution), Prado's P2M3.
- Most recent Maturity Models – such as NPM3, MMM, SPM3.

3.1. Maturity Models of the leading PM Organizations

3.1.1. Organizational Project Management Maturity Model (OPM3)

The Organizational Project Management Maturity Model (OPM3) is a model developed by the Project Management Institute (PMI) from 1998 to 2013; now this is its 3rd printing. (PMI, 2013). The main goal of OPM3 is to give an approach to any kind of organization to assess their maturity against a global organizational project management best practice. The OPM3 supports organizations to accomplish successful achievement by supporting them to achieve successful projects, programs, and portfolios. (Silva et al., 2014).

The most important advantages of this model are:

- Reducing the differences between strategies adopted and individual projects by implementing the project management principles and practices of the strategic organization.
- In-depth understanding regarding the organizational project management proven methods and best practices.
- Assessing precisely which organizational project management's best practices and capabilities to adopt and which to avoid.
- Assisting organizations to understand exactly which organizational project management best practice and capabilities to embrace or leave out.
- Helping organizations to seek improvements for some critical areas of the portfolio, program, or project management by prioritizing and planning (PMI, 2013).

Table 3. Comparison of Project Manager Maturity Models.

1. Maturity Models of the leading PM Organizations	Organisation (Year)	Core Elements	Maturity Levels	Program Mgt Process	Portfolio Mgt Process	Complexity
1.1 OPM3	PMI (1998)	1. Knowledge 2. Assessment 3. Improvement	1. Initial 2. Structured 3. Institutionalized 4. Managed 5. Optimized	Yes	Yes	High
1.2 IPMA Delta	IPMA (2016)	1. Individuals 2. Projects 3. Organizational	1. Initial 2. Defined 3. Standardized 4. Managed 5. Optimized	Yes	Yes	Medium
1.3 P3M3 / P2MM	OCG (2006)	1. Org. Governance 2. Mngt Control 3. Benefits Mngt 4. Risk Mngt 5. Stakeholder Mngt 6. Finance Mngt 7. Resource Mngt	1. Awareness 2. Repeatable 3. Defined 4. Managed 5. Optimized	Yes	Yes	Medium
2. Historical, most cited, PM Maturity Models	Author (Year)	Core Elements	Maturity Levels	Program Mgt Process	Portfolio Mgt Process	Complexity
2.1 CMMI	Humphrey (1998)	1. Causal Analysis 2. Configuration Mngt 3. Decision Analysis 4. Integrated PM 5. Meas.ment & Anal. 6. Org. Process Def. 7. Org. Process Focus 8. Org. Perf. Mngt 9. Org. Process Perf. 10. Org. Training 11. Project Monit. Ctrl 12. Project Planning 13. Quality Assurance 14. Quantitative PM 15. Requirem. Mngt 16. Risk Management	1. Initial 2. Managed 3. Defined 4. Quantitatively managed 5. Optimized	Yes	No	High

3. Recent PM Maturity Models	Author (Year)	Core Elements	Maturity Levels	Program Mngt Process	Portfolio Mngt Process	Complexity
2.2 Berkeley/PM2	Ibbs and Kwak (2000)	PMBOK's 10 Knowledge Areas and 5 Process Groups	1. Basic 2. Planned 3. Managed at project level 4. Managed at corporate level 5. Continuous learning	No	No	Medium
2.3 Kerzner/KPMMM/KPM ³	Kerzner (2002)	PMBOK's 10 Knowledge Areas and 5 Process Groups	1. Common language 2. Common processes 3. Singular methodology 4. Benchmarking 5. Continuous improvement	No	No	High
2.4 PMMM	PM Solutions (2002)	PMBOK's 10 Knowledge Areas and 5 Process Groups	1. Initial 2. Structured 3. Institutionalized 4. Managed 5. Optimized	Yes	No	Medium
2.5 PMMM/P2M3/MMGP	Prado (2010)	1. PM knowledge 2. Tech aspects 3. Behaviour 4. Methodol. usage 5. Computerization 6. Convenient organ. 7. Strategic alignment	1. Initial 2. Known 3. Standardized 4. Managed 5. Optimized	No	No	Medium
3.1 NPM3	Seethofer and Graf (2018)	1. Project governance & controlling 2. Project planning & organization 3. Project execution 4. Project communication management 5. Project resource management 6. Project quality management	1. Nascent 2. Developing 3. Adolescent 4. Maturity	No	No	Low
3.2 MMM	Langston and Ghanbaripour (2016)	1. Stakeholder management 2. Human resource management 3. Procurement management 4. Communication management 5. Quality management 6. Environmental management 7. Integration management	1. Initial 2. Managed 3. Defined 4. Quantitatively managed 5. Optimized	Yes	Yes	Low
3.3 SPM3	Silvius and Schipper (2015)	1. Project process 2. Project product	1. Compliant 2. Reactive 3. Proactive 4. Purpose	No	No	Low

OPM3 takes into account five levels of Maturity:

- Level 1: an Initial Process.
- Level 2: a Structured Process with Standards.
- Level 3: an Organizational Standard and an Institutionalized Process.
- Level 4: a Fully-Managed Process.
- Level 5: an Optimized Process.

The growth of organizational maturity is achieved throughout:

- Knowledge on best practice, capabilities, and approach of putting the model into practice.
- Assessment of the best practice.
- Development of best practices thought capabilities aggregation.

The model determines planned outcomes, gives recommendations and suggests KPI to the organizations in order to improve the project management efficiency and for reduce the resources (Yerenskaya, 2017).

Nenni et al. (2014) in their research stated, in agreement with the theory of Khoshgoftar and Osman (2009), that OPM3 is the better maturity model to improve the organizational work, as their approach is steady which is an advantageous aspect.

3.1.2. IPMA Delta Model

The International Project Management Association (IPMA) developed in 2016 a methodology called "IPMA Delta" (Version 1.1) in order to certify the ability of an organization to use project management techniques.

The IPMA Delta Model comprises three "Modules":

- Module I (Individuals): evaluating individual competences: project, program and portfolio managers, project staff, senior executives, administration, and support functions. The assessment focuses on both individuals' experience and knowledge in their respective domains.
- Module P (Projects): evaluation of selected projects. The evaluation aims at the results and achievement of completed projects and the adoption of the agreed methods and tools of project management in the evaluated projects.
- Module O (Organisation): evaluation of the organizational competence in managing projects, primarily seen from the organization's top management's point of view, giving assistance to the management as well as appointing the administration members to approve smooth and successful projects. This testing is done chiefly through interviews with the organization's top management and the coordinators responsible for the project management system.

IPMA Delta presents 5 competence called "Classes" that are:

- Initial: there are no existing formal Project Management (PM) standards structures and processes in the organization.

• Defined: there are partially adopted PM standards, structures and processes in the organization.

- Standardized: there are well-defined PM standards, structures and processes endorsed in the organization.
- Managed: there are fully achieved PM standards, structures and processes which are fully implemented and constantly checked in an enterprise.
- Optimized: there are completely developed PM standards, structures and processes which are wholly embraced by in the organization, which are regularly checked, improved and optimized by the managers of the organization.

This assessment identifies which class is part of the organization as a whole and what kind of modules are (I, P, O).

The results of the assessment show in detail the room for improvement, giving also recommendations for the future areas that need to be refined.

- The principle advantages of the assessment are: comprehensive and honest determination of the actual maturity in the project and program management; basis for the strategic orientation of the organization in project and program management under the guidance of top management; starting point for planning and developing the organization; better understanding and communication among the stakeholders - including top management - regarding the role of project management in improving performances.

3.1.3. Portfolio, Program & Project Management Maturity Model (P3M3) and PRINCE2 Maturity Model (P2MM)

The Portfolio, Program and Project Management Maturity Model (P3M3) was developed in 2006 by the UK's Office of Government Commerce (OCG), that created and promoted also the advancement of the PRINCE2 methodology ("Projects IN Controlled Environments" – 1989).

The P3M3 is organized with five levels of maturity:

- Level 1: Awareness of process.
- Level 2: Repeatable process.
- Level 3: Defined process.
- Level 4: Managed process.
- Level 5: Optimised process.

P3M3 comprises also three maturity sub-models also independently used:

- Portfolio Management (PfM3).
- Program Management (PgM3).
- Project Management (PjM3).

Each sub-model comprises seven PM process perspectives: organizational governance, management control, benefits management, risk management, stakeholder management, finance management, resource management.

P3M3 evaluates the process of PM, the competencies of the professions, the tools used, and the management information provided to deliver improvements.

According to Axelos, a joint venture company born in UK to manage the global best practice portfolio, the main advantages from adopting P3M3 model are: "cost savings, improved benefits delivery, increase return on investment, providing plans for continuous improvement".

The PRINCE2 Maturity Model (P2MM) is a standard originated from P3M3 that can be adopted by the organizations that had previously select PRINCE2, instead of using Project Management Maturity Model (PjMM) which is one of the sub-models of P3M3.

The PRINCE2 Maturity Model is quite close for structure to P3M3 and it has the same seven perspectives of the process, covering key characteristics of project management and specific features for each stage of maturity within each perspectives of the process (OCG, 2019).

Lianying et al. presented in 2012 a new project management maturity model named P2CMM, derived from P2MM, where the "c" meaning "Capability"; it's based on a quantitative evaluation index system, a web-survey tool, and a cobweb graph as a tool to share the final improvements.

3.2. Historical, most cited, PM Maturity Models

3.2.1. Capability Maturity Model Integration (CMMI)

The Capability Maturity Model Integration (CMMI), was developed in 1991 by the CMMI, which represents a group from industries, government (i.e. US Department of Defence) and the Software Engineering Institute (SEI). As defined, it is "a capability improvement model that can be adapted to solve any performance issue at any level of the organization in any industry". The current version of CMMI, the 2.0, is introduced in March 2018 and it is user-friendly and well connected to Agile with SCRUM safety and security.

It aims at supporting the engineering companies to identify and to achieve specific and measurable objectives, improving their performance for new specialized processes and decreasing at the same time the costs for the organization (Pane and Sarno, 2015).

CMMI model proposed five maturity levels:

- Level 1: initial.
- Level 2: managed.
- Level 3: defined.
- Level 4: quantitatively managed.
- Level 5: optimizing (CMMI Institute, 2019).

In 2019, Ayyagari and Atoum proposed a new software process improvement model which is a simplification of the CMMI model; it can be used by small organizations with low budgets and resources (Ayyagari and Atoum, 2019).

3.2.2. Berkeley PM Maturity Model (PM2)

The model, created by Kwak and Ibbs in 2000, helps the enterprises to reach an high level of performance. This concept proposes practical tools and guidelines for measuring different PM processes by assessing PM knowledge areas and PM processes.

The Berkeley PM2 is based on five steps:

- Level 1: basic PM.
- Level 2: planned.
- Level 3: managed at project level
- Level 4: managed at corporate level.
- Level 5: continuous learning.

The model has been continuously polished up to set and evaluate a more efficient PM maturity level, to observe progress in the PM knowledge (Derenskaya, 2017). The primary benefit of the Berkeley PM2 Model is that it can be commonly used over the organizations, while other models are more focused on specific targets like software or new product development (Kwak and Ibbs, 2000).

3.2.3 Kerzner's Project Management Maturity Model (KPMMM)

The model was conceived by Kerzner in 2002 to advance organizational skills and culture in order to embrace PM practices in the organizational processes and procedures (Kerzner, 2005). KPMMM analyses the efficiency of project management organization, drawing attention to the importance of strategic project management to improve know-how in the marketplace.

The model provides five levels of maturity:

- Level 1: common language.
- Level 2: common processes.
- Level 3: singular methodology.
- Level 4: benchmarking.
- Level 5: continuous improvement.

KPMMM presents a list of specific criteria to evaluate the quality of PM and a guide to discuss practices, based upon the status of PM functionality, to improve organizational skills from project management's point of view (Sokhanvar, 2014).

3.2.4. PM Solutions Project Management Maturity Model (PMMM)

The Project Management Maturity Model (PMMM) is developed in 2002 by PM Solutions to:

- assist organizations in developing and measuring their project management skills systematically and efficiently based on five levels of maturity (those of PMI's OPM3);
- help organizations to develop maturity throughout the ten knowledge areas framed in the PMI's "Guide to the Project Management Body of Knowledge" (Crawford, 2015).

Once the initial level of maturity and the areas for betterment have been identified, PMMM supplies a guide designating necessary measures to reach maturity in PM (PM Solution, 2019).

The goal of the PMMM methodology is to allow any enterprise to develop their PM capabilities following a systematic approach (Souza and Gomes, 2015).

It offers a methodological approach to reach high standards and gives an assessment framework which enables enterprises to improve the PM maturity, resulting in better investments.

3.2.5. Prado's Project Management Maturity Model (PMM)

The PMM model (PMMM or sometimes P2M3 or MMGP) was created by Darci Prado in 2008 to perform the benchmarking of the maturity level of any kind of organization's department or sector that adopts it.

The model has five different levels:

- Level 1: initial.
- Level 2: known.
- Level 3: standardized.
- Level 4: managed.
- Level 5: optimized.

It also adopts a questionnaire survey composed of fifty-five questions: fifteen of which, focused on the general characterization of the organization, and forty, targeted on seven specific areas:

1. Competence in Project and Program Management.
2. Competence in Technical and Contextual Aspects.
3. Behavioral Competence.
4. Methodology Usage.
5. Computerization.
6. Usage of the Convenient Organizational Structure.
7. Strategic Alignment (Prado, 2010).

3.3. Most recent Maturity Models

3.3.1 National Project Management Maturity Model (NPM3)

The NPM3 was developed by Seelhofer and Graf in 2018 with the purpose of widening the field of organizational project management maturity to the national contexts. It includes four levels:

- Level 1: nascent – PM best practices are not adopted by many organizations, so the initial level is disorganized and unsystematic, with little support given by the government and project management associations.
- Level 2: developing – A small number of organizations use PM best practices with irregular support from the government or professional associations.
- Level 3: adolescent – A great number of organizations use PM best practices routinely but unsystematically; professional associations assist systematically and the government only sporadically.
- Level 4: mature – A large majority of organizations use PM routinely and consistently with systematic support by the government and professional associations.

Additionally, Seelhofer and Graf proposed four key maturity drivers: National PM culture, National PM process saturation, National PM experience sharing, and national PM application support that should be fostered by governments and project management associations.

The NPM3 model involves also many different professionals (i.e. government entities, professional associations, universities) who can work together to foster, support and implement the Countries' PM best practices, improving also the project's sustainability.

3.3.2. Management Maturity Model (MMM)

MMM was developed by Langston and Ghanbaripour (2016) with the aim to assess the PM organizations, using tailored, systematic, strategic and practical methodology, without following the rigid increments of maturity.

It takes six KPI for a project to achieve success (value, efficiency, speed, innovation, complication and impact) plus an overall KPI which takes into consideration the combined effect of the four success factors (scope, cost, time and risk).

The model is focused on a strategy of continuous improvement and it follows the four steps of the PDCA cycle to put into practice this approach:

- Plan: establish targets.
- Do: measure outcomes.
- Check: assess performance.
- Act: enhance protocols.

It aims to reach specific goals and capabilities for project, program and portfolio domains. Moreover, it offers a revolutionary improvement on how a project is applied, based on organizational performance assessment compared to existing overcomplicated strategies on the market.

3.3.3. Sustainable Project Management Maturity Model (SPM3)

SPM3 was developed by Silvius and Schipper (2015). It is a practical tool used for evaluating and developing organizational skills and integrating them into projects and project management.

The model identifies the project as a single unit for the analysis and subdivides it into two subdomains:

- Project process: It comprises the resources used in relation to the process and how the process is carried out and managed.
- Project product: It considers the deliverables of the project and their impact on all the stakeholders.

SPM3 is based on a scale of four maturity levels:

- Level 1: compliant.
- Level 2: reactive.
- Level 3: proactive.
- Level 4: purpose.

For each level, it adopts specific indicators of economic, environmental, and social sustainability.

By incrementing the level of maturity of the SPM3's model, the vision of the organization, as a whole, goes from reactive to proactive influencing positively the sustainability of its environment.

4. Comparison of Project Management

Maturity Models

The Project Management Maturity Models (PMMM) found in the literature are very different in terms of complexity, scope of analysis, characteristics and factors considered.

Table 3 shows the main PMMMs, classified according to Par. 3 (PMMM of the leading PM Organizations, Historical and most cited PMMM, and Most recent PMMM), with key variables in order to compare them from a synthetic point of view:

- Name/acronym of the model.
- Organization or Author who proposed the model (and the year).
- Core Elements (in Table 3 we have considered the main elements characterizing the model – some models report various types of “elements”, also called areas, perspectives, principles, components, factors, etc.).
- Maturity levels.
- Consideration also of Program Management.
- Consideration also of Portfolio Management.
- Complexity (high number of parts, interacting with each other and with the external environment in multiple ways, both in breadth and in-depth).

The only feature on which almost all the models seem to converge is the determination of 5 levels or stages of maturity, even if they are not perfectly equal neither in the contents nor in the denominations; we can try to summarize these levels or stages as follows:

- Level 1: initial or basic (awareness).
- Level 2: defined or structured (managed, repeatable).
- Level 3: standardized or institutionalized (use of the methodology).
- Level 4: fully managed at the corporate level.
- Level 5: optimized (with learning & improvement).

As for what we have called “Core Elements”, they are the main object of analysis and assessment in order to identify at which level the organization arises. Different models, taking the areas of knowledge and the PM processes considered by the PM professional certifications, assign scores to them, using questionnaires and scales.

Both the number of items investigated, and the method of submission are very varied:

- Self-assessment.
- Guided interviews.
- Real audits i.e., external evaluations.

In addition, the type or the mix of questions presents strong differences, including questions:

- With an objective answer (e.g., the number of Project Managers with a recognized professional certification).
- With an objective answer but with an adequacy consideration need (e.g., the existence of PM procedures or the use of PM best practices).
- With a purely subjective answer.

The PMMM of the leading PM Organizations, with their medium-high complexity, allow to consider the maturity deriving from three different sources or drivers:

- Individuals (even if the knowledge possessed by the project managers and those owned by other members of the project teams should be distinguished).
- Projects (that is the management of individual projects following the PM methodology and best practices).
- The organization (the widespread culture of PM, the existence of state-of-the-art PM procedures, the creation and use of a “repository” of PM experiences, the role of the PMO - Project Management Officer, etc.).

In addition, this would seem to be a useful and fundamental pre-condition of analysis, even if it could lead to different levels of maturity for the three different drivers, and consequently create difficulties to arrive at a synthesis or belonging to a single level or stage for that company.

5. Implications and Future Directions

The interest in Project Management Maturity Models is growing and stimulated by the increasingly widespread awareness of the link between the competitiveness of companies and their ability to manage projects. Beyond approaches and contents sometimes quite different, the benefits are valuable:

- They allow an assessment of the organization concerning project management capability and consequently they are a tool to support business competitiveness.
- Once the degree of maturity has been assessed, a company finds indicated in the models some improvement paths, both as objectives and actions to be taken.
- They can also be a business card or a promotional lever, especially in certain sectors and businesses.
- They can allow to win tenders as a general contractor or to obtain subcontracts as suppliers.

The PMM models aim to analyze and evaluate the organizational competencies in the PM, and therefore realize an assessment in the more general framework of the organizational competencies described by the Resource-Based View and Competence-Based Competition (De Toni and Tonchia, 2003): “The competencies explain how two firms, though with similar objectives and the same resources, can achieve different performances”.

Having found that some models are quite complex and that most organizations have never performed an assessment - nor therefore have a ranking - in their PM maturity, perhaps it would be the case that the first model that is adopted was relatively simple, easy to apply and clear in the methods of analysis and results.

At the same time, given that most of the items investigated are subjective or at least require a subjective interpretation, a self-assessment is hardly possible and indeed it is required that the evaluators (better external auditors) possess high knowledge and experience of PM. So there is

he “paradox” of analyzing in a simple way an organizational system that in most cases has never been formally investigated in relation to the PM, but to do so, auditors with special skills in the PM are needed.

While differentiating between 5 levels of maturity seems the most appropriate thing (less than 5 levels would not skim the different situations, more than 5 levels would make the improvement paths less clear), it would seem useful to evaluate separately – as “determinants of maturity” – the individuals (distinguishing between project managers and other project team members and company managers), the projects managed (with extension also to portfolio and programs), the organization as a whole and its capacity to deploy and apply PM. As a first assessment step, without using particularly complex models, grids (“frames”) could be used, entrusted to PM evaluation experts, such as the one exemplified synthetically in **Table 4**.

Finally, it must be considered that having high levels of maturity is not an absolute objective but contingent in relation to at least three factors:

- The multiplicity of the stakeholders and their satisfaction (the concept of stakeholders, introduced with the PMBOK 2013 edition and then expanded with the 2017 edition, is increasingly central to the PM).
- The complexity of the project scope.
- Comparison (benchmarking) with the best competitors.

Likewise, if maturity levels exist, the path of the organizations to level-up could also be relative, that is contextual or contingent – and not predetermined – by factors of “path dependency” (the history of the company), by acquisition from outside of project managers who were already operating in mature organizations, or due to the existence of clients who “pull” the best practices of PM, also by collaborations with the Universities, etc.

These last situational aspects, while on the one hand, allow us to consider a company in its specificity and needs, on the other hand, however, they could make both the assessment of maturity and the definition of growth paths in the PM more problematic and not univocal.

Research on Project Management Maturity Models is a field in development, which probably will lead to a better clarification of some models, perhaps even a synthesis and furthermore indications for testing the models in several and different types of organizations. This paper aims to be a turning point: on the one hand, it has been considered and compared to the main models developed over time; on the other hand, it allows further research to synthesize and parameterize one or more models to deepen the testability of measuring maturity in Project Management.

Maturity Levels	A. Individuals	B. Projects	C. Organization	Overall = A + B + C
1 - Initial	few know a little	basic planning & control	informal role of project manager	
2 - Defined	only a few project managers know	WBS and Gantt	formal role of project manager	
3 - Standardized	several project managers know	CPM, workloads by tasks, ...	PM procedures; PM reporting; use of a PM software	
4 - Managed at a Centralized Level	PM knowledge diffused also outside the PMs	Earned Value, RACI matrix, KPIs (NPV, IRR, ...), Risk Management	WBS templates plus PM procedures for different project families; PM software integrated into the ERP	
5 - Optimized through Learning	PM knowledge diffused in all areas and at all levels	Lesson Learned, Agile, ...	Project Management Office(r) – PMO/ repository of experience in PM	

Table 4. Maturity Levels based on: Individual PM Knowledge (A.), Projects’ best practices (B.), Organization compliance to PM (C.).

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PROJECT MANAGEMENT MATURITY MODELS

LITERATURE REVIEW AND NEW DEVELOPMENTS