TALLINN UNIVERSITY OF TECHNOLOGY
SCHOOL OF ENGINEERING
Department of Mechanical and Industrial Engineering

DEVELOPMENT OF A PROJECT MANAGEMENT MATURITY MODEL FOR AN AGILE SOFTWARE COMPANY

PROJEKTIJUHTIMISE KÜPSUSMUDELI ARENDAMINE AGIILSET METOODIKAT KASUTAVALE TARKVARAFIRMALE

MASTER THESIS

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Tallinn 2022

AUTHOR'S DECLARATION

Hereby I declare, that I have written this thesis independently.
No academic degree has been applied for based on this material. All works, major viewpoints and data of the other authors used in this thesis have been referenced.

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THESIS TASK

Student: Hans Johan Erikson, 204685MARM
Study programme: MARM Industrial Engineering and Management
main speciality: Industrial Engineering and Management
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Thesis topic:

(in English) Development of a project management maturity model for an agile software company

(in Estonian) Projektijuhtimise küpsusmudeli arendamine agiilset metoodikat kasutavale tarkvarafirmale

Thesis main objectives:

1. Reviewing available literature to find and develop a suitable project management maturity model for the assessment of an agile software company.
2. Applying the developed project management maturity model on an example software company and proposing project management process improvements based on the assessment results.

Thesis tasks and time schedule:

No	Task description	Deadline
1.	Review of literature, analysis of available models and development of the assessment.	10.04
2.	Assessment of the software company.	24.04
3.	Presentation and analysis of assessment results, improvement proposals. Finalization of the thesis.	21.05

Language: ENG **Deadline for submission of thesis:** 23.05.2022

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PREFACE

This thesis was initiated by the author while working as a project manager in an agile software development company. Since the author was interested in both developing himself professionally, and improving the project management practices at the company, the topic of project management maturity models was chosen as something that could benefit both sides.

The author would most of all like to thank his supervisor Algis Perens for excellent collaboration and constant support during the writing of this work. The author would also like to thank the company for providing a basis for this thesis. And finally, the author thanks his girlfriend Ginevra for supporting him in the oscillating times of this journey, damping the peaks in his state of mind.

Hopefully this thesis can provide a useful input to further research on project management maturity models and applying them in the field of agile project management.

Project management maturity model, project management, agile project management, master thesis

LIST OF ABBREVIATIONS

Abbreviation	Explanation
ASD	Agile Software Development
CMMI	Capability Maturity Model Integrated
COE	Centre of Excellence
CPMMM	Crawford Project Management Maturity Model
KPMMM	Kerzner Project Management Maturity Model
PM	Project management
PM Solutions	Project Management Solutions, Inc.
PMBOK®	Project Management Body of Knowledge
PMI	Project Management Institute
PMMM	Project Management Maturity Model
PMO	Project Management Office
POS	Point of Sale
XP	eXtreme Programming

1. INTRODUCTION

In our current fast-paced world of global competition where ideas need to be turned into products and services fast to stay ahead, organizations are realizing that project management is one of the key competitive advantages in translating strategy into organizational success through projects. (Fahrenkrog, Haeck, Abrams, & Whelbourn, 2003)

In its essence, project management is the art and science of getting work done - what steps need to be taken to get from where we are now, to where we want to be.

As organizations started applying project management to realize their vision through projects and portfolios of projects, project management became responsible for the organization's success and thus, it became an issue to be considered at organisational level. This led to the concept of project management maturity. (Görög, 2016)

When ideas around project management maturity and project management maturity models (PMMMs) were first published around the turn of the millennium, they were met with praise by both academics and professionals, expecting a correlation between the application of maturity models and project success. (Görög, 2016) However, studies published in the following years failed to report such a correlation, and the models started receiving a fair share of criticism, emphasising their mechanistic approach, narrow focus, and the presumption that maturity can be achieved "through documents, surveys, guidelines, templates, or manuals". (Jugdev K, 2005, p. 21)

Maturity models indeed have their weaknesses. Models, as such, are "a simplification: wrong but hopefully useful", as expressed by Martin Fowler, one of the creators of The Agile Manifesto. (Fowler, 2014) Still, applying maturity models in organizations has three primary benefits: 1) assessing the current state of maturity, 2) giving guidelines to reach higher level maturity and 3) giving a possibility to benchmark with other organizations. (Görög, 2016)

Strong project management can be advantageous to any organization, but it is especially useful in the field of software development, where projects involve much more unknowns and risk than traditional projects.

In the beginning of a software project, it is impossible to predict the final solution used, due to the speed with which new technologies emerge and new solutions become available. (Tolbert & Parente, 2020, p. 17) In this "Age of Accelerations" as coined by Tom Friedman, project managers are under much more pressure to deliver fast under

very volatile requirements and tight constraints. (Tolbert & Parente, 2020, p. 17) As a result, Agile Software Development (ASD) methods emerged, an umbrella term for iterative and incremental development methods, such as Scrum and eXtreme Programming (XP). (Shastri, Hoda, & Amor, 2021)

While Scrum has now become the industry standard method for software development companies (a 2021 survey reporting 66% of respondents using Scrum as the main agile method), the role of project manager does not exist in Scrum, with roles such as *product owner* and *Scrum master* taking over many roles traditionally held by the project manager. (Digital.ai, 2021, p. 13) Still, the job title of the project manager is reported to exist in the majority of agile projects. (Shastri, Hoda, & Amor, 2016) This raises the question - if ASD methods do not mention the role of project manager, why is it still present in agile projects? Even the Agile Practice Guide published by PMI and the Agile Alliance expresses the vagueness of the role, saying "the role of the project manager in an agile project is somewhat of an unknown, because many agile frameworks and approaches do not address the role of the project manager". (Project Management Institute, 2017, p. 37)

Realizing the co-existence of project managers with agile teams, the project manager becomes a "servant leader" in the Agile Practice Guide, shifting from the centre of the project to coaching, facilitating collaboration, and aligning stakeholder needs. (Project Management Institute, 2017, p. 38) In addition, the project manager also continues to fulfil some organizationally necessary functions, such as tracking project progress, budgeting, and forecasting. (Shastri, Hoda, & Amor, 2021)

Therefore, since project management has its place in agile software development, PMMMs can prove to be useful tools in agile environments. That is why this thesis took on the task of applying PMMMs on an agile software development company.

The company used as the example in this thesis is a software company established 12 years ago, offering business management software to both small to large-sized retail enterprises. The main product is a cloud-based Point of Sale (POS) solution, heavily focused on customization to offer clients features based on their specific needs. In addition to the main POS solution, the company offers a wide variety of tools and applications to help the business with CRM solutions, sales optimization, reporting tools, warehouse management etc. The company also offers its solutions across industries, customized for example to restaurants and vehicle repair shops.

Organizationally, the company consists of agile core product teams and client-specific solution teams for larger clients. Teams consist of dedicated developers who are

constantly improving the products, based on customer feedback. The teams are primarily using Scrum methodology. In addition to agile teams, the organization employs project managers leading various internal and customer-facing projects, while utilizing and coordinating resources across teams.

This thesis has two main objectives. First objective is analysing available literature on PMMMs considering agile companies to find an appropriate model for the basis of assessment, and then applying it on the example company. This is presented in chapter 2, which starts out with literature review, then selects suitable models for description and comparison, and finally presents a maturity model tailored to the organization.

Second objective is carrying out an assessment using the developed model, presenting the assessment results, interpreting them, and finally offering an improvement roadmap towards further maturity. This is presented in chapter 3, which presents the assessment plan, results, and interpretation of the results along with a suggested improvement roadmap.

Kent Crawford's book "Project Management Maturity Model" describes the Project Management Office (PMO) at the lowest maturity level 1 as such: "An informal PMO may exist that generally consists of one or two people who have an interest in bringing project management standards to the organization." (Crawford, 2021, p. 25) The author of this thesis tends to be one of these people, always fascinated by ways to do things more efficiently and effectively, and looking for new systems, processes, ideas to explore and apply.

After having worked close to a year as a project manager in the same software company which this thesis is based on, interest in project management maturity models came naturally as a possible tool to both help manage projects better as an individual project manager and improve project management practices in the whole organization. The author hopes this thesis is a step in that direction.

2. DEVELOPMENT OF THE ASSESSMENT

2.1 Overview of PMMMs

2.1.1 Introduction to PMMMs

A project management maturity model (PMMM) is a model of progressive improvement in project management systems and processes that can be used to assess an organization's capabilities and to provide an improvement path. (Pennypacker & Grant, 2002) The concept of project management maturity of organisation stems from the concept of process maturity. (Shastri, Hoda, & Amor, 2021) Maturity models started gaining popularity in the beginning of 2000s with the rise of software development companies. In the end of 2002, there were already 27 models listed by the Project Management Institute. (Pennypacker & Grant, 2002)

The first PMMM originated from the field of software development. Since the complexity of software projects involves more unknowns and intangibles, and obtaining predictable results is more of a challenge compared to "traditional" projects in other industries, this led to the creation of the first Capability Maturity Model, developed in the Software Engineering Institute of Carnegie-Mellon University in 1986. (Crawford, 2021, p. 5) (Software Engineering Institute, 1993) This evolved into the Capability Maturity Model Integrated (CMMI) owned by the CMMI Institute, which has become widely accepted as a standard basis for maturity models. (Pennypacker & Grant, 2002)

The main benefit of maturity models is structuring and prioritization of learning. The models are essentially levels of increasing effectiveness based on the principle that there is a predictable path of development. It determines the current level of effectiveness and sets priorities for what should be learnt next to advance. (Fowler, 2014)

Prioritization of learning is based on the idea that if you are at level 2 of effectiveness, it is more important to learn the level 3 topics than level 4. (Fowler, 2014) This structure of continuous stages helps to give guidance as to what project management maturity looks like, while achieving maturity without any guidance could take decades while learning from own mistakes. (Kerzner, 2019, p. xv)

2.1.2 Review of Literature on PMMMs

To find a suitable PMMM to be used for this thesis, the author first researched the available material on the subject. Research database search engines like PRIMO

(available for Tallinn University of Technology), Google Scholar and O'Reilly's database were utilized to identify available maturity models and accompanying articles on the topic.

The search provided plenty of results, including project management maturity models with different levels of depth and relevancy, some up to date with the latest standards, and others dating back 20 years. Various types of maturity models were found, such as organizational project management maturity models (focusing on the organization-level strategy and considering program and portfolio management) and agile maturity models (focusing more on the agile practices of software development rather than project management in general).

Following is a list of maturity models that either had the entire model or at least overview-level information available, ordered by the year of latest edition (see Table 1).

#	PMMM Name and Author	Year of Latest Edition
1	Project Management Maturity Model (4th edition) by Kent Crawford and PM Solutions	2021
2	Kerzner's Project Management Maturity Model by Harold Kerzner	2019
3	Portfolio, Programme, and Project Management Maturity Model (P3M3®) by Axelos	2015
4	Organizational Project Management Maturity Model (OPM3®) (3rd edition) by Project Management Institute	2013
5	Agile Maturity Model (AMM) by C. Patel and M. Ramachandran	2009
6	Project Management Process Maturity (PM2) Model by Young Hoon Kwak and C. William Ibbs	2002

Table 1. Overview of PMMMs found during literature review.

2.1.3 Selection of suitable PMMMs for further analysis

Since this thesis chose to focus purely on project management maturity models, other types of models were disregarded. That includes the organizational PMMMs P3M3 and OPM3, and the Agile Maturity Model (AMM).

Furthermore, the PM2 model by Young Hoon Kwak and C. William Ibbs was also be left out for two reasons. First, the model is outdated with the latest edition released in 2002. Second, the model is not comprehensive, offering only a 6-page white paper.

After literature review and discarding unsuitable models for this thesis, two PMMMs remained: 1) Kerzner's Project Management Maturity Model (KPMMM) by Harold Kerzner and 2) Project Management Maturity Model (4th edition) by Kent Crawford and PM Solutions (CPMMM).

Both authors offer thorough and comprehensive project management maturity models that are up to date with the latest standards and trends of project management, released in 2019 and 2021, respectively. The models are also available either directly through the university database or for a reasonable price.

In the following section, both models are described and compared in-depth, with the goal of finding a suitable model for the assessment of the organization.

2.2 Description of Harold Kerzner's PMMM

Harold Kerzner is a recognized expert in the field of project management who first published his PMMM in the 2002 book "Strategic Planning for Project Management Using a Project Management Maturity Model". (Kerzner, 2002) This thesis follows the most recent 3rd version of this model, published in 2019. (Kerzner, 2019)

2.2.1 Basis of the model

Harold Kerzner's project management maturity model (KPMMM) involves five levels of increasing project management maturity. The levels work in a way that a company must progress through each level, before the next one can be completed. Still, processes from different levels can happen in parallel, such as developing project management processes (level 2), while training the employees (level 1). (Kerzner, 2019, p. 41)

Following here are the characteristics of each level, taken from the model. (Kerzner, 2019, pp. 40-41)

1. Level 1: Common Language.
    a. The organization recognizes the importance of project management and the need for a good understanding of basic project management knowledge.

2. Level 2: Common Processes.
    a. The organization recognizes the need for common processes, so that the success of one project can be repeated on other projects.
    b. Also recognizes the application of pm principles to other methodologies used in the company.
3. Level 3: Singular methodology
    a. The organization recognizes the synergistic effect of combining all methodologies into a singular methodology with project management at the centre.
    b. At this point companies can choose to take a flexible project management approach, where each project manager can customize the tools for the client.
4. Level 4: Benchmarking
    a. The organization recognizes that process improvement is necessary to maintain a competitive advantage, using benchmarking. It must be decided against who and what to benchmark.
5. Level 5: Continuous Improvement
    a. The organization evaluates information obtained through benchmarking and decided whether to use it to improve project management processes.

2.2.2 Model structure and assessment

The KPMMM model offers assessment tools for each of the five levels, which consist of a questionnaire and explanation of the results. This model does not assess the same dimensions on five different levels; instead, it assesses the maturity of what is at the centre of that stage. Following is the description of the five levels and their assessments.

An organization on level 1 called "Common Language" is at the beginning of the road to project management maturity. There is sporadic use of project management, if at all. There is no investment or support for project management training and education and no visible executive support for the practices. To move forward, the most important step the organization can take at this point is recognizing the need and benefits of project management, and education of its staff on the basic principles and knowledge. (Kerzner, 2019, p. 45)

Level 1 assessment focuses on the maturity of project managers in the organization, assessing their basic knowledge about the fundamentals of project management and the terminology used. The assessment includes a questionnaire of 80 questions covering

the Project Management Body of Knowledge (PMBOK®) Guide by Project Management Institute (PMI). (Kerzner, 2019, p. 48)

Questions are divided into eight knowledge categories: Scope, Time, Cost, Human Resources, Procurement, Quality, Risk and Communications Management. (Kerzner, 2019, p. 62) Total results for each category are added up to represent the level of knowledge about the category, from 0 points to 100 points. If the result is 60 points or more, it indicates a reasonable knowledge of the basic principles of project management. (Kerzner, 2019, p. 63) A lesser score indicates a deficiency in the category. A score less than 30 points to a need for more training.

The assessment can be done both on an individual level or on an organizational level by taking the average of the results. From this assessment, the organization is considered ready to move to level 2 if the total score on all categories is 600 or more.

Level 2 called "Common Processes" focuses on the project management processes and methods used in the organization. An organization at this level has project managers who are reasonably knowledgeable about the basic principles of project management, so the next step is the effective application of those principles by developing processes and methods. (Kerzner, 2019, p. 65)

Level 2 presents five subphases of developing common project management processes.

1. Embryonic stage. The organization recognizes the benefits of project management, its need, applications, and changes necessary to implement it. (Kerzner, 2019, p. 66) This stage is usually surpassed once executive management understands that project management might be necessary for company survival (Kerzner, 2019, p. 67)
2. Executive management acceptance. There is visible executive support, sponsorship and understanding of project management. There is willingness for change. (Kerzner, 2019, p. 67)
3. Line management acceptance. The middle management will accept project management practices once they see executive support. (Kerzner, 2019, p. 68)
4. Growth phase. This is the creation of the project management process, including development of project management life cycles, methodology. There is a commitment to planning, controlling scope changes, and using project management software (Kerzner, 2019, p. 68)

5. Initial maturity phase. This includes the development of a cost/schedule control system, integration of schedule and cost control and an internal continuous project management educational program. (Kerzner, 2019, p. 68)

Level 2 assessment includes a questionnaire of 20 questions, which gauge, how mature in terms of these level 2 subphases the project manager believes the organization to be. (Kerzner, 2019, p. 70) The questions are statements based on the characteristics of each of the five stages and answers can be opinions ranging from strongly disagree to strongly agree.

The results will be added up into five categories for the five phases and will range from -12 to 12. A high score (+6 or more) indicates that the phase has been achieved. A lower result means that the respective phase has not been achieved yet. (Kerzner, 2019, p. 74)

Level 3 called "Singular Methodology" focuses on an organization who understands that there is great synergy in combining all corporate methodologies into a single methodology with project management at the centre. (Kerzner, 2019, p. 75) It is recognized that this approach offers more control and standardization for projects. As the company develops, the singular method becomes flexible where the project manager can choose from a library of guidelines, templates, and checklists those suitable for the project.

There are six characteristics which distinguish a level 3 organization from the lower, forming what the model calls the *hexagon of excellence*. (Kerzner, 2019, p. 76) There are **integrated processes** (multiple processes streamlined into one), **cultural support** (whole company cooperates and supports project management approaches), **management support** (each corporate layer understands its role), **informal project management** (methodology based in flexible guidelines and checklists), **training** (continuous project management training for employees) and **behavioural excellence** (behavioural training programs to enhance project management skills).

Level 3 assessment is 42 multiple-choice questions assessing the company regarding the six *hexagon of excellence* characteristics. (Kerzner, 2019, pp. 84-92) The results are added up under the six categories and results interpreted. A high score indicates that the company compares well to a mature level 3 organization and is on the track of continuous improvement. A medium score indicates that company may not fully understand the benefits of project management and what they should be doing to mature. A low score can indicate that there is no understanding of project management or wish to change. (Kerzner, 2019, p. 94)

Level 4 called "Benchmarking" focuses on the company comparing its project management practices to other companies in the world by determining a set of critical success aspects for benchmarking and who to benchmark against. (Kerzner, 2019, p. 97) The goal of this level is establishing a process of benchmarking in the organization.

Advancing from level 4 to 5 requires certain key actions to be taken by the company: (Kerzner, 2019, p. 103)

- Establishing a benchmarking dedicated organisation usually called a PMO (project management office) or a COE (centre of excellence), which centralizes organizational project management knowledge.
- Establish a process for project management benchmarking.
- Decide what to benchmark and who to benchmark against.
- Recognize benchmarking benefits.

The level 4 assessment contains 25 questions concerning the way company conducts both quantitative and qualitative benchmarking. (Kerzner, 2019, p. 103) The question responses include opinions ranging from strongly disagree to strongly agree. The results are summed up under the two categories and results interpreted. Results give answers to two questions: is the organization performing benchmarking and is quantitative or qualitative benchmarking more emphasised (Kerzner, 2019, p. 106)

Level 5 called "Continuous Improvement" recognizes the project management practices as a never-ending cycle of benchmarking, continuous improvement, and methodology enhancement. (Kerzner, 2019, p. 112)

A level 5 company has four distinctive characteristics: (Kerzner, 2019, p. 109)

1. The company uses lessons-learned documents, gathered from each project. Failures are recorded, so they would not be repeated.
2. Lessons-learned from one project are applied to other teams and projects.
3. A mentorship program is put in place to train beginning project managers and transmit knowledge and lessons learned.
4. There is a companywide understanding that strategic planning for project management is a continuous, ongoing process.

Level 5 assessment contains 16 questions about the continuous improvement changes, which have happened in the company in the past 12 months. (Kerzner, 2019, p. 135)

The question responses include opinions ranging from strongly disagree to strongly agree. The question results are summed up and interpreted, with the score indicating how dedicated the company is to benchmarking and continuous improvement. (Kerzner, 2019, p. 137)

2.3 Description of Kent Crawford's PMMM

The Project Management Maturity Model (shortened to CPMMM in this thesis, after K. Crawford, its author) has been developed by the management consulting firm Project Management Solutions, Inc. (PM Solutions) and authored by Kent Crawford, CEO of PM Solutions. (Crawford, 2021, p. 1) First published in 2002, the model has received its fourth edition in 2020, which considers changes from PMBOK Guide (Sixth Edition) and including modelling of agile project management practices. (Crawford, 2021, p. 2) The book released in 2020 describes the up-to-date model in full and gives assessment tools for improving an organization's project management practice. (Crawford, 2021, p. 1)

This thesis is based on the fourth edition of the model, released in 2020.

2.3.1 Basis of the model

CPMMM follows closely the ten project management knowledge areas laid out in the industry standard PMBOK® Guide (Sixth Edition). These knowledge areas are broken down into their components and described on five levels of maturity. (Crawford, 2021, p. 3) The five levels are patterned after the CMMI Stage Representative Model from CMMI Institute. (Crawford, 2021, p. 7) Assessing these ten knowledge areas on five levels of maturity is the basic framework of the model (see Figure 1). (Crawford, 2021, p. 8)

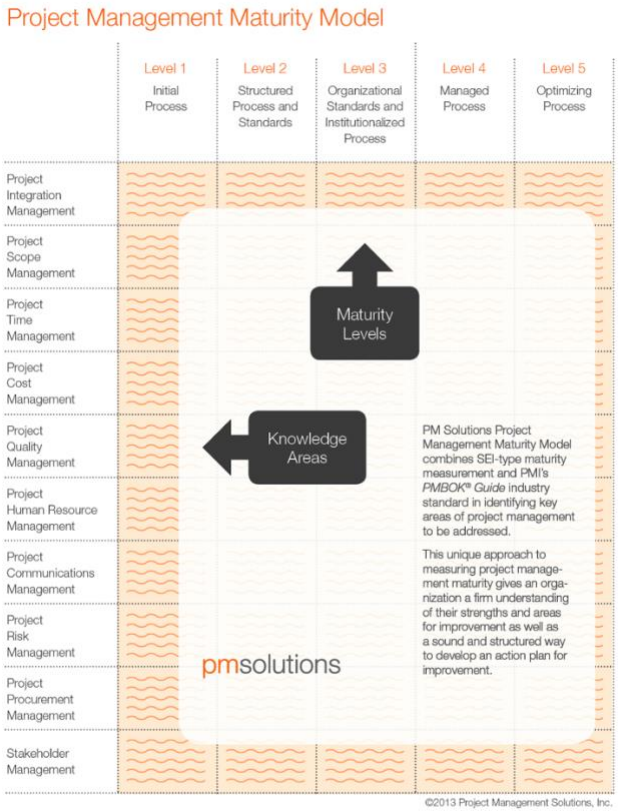

Figure 1. CPMMM framework showing the ten project management knowledge areas and five levels of maturity (PM Solutions, 2012)

Following are the five maturity levels and their distinctions. (Crawford, 2021, pp. 19-20)

1. Level 1: Initial Process
   - No established project management practices or standards.
   - Project managers are not held to specific accountability by any process standards.
   - Documentation is loose and ad hoc.
   - Management is aware of the need for project management.
   - Metrics are informal and ad hoc.
2. Level 2: Common Processes
   - Many project management practices exist in the company but are not the organizational standard.
   - Management does not require project management processes for all projects.
   - Documentation on basic processes.
   - Project information is a mix of summary and low level.

- Basic metrics (cost, schedule, performance), but data can be correlated manually.

3. Level 3: Singular methodology

   - Project management processes established as organizational standards.
   - Processes involve clients and internal customers as active members of the project team.
   - Formal documentation existing on all processes and standards.
   - Management is involved in input and approval of key decisions and issues.
   - Project management processes are automated.
   - Each project is evaluated in light of other projects.
   - Processes must be tailorable to each project; all processes cannot be blindly applied equally. Consideration must be given to differences between projects.

4. Level 4: Benchmarking

   - Projects are managed with consideration as to how they performed in the past, what is expected in the future.
   - Management uses metrics to make decisions regarding a project.
   - All projects, changes, issues are evaluated based on metrics from cost estimates, baseline estimates etc.
   - Processes and standards are documented and support using metrics to make project decisions.
   - Management manages at the right level. differentiates management styles and requirements for different projects.
   - Project management processes are integrated with other processes and systems.

5. Level 5: Continuous Improvement

   - Processes are in place to actively improve project management activities.
   - Lessons learned are regularly examined and used to improve standards and documentation.
   - Management is also focused on continuous improvement.
   - Metrics are used to understand project performance and to make organizational management decisions in the future.

The model utilizes the ten knowledge areas of the PMBOK® Guide. Since each knowledge area comprises a large amount of information, each is again broken down

into key components. These components are described on five levels of maturity, and these are the basis of maturity assessment. (Crawford, 2021, p. 9)

Since the fourth edition of the model, each knowledge area also includes agile project management components, which were developed based on "The Manifesto For Agile Software Development". (Crawford, 2021, p. 2) For example, the knowledge area "Scope Management" includes Epics and Features as key components to be assessed, in addition to components defined from the PMBOK® Guide. (Crawford, 2021, p. 10)

In addition to the previous, three distinctive components are defined by the model, which have significant influence on the adoption of project management practices: (Crawford, 2021, p. 11)

1. The Project Management Office (PMO). Organizational structure concerned with project management knowledge and tools, training and mentoring of the staff, and development of the project management practices inside the organization. (Crawford, 2021, p. 12)
2. Management oversight. Management's understanding and support of project management practices in the organization. (Crawford, 2021, pp. 12-13)
3. Professional development. The processes of continuous development of project managers in the organization. (Crawford, 2021, p. 13)

2.3.2 Model assessment

The model states that any thorough maturity assessment consists of four aspects: (Crawford, 2021, p. 14)

1. Personal and/or group interviews
2. Artifact (evidence) collection and evaluation
3. Widespread survey input
4. Benchmarking against a standard

Assessment of the levels is based on conducting interviews with the project management practitioners of the organization, to understand the policies, understanding, documentation and general view of project management. (Crawford, 2021, pp. 14-15)

Assessment can be done either by an external expert or an internal assessor. (Crawford, 2021, p. 15) Both approaches have their pros and cons, such as the expense of hiring

an external expert or the possible lack of internal expertise or the bias of employees assessing other employees.

Whether done with external or internal assessors, organization's maturity levels are determined in each knowledge area through staff interviews. Then, assessors and management work together on a gap analysis between current project management practices and the desired level of maturity. Based on that, an improvement roadmap including initiatives and change management is developed. (Crawford, 2021, pp. 15-16)

The maturity level of the organization is achieved cumulatively - meaning that to achieve a level, all requirements from the previous levels must be fulfilled. (Crawford, 2021, p. 155) The organizational maturity level is determined by the lowest score from the knowledge areas. (Crawford, 2021, p. 156) The maturity level of each knowledge area is similarly determined by the lowest score from its components. (Crawford, 2021, p. 155)

2.4 Comparison of the models

In the previous section, two PMMMs were described in terms of theoretical basis and assessment methods. In this section these PMMMs are compared by the following characteristics:

1. Maturity levels
2. Assessment dimensions
3. Assessment tools

2.4.1 Comparison of maturity levels

This is a comparison of the maturity levels of the two models (KPMMM and CPMMM), based on how the models characterize an organization on each level. Main characteristics have been brought out (see Table 2).

	KPMMM	CPMMM
Level 1	**Common Language (Kerzner, 2019, p. 46)**	**Initial Process (Crawford, 2021, p. 19)**
Characteristics	Lip service to project management	No established project management practices or standards.
	Virtually no executive-level support	Project managers are not held to specific accountability by any process standards.
	Small "pockets" of interest	Management is aware of the need for project management.
	No attempt to recognize the benefits of project management	Documentation is loose and ad hoc. Metrics are informal and ad hoc.
	Self-interest comes before company's best interest	
	No investment in project management training and education	
Level 2	**Common Processes (Kerzner, 2019, p. 66)**	**Structured Process and Standards (Crawford, 2021, p. 7)**
Characteristics	Recognition of the benefits of project management	basic processes; not standard on all projects; used on large highly visible projects
	Organizational support at all levels	Management supports and encourages use
	Recognition of the need for processes / methodologies	Mix of intermediate and summary-level info
	Recognition of the need for cost control	Estimates and schedules based on expert knowledge and generic tools.
	Development of a project management training curriculum	Project-centric focus
Level 3	**Singular Methodology (Kerzner, 2019, p. 76)**	**Organizational Standards and Institutionalized Process (Crawford, 2021, pp. 6-7)**
Characteristics	Integrated processes	All processes standard for all projects and repeatable
	Cultural support	Baseline and informal collection of actual data
	Management support on all levels	Management has institutionalized processes
	Informal project management	Summary and detailed information
	Return on investment for project management training costs	Informal analysis of project performance
	Behavioural excellence	Estimates and schedules may be based on industry standards and organizational specifics
		Organizational focus
Level 4	**Benchmarking (Kerzner, 2019, p. 99)**	**Managed Process (Crawford, 2021, pp. 7-8)**
Characteristics	Establishment of a PMO or COE	Process integrated with corporate processes
	Dedication to benchmarking	Management mandates compliance
	Looking at same and other industries	Management takes an organizational entity view
	Quantitative benchmarking (processes and methodologies)	Solid analysis of project performance
	Qualitative benchmarking (cultures)	Estimates and schedules normally based on organization specifics
		Management uses data to make decisions
Level 5	**Continuous Improvement (Kerzner, 2019, p. 110)**	**Optimising Process (Crawford, 2021, p. 8)**
Characteristics	Lessons learned files	Processes to measure project effectiveness and efficiency
	Knowledge transfer	Processes in place to improve project performance
	COE PMO Mentorship program	Management focuses on continuous improvement
	Strategic planning for project management	

Table 2. Comparison of the models' maturity levels.

Both models define five consecutive levels of maturity, which are defined quite similarly until level 3, but diversely on the higher levels.

Both models define a level 1 organization mainly as not having established project management practices in place and executive management either not recognizing or starting to recognize its benefits and needs. (Kerzner, 2019, p. 46) (Crawford, 2021, p. 19)

According to both models, a level 2 organization is about realizing the benefits of project management approaches and developing and using basic processes/methods. There is now support on all levels of organization, most importantly the executive management. (Kerzner, 2019, p. 66) (Crawford, 2021, p. 7)

A level 3 organization is by both models defined as one that has developed a singular standardized project management methodology that is repeatable and used on all projects. (Kerzner, 2019, p. 76) (Crawford, 2021, pp. 6-7)

Level 4 is where the models diverge on the specifics, although the focus remains similar. After achieving standardized processes and good employee project management knowledge, the road to further maturity becomes about feedback and process improvement. In KPMMM, level 4 focus is specifically on the establishment of benchmarking, i.e., comparing the organization project management methodology both quantitatively and qualitatively to other organizations, both in the same and other industries. (Kerzner, 2019, p. 99) In CPMMM, the level 4 characteristics are more general, indicating that at this level, the organization becomes data driven, management learns to use the right management styles at the right levels. (Crawford, 2021, pp. 7-8) Project management process is integrated with other corporate processes, which in the KPMMM is already part of level 3. Finally, KPMMM level 4 organization establishes a PMO (Project Management Office) or a COE (Centre of Excellence), while in the CPMMM, the PMO is considered a component of one of the knowledge fields and developed already in levels 2 and 3. (Crawford, 2021, pp. 28, 32)

Level 5 is defined for both models as focused on continuously improving or optimising the project management practices of the organization. KPMMM brings out a few distinctive characteristics of this level, such as usage of lessons-learned documents, knowledge transfer across teams and from senior to junior project managers, an internal mentorship program and continuous strategic planning for project management. (Kerzner, 2019, p. 110) CPMMM is again more general, characterising a level 5 organization as focused on continuous improvement, having processes in place to measure project effectiveness and efficiency, and to improve project performance. (Crawford, 2021, p. 8)

In conclusion, the two models offer five very similar stages of maturity, following a path from basic project management knowledge to basic processes, to standardized processes and finally to continuous improvement and optimization. Characterising the levels, KPMMM tends to bring out more concrete processes that need to be in place, while CPMMM is more general. Still CPMMM mentions similar processes (lessons learned files used, as an example of level 5), when studying the model more closely. (Crawford, 2021, pp. 64-65)

2.4.2 Comparison of assessment dimensions

In this section, a comparison is made between what is assessed by CPMMM and KPMMM on each level of maturity.

CPMMM follows the 10 knowledge areas of PMBOK (some additional elements), as mentioned before, which are broken down into key components. The model describes each component at five levels of maturity. Each component of each knowledge area is then assessed on five levels, determining the current level of the organization.

An example is brought out here of the component "Project Charter Development" from the knowledge field Project Integration Management (see Table 3). In a similar way, the model provides descriptions of all components.

Level	Description
1	There is no formal requirement for project charter; one may be developed. No prescribed format is followed. Content and layout vary by project and project manager.
2	Project charters are used for larger and more complex projects. Charter is authored by the sponsoring entity. A basic template is provided, but content veries among projects. Benefits associated with project outcomes are described for measurement and forecasted for delivery in the project charter. Value metrics are estimated for benefits as goals for attainment.
3	Project charter required for all projects. Standard template is provided. Process for documenting, reviewing and approving for project charter is in place. Level of detail vary based on the project. Values associated with project benefits are derived using standard processes.
4	All project charter processes are in place, documented and used. Charters are integrated into and support organization strategic plans and objectives.

5	Project charter continuous improvement process in place. Lessons learned are captured and used. Value of project charters is clearly understood and included in the planning process.

Table 3. Description of the component "Project Charter Development" at 5 levels of maturity in CPMMM.

KPMMM focuses the assessment on the specifics of each maturity level. The model establishes certain characteristics for each level and the assessment is based on how well the organization embodies those.

For example, level 1 is based on basic project management knowledge - assessment is a questionnaire on that basic knowledge against the PMBOK® standard. Level 2 includes development of basic project management processes and organizational support - level 2 assesses how committed the company is to developing and applying project management processes, through the opinion of the questionnaire taker. Similarly, the rest of the levels are assessed.

In conclusion, while CPMMM provides the same assessment dimensions across five levels of maturity, KPMMM focuses specifically on assessing the characteristics of each level.

2.4.3 Comparison of assessment tools

This section compares the two models in terms of how applicable the assessment tools are, which they present. This is an important factor, as the goal of this thesis is applying a model practically on a software development company.

To assess the organizational project management maturity level, the CPMMM includes a self-assessment survey. (Crawford, 2021, pp. 155-160) This is comprised of a checklist of the ten knowledge areas divided into key components, with checkboxes for each component marking levels 1-5. This relatively simple checklist can be used to get an overview of the organization's maturity level. Each component is assessed independently, and results marked in the list.

The basis for assessment is the descriptions of the knowledge area components at five levels of maturity. In this way the possible development of each component can be easily comprehended and understood.

Even though the model gives both a high-level checklist and descriptions for each item on the list, it does not offer a template for gathering the information for the assessment.

It is left for the assessor to decide, in which way to construct the interviews to the project management practitioners of the organization.

This is not a small work, as the model assesses close to a hundred different components of project management, at five levels. This poses a problem of how to effectively carry out the assessment. Creating a questionnaire of nearly a hundred questions and five possible descriptions as answers both needs a lot of time for preparation and makes it less likely that the employees are going to take the time and energy required to finish it.

KPMMM provides ready-made questionnaires for each of the five levels, focusing on the main characteristics of the levels. In this way, KPMMM is very applicable as a model, as the questionnaires can be taken and applied immediately for collecting feedback, if the assessor does not wish to do any modifications.

The questionnaires are also designed to be easily answered. Only the level 1 questionnaire is a pure theoretical test of knowledge. The rest of the four questionnaires contain questions about the test-takers opinions on various characteristics or changes in the organization.

In addition to questionnaires, the model provides guidelines on how to quantify and interpret the results.

In conclusion, considering the readiness of the assessment tools these two models offer, KPMMM is clearly much more applicable *out of the box*, since the interviews for assessing each maturity level have been already designed. Although CPMMM offers a fully described maturity path for each assessment component, the way to obtain information (through an interview for example) would need to be assembled and designed.

2.5 Development of the assessment

In this section, based on the description of the two project management maturity models and comparison of their aspects, a basis for the assessment of the company will be developed.

2.5.1 On using PMMMs to assess a single organization

When applying maturity models, the question will inevitably arise whether to apply it as a standard tool or customize it to the specifics of the organization. For the organization it is important to decide its goals when applying a maturity model and whether a general or customized model is more useful for achieving its goals.

Using standard and customized models both have their pros and cons. The primary benefit of using a standard assessment model is the ability to compare the results against other organizations who have carried out the same assessment. This helps to benchmark the organization to others that are in the same industry, are the same size, or have other similarities. (Kerzner, 2019, p. 32)

Using a standard model can however also include the risk of assessing topics that are not relevant to your company and therefore giving a false understanding of the organization's true maturity level. (Kerzner, 2019, p. 32) Another issue is that a heavily documented complex model might scare away the management from understanding the resources needed to apply the model. As Harold Kerzner has said, "with maturity models, complexity breeds avoidance". (Kerzner, 2019, p. xvii)

The real value of a maturity model assessment is understanding where the level of project management is now and what are the next steps the organization should take to reach its desired level of effectiveness and efficiency.

The process of applying the model also includes a realization of what "maturity" looks for an organization, because reaching level 5 is not optimal in all cases for all organizations. As CPMMM brings out, many organizations will already achieve significant benefits by reaching the "repeatable process" level. (Crawford, 2021, p. 7) In the process of repeatedly applying a maturity model, whether standard or customized, the organization will realize its strengths and weaknesses and its own definition of maturity can and will change based on the improvements made. (Kerzner, 2019, p. 32)

Since the goal of this thesis is the project management maturity assessment of a single company, the assessment model must be selected in light of what is most valuable for this company.

More focus will be put on assessing tools and processes specific to the company to provide the most useful assessment of where the company currently is, and what would be the next improvement priorities in its own context of maturity.

Applied standard maturity models such as the two compared in the previous chapters are very useful for conducting industry-wide research. For example, the KPMMM level 3 ("Singular methodology") assessment states that the assessment results will allow the organization to compare itself against other companies regarding the level of maturity. (Kerzner, 2019, p. 84) When only focusing on one company, however, the assessment model needs to be customized, as the same level 3 assessment also states: "This level may have to go through major changes if the assessments are being done and the firm is a heavy use of the agile or Scrum approach". (Kerzner, 2019, p. 95)

Moreover, after studying both the KPMMM and CPMMM, applying either of these models in their entirety would exceed the scope this master thesis, since both involve very thorough assessments. This is one of the reasons why the final maturity model needs to be condensed.

For these reasons, a customized project management maturity model will be created based on the selected models. The most relevant aspects of the models for the company will be chosen, with these considerations:

- The organization is a software development company offering a SaaS product. The company is heavily project based, using agile methodologies to manage its product and project teams.
- Highest benefit is found in establishing repeatable project management processes across the organization (equal to "Organizational Standards and Institutionalized Process" in CPMMM or "Singular methodology" in KPMMM).
- The customized model should still provide a possibility to benchmark its components against the industry or other organizations.

2.5.2 Basis for the maturity assessment

The model for assessment will be created based on the maturity models by Harold Kerzner and Kent Crawford and the assessment itself will be carried out in the form of a questionnaire. Target assessment group will be the organization's project managers, who will be asked to answer the questionnaire.

The assessment questionnaire will focus on two areas. First, it will focus on assessing the current maturity level of the organization, from level 1 to level 5 on the maturity models. Second, since the organization is heavily using agile methodologies, the application of agile practices will be focused on in more detail.

The questionnaire will be created based on the assessment tools offered by the aforementioned models. Questions will be analysed, selected, and organized.

2.5.3 Assessing the organizational project management maturity

As described in the previous sections, both CPMMM and KPMMM offer five project management maturity levels. Each level is described in respect to the aspects of project management the organization must embody.

As to giving a broad overview of the maturity level of the organization, neither model gives a concrete tool to assess it.

The assessment tools offered by KPMMM do not offer a broad overview, rather, they are focused on assessing the characteristics of each maturity level. Level 1 assessment is a test on the fundamental project management knowledge of the individual project managers, based on the PMBOK® Guide. (Kerzner, 2019, p. 48) Level 2 assesses the adaption of common project management processes in the organization. (Kerzner, 2019, p. 70) Level 3 focuses on the organization's culture and support for project management. (Kerzner, 2019, p. 84) Level 4 on the establishment of benchmarking and level 5 on continuous improvement on the established processes. (Kerzner, 2019, pp. 103, 135) KPMMM also brings out the main characteristics of each maturity level.

CPMMM, as mentioned, does not offer assessment tools or questionnaires included with the model. The model offers key components of project management methods, following the knowledge areas of the PMBOK Guide, described at five levels of maturity. It also brings out the general qualities of an organization at each maturity level. (Crawford, 2021, pp. 19-20)

To give an overview of the current maturity level of the organization, a questionnaire can be made based on the characteristics that assesses how the project managers perceive the organization in terms of these characteristics. Each characteristic is presented with an option to either agree or disagree that the organization embodies the characteristic. When the characteristics of all maturity levels are assessed, this gives a broad overview of which level characteristics the organization has, and which not, in the opinion of the particular project manager. If the opinions are gathered from all project managers of the organization, the rough maturity level of the organization can be determined.

To create an assessment questionnaire based on the maturity level characteristics, characteristics presented by both CPMMM and KPMMM are compared. Both are brought out in Appendix 1. Maturity Level characteristics presented by CPMMM and KPMMM.

Due to the simplicity of the characteristics described by CPMMM, they can be more easily used for assessing the opinions of project managers. They are described as statements (such as "Project documentation is loose and ad hoc."), which are understandable from the project manager's perspective.

To capture the project manager's opinion on the statement, the Likert scale will be used, a rating system that is designed to capture people's attitudes, opinions, or perceptions. (Fahrenkrog, Haeck, Abrams, & Whelbourn, 2003)

2.5.4 Assessing the maturity of agile project management practices

To assess how agile project management practices are applied in the company, a basis need to established.

KPMMM is designed to assess the project management processes, whether they be traditional or agile, and the assessor is encouraged to customize the assessments in case the organization uses agile. However, it does not offer concrete assessment tools for that case.

On the other hand, CPMMM describes 25 agile process components, which are included in the assessment of the ten knowledge areas of the PMBOK® Guide (see Appendix 2. Agile project management processes according to CPMMM and their respective PMBOK® knowledge area). Each of these components are described at five different maturity levels. The assessment will include questions on each component with the five descriptions as possible answers. To gauge the level of maturity for each component, the respondent has to choose the description that their opinion best characterizes how the particular agile component is practiced in the organization.

2.5.5 Finished project management maturity assessment

The final assessment is a questionnaire containing two parts with 27 and 25 questions respectively. The questionnaire can be found under Appendix 3. Questionnaire.

First, the project management maturity level of the company will be assessed through the opinions of the project managers working in the company. The assessment is based on the characteristics of the organization at five different levels of maturity. The opinions will be captured using the Likert scale.

Second, the maturity of agile practices used in the company is assessed. The assessment is based on the descriptions of agile process components from the CPMMM.

The maturity level of each component will be assessed by choosing the description that is most suitable.

3. APPLYING THE DEVELOPED ASSESSMENT ON A SOFTWARE COMPANY

This chapter presents the results of applying the project management maturity model developed in the last chapter on an actual software company. A brief overview of how the assessment was carried out is given, the results are presented. As the result of the assessment, improvement steps are proposed to move the organization towards further maturity.

3.1 Assessment plan

3.1.1 Survey participation

The software company's project management maturity was assessed by surveying the project managers working in the company. All employed project managers were asked to answer the questionnaire developed in chapter 2 of this thesis (brought out in Appendix 3).

At the time of this assessment, the company employed both full-time project managers and other managers and team leaders, who lead projects or fulfilled project management functions as part of daily work. Both were asked to participate in this survey.

3.1.2 Getting an accurate overview of the current maturity level

As KPMMM emphasises, it is important to get a broad and diverse representation of the entire organization, include key stakeholders across departments and involve the whole hierarchy, since each level has a different belief about the organization's level of maturity. Still, it might be easier to begin in a receptive department, before scaling the assessment in the organization. (Kerzner, 2019, p. 181) Therefore, this assessment was conducted only on the project managers.

Considering that the project managers participating in the survey have various experience and work with different projects and clients, the results should give a sufficiently broad overview of the current project management maturity level.

CPMMM warns that employees might not feel comfortable sharing honest information when being surveyed by other employees. (Crawford, 2021, p. 15) Therefore, the survey was conducted anonymously, for the results to remain as objective as possible.

3.2 Assessment results

In this part, assessment results are presented and analysed. Results are divided into two parts: 1) organizational level of project management and 2) agile project management practices.

3.2.1 Organizational level of project management (part 1)

As discussed in chapter 3.2.1, the first part of the survey aimed to give an understanding of the current maturity level of project management processes in the company. It contains statements of each of the five maturity levels, and the respondent must give their opinion about how characteristic the statements are to the organization.

An overview of the statements and corresponding levels has been brought out under Appendix 4. Assessment Results (Part 1), including the average response and standard deviation to indicate, whether there was consensus between the respondents or not. These results are presented here, divided into five levels.

Level one (statements 1-5) shows a mixed result with no clear consensus between the respondents. What can be concluded from the responses is that

1. Project documentation tends to be loose and ad hoc,
2. Project metrics are collected ad hoc,
3. The management does not understand well the definition of a project or is aware of the need for project management.

Overall, these results show that the use of project management practices and processes vary heavily across the organization, from one project manager to the next.

Level two (statements 6-10) shows a more uniform opinion with the respondents agreeing on all statements, except the ones related to documentation and metrics. Responses show that

1. There are PM processes in the organization, but they are not considered organizational standards,
2. There is management support, but no consistent understanding or involvement, or mandate for all projects,
3. Project information is usually a mix of summary and low-level data,
4. Metrics and documentation quality varies across the organization.

Level three statements (statements 11-17) show some very clear trends. There is strong agreement that:

1. There are no organizational standard PM processes established,
2. External and internal customers are considered active members of the project team,
3. There is no formal documentation existing on all PM processes and standards.

Besides these, respondents also slightly agree that management is regularly involved in key project decisions and issues. The respondents tend to disagree that PM processes are automated, and there is strong difference in opinion whether each project is evaluated and managed in light of other projects.

The answers for level four statements (statements 18-23) tend to stay between "no opinion" and "disagree".

Only notable exception is statement 18 ("Projects are managed with consideration as to how they performed in the past, and what is expected in the future.") where all respondents answered "slightly agree".

All level five responses (statements 24-27) range from "slightly disagree" to "strongly disagree".

The strongest consensus was found for statement 25 - all respondents disagree or strongly disagree that lessons learned files are regularly used to improve PM processes, standards, and documentation.

In conclusion, the results show rather mixed responses for level 1 statements, indicating that the use of project management practices varies strongly across the organization. There are likely project managers who have established certain processes and methods, and others with less developed practices.

The most uniform agreement was found for level 2 statements, which indicates that the organization is most likely at this maturity level. PM practices exist in the organization but are not organizational standards. There is management support for PM practices, but no obligation to use them for all projects.

Level 3 statements show some clear trends. There is strong agreement that there are no PM processes established as organizational standards, nor is there documentation on the processes and standards. There is also strong agreement that external and internal customers are considered active members of the project team.

What can be seen throughout the levels 1-3 is agreement that there is a lack of documentation on PM processes and standards in the organization.

Levels 4 and 5 results showed general disagreement. This indicates that the organization has not reached these levels of maturity.

3.2.2 Agile project management practices (part 2)

This part of the survey (as laid out in chapter 2.5.4) assesses the maturity level of 25 agile project management processes. The respondents had to choose a description for each process, which in their opinion best characterized the process in their company. Descriptions ranged from maturity levels 1 to 5.

The survey results brought out here present the average response (see Appendix 5. Assessment Results (Part 2)). The individual maturity levels of the processes were found by taking an average of the individual results and rounding the result down to the nearest integer. Further, the agile processes were grouped under the corresponding PMBOK® knowledge areas. These were given a cumulative maturity level, based on the lowest level of the corresponding processes. As said in CPMMM, all criteria must be met to achieve a level of maturity. (Crawford, 2021, p. 155) Results are analysed here according to knowledge areas, from the highest level to the lowest.

From the assessment, 5 knowledge areas were graded at level one, 4 at level two and only 1 at level three maturity. These knowledge areas contained 3 level three, 14 level two and 8 level one agile processes.

There was only one knowledge area, which received level three maturity:

1. Project Stakeholder Management

This knowledge area includes the agile process "Stakeholders". Project managers believe that all project stakeholders interact closely with the agile team at all stages of the project.

Next knowledge areas were rated at level two maturity. These involved:

1. Project Scope Management
2. Project Communications Management
3. Project Procurement Management
4. Project Risk Management

All corresponding agile processes received maturity level two, except "Iteration Planning", which was graded at level three.

The other knowledge areas received a maturity level one. This included:

1. Project Integration Management
2. Project Schedule Management
3. Project Cost Management
4. Project Quality Management
5. Project Resource Planning

Although these knowledge areas received the lowest level, many of the corresponding agile processes were graded at level two. The process "Collaboration" was even graded at level three maturity, even though "Servant Leadership" and "Project Management Office" of the same knowledge area were at level one maturity.

In conclusion, the assessment of these agile project management processes shows that while there are a few more mature processes in the organization, most of the processes are either not yet established or exist separately with no organizational standard.

3.3 Proposed improvement plan

3.3.1 Setting goals for improvement

What the first part of the assessment mainly revealed was that project management maturity varies strongly across the organization, but there is management support for PM practices. Various processes and methods exist, but they are not considered organizational standards.

The second part of the assessment shined light on which exact agile PM processes were considered established as standardized processes and which exist as basic processes or do not exist yet in the organization.

With this information, next priorities can be set. CPMMM offers some principles to keep in mind when setting improvement goals. First, the organization needs to decide, which higher levels of maturity would provide the organization most value, whether

determined in ROI, customer satisfaction or some other meaningful measure. (Crawford, 2021, p. 151) The main benefit of improved maturity is increased value delivered to the organization's business goals. (Crawford, 2021, p. 152) In addition to improving maturity areas, which deliver most value, CPMMM also recommends developing weaker areas and overall, keeping an even level of maturity across the knowledge areas. The benefit of achieving a level 5 maturity in a single knowledge area can be cancelled if all other areas are at level 2 maturity. (Crawford, 2021, p. 151)

As discussed in a chapter 2.5.1, it has been found that many organizations receive significant benefits by reaching the "repeatable process" level, where processes have been established as organizational standards. Based on this and the previous principles for setting priorities, all assessed agile processes are presented as a table, sorted from lowest to highest level of maturity. The table can be found in Appendix 6. Agile processes from lowest to highest level of maturity. It includes descriptions of the next stages of maturity for each process, to give an understanding, what further maturity looks like.

Following is the first part of the table, including all agile processes at maturity level 1 (see Table 4). This gives a good basis for setting priorities.

Current Level	Agile Process	Next Level	Next Level Description
1	Capacity/Demand	2	Team capacity determined by product backlog; team members do not multitask.
1	Professional Development Management	2	On key teams, professional development for scrum master is supported.
1	Estimation	2	Agile team is using standard estimation methods, velocity is measured based on data (using burn-up, burn-down charts).
1	Servant Leadership	2	Servant leadership disciplines are documented but inconsistently executed.
1	Project Management Office (PMO)	2	Basic PMO established and recognized by executive management as responsible for defining the processes and standards for project management.
1	Costing	2	Agile team is budgeted as resources to a project not a product.
1	Continuous integration	2	Automation is implemented in the build and test phase but remains siloed.
1	Management Oversight - Awareness and support	2	Management oversight on larger and more visible projects encourages the establishment of cost, schedule, technical performance planning and tracking. Management provides the project managers the tools or training required to develop such project planning elements. Mandatory to implement project management processes for larger projects because management recognizes the benefit.

Table 4. Agile Processes at maturity level 1

From this information a decision needs to be made, which processes should be worked on, and which maturity levels would be optimal for the company. A target needs to be set (for example six months) to improve the process and then reassess at the end of the period to understand the changes. Some companies decide to focus on specific areas

of improvement, working for six months on one maturity level of one process. (Crawford, 2021, p. 150) In this sense, PMMMs can be used as a tool to find and fix weaknesses.

While improving any of the agile processes brought out in the table above, the models argue that the greatest benefit can be achieved in starting a PMO. PMO is the organizational entity focused on assisting project managers and teams, and implementing PM principles, practices, methodologies, tools, and techniques. (Xiaoyi Dai & Wells, 2004) Therefore it is also the main force implementing PM improvement in the company. KPMMM emphasises that deployment of changes as a result of these assessments should be led by the company's PMO or at least an action team, if no PMO is in place yet. (Kerzner, 2019, p. 182)

3.3.2 Periodic assessment and wider participation

Once goals are set for improvement and work on the cultural change of the organizational project management has begun, periodic reviews must be done to understand, if changes are being implemented and goals reached. This means repeating the PMM assessment. CPMMM recommends carrying the survey out annually. (Crawford, 2021, p. 150) According to KPMMM, companies who are serious about improving their PM practices should conduct the assessment at least once a quarter. (Kerzner, 2019, p. 182)

After the assessment has been carried out for the first time and the organization has seen benefits from using it, it is recommended to increase the participation.

KPMMM suggests including in the assessment not only project managers, but the whole hierarchy (executive, middle, lower). Each level is in different ways involved in the company project management and has an opinion about how mature it is. (Kerzner, 2019, p. 181) Participation can be optional at first and mandatory later, when application of PMMMs has proven to provide value to the company and the efforts can be scaled up. (Kerzner, 2019, p. 182)

3.4 Conclusion

While the objectives of this thesis were achieved (the project management maturity of an example company assessed and improvement points identified), the validity of the model developed here needs to be further studied.

To give validity to this model, it should be used to assess other similar organizations. Then, the project performance of those assessed organizations should be analysed to understand whether there is a correlation between the application of this model and improvement in the organization's project success, measured in time, cost and performance.

Furthermore, additional data gathered should be used to clarify if there is a correlation between project success and the maturity level given by this project management maturity assessment.

If such a correlation exists, this would have two benefits. First, it would give assurance to organizations who wish to improve their project management processes that if they use the maturity model to improve their project management maturity, this will also have economic benefit. Second, the results can be used to improve the maturity model.

4. SUMMARY

As companies started seeing project management as a key strategic advantage in realizing its vision, project management maturity models (PMMMs) emerged as a tool to increase project success through assessment and improvement of project management processes in companies. These models offered three primary benefits: 1) assessing current process maturity, 2) offering a path towards higher maturity and 3) allowing the company to benchmark itself against other similar companies.

The more complex the projects, the more essential it is for the organization to have strong project management capability, and a field where projects involve an especially high amount of uncertainty and unknowns, is software development. Although nearly all software development companies nowadays apply agile methodologies like Scrum and eXtreme Programming, which do not mention a project manager role, surveys show that the role is still present in most agile software projects. Considering that the role of project manager is present in agile software projects, PMMMs could be a useful tool for improving project management processes in agile software companies. Based on this, this thesis set out two objectives.

First objective, presented in chapter 2, was finding a suitable model for the assessment of an example agile software company. The company chosen was a medium-sized software development company, offering business management solutions to both small to large-sized retail enterprises. It consisted of core product and customer-specific teams of dedicated developers, applying Scrum methodology and agile practices.

The author started with reviewing available literature on PMMMs with focus on agile methodologies. From different research databases, six possible models were found. The suitability of the models was assessed based on their applicability, assessment tools, comprehensiveness, and whether agile processes were included in the model. Two models were chosen for further analysis: Project Management Maturity Model (4th edition) by Kent Crawford and PM Solutions and Kerzner's Project Management Maturity Model by Harold Kerzner.

Both models were analysed in depth, describing their theoretical basis, structure, and assessment instruments. The models are structured around five levels of increasing maturity, both based on the industry standard PMBOK® Guide. Where the two models differ is the assessment focus. While Kent Crawford's model describes certain project management processes at five linear consecutive levels of maturity, Harold Kerzner's model assesses the specific characteristics of level of maturity, from the individual

project manager's knowledge, to assessing the adaption of project management processes, to assessing company culture and support for project management.

Since both models included very thorough and extensive assessments, it was decided for two reasons that a customised model needed to be created to assess the company at hand. First, the aim was only assessing a single company and not doing an industry-wide survey, so the assessment model needed to account for the specifics of this company, offering it maximum benefit. Second, applying one of the PMMMs fully would have far exited the scope of a master thesis. Using the two analysed models, a more condensed assessment model was created, which included two parts: 1) assessing the organizational project management maturity and 2) assessing the application of agile practices.

Second objective, presented in chapter 3, was assessing the example company using the developed model, presenting the findings, and offering an improvement roadmap. The assessment was carried out as an anonymous survey on the project managers working in the company. Overall, the assessment results showed mixed responses, although certain trends were clear.

The results from the first part of the survey indicated that across the organization, there is strong variation in the use of project management practices. Certain practices exist in the organization, but are not organizational standards, nor mandate to use them for all projects. There is a general lack of documentation on PM processes and standards in the organization. Second part of the survey showed that while there were a few institutionalised agile processes in the organization, most of them were not yet established or standardised.

After presenting the assessment results, a proposed plan was offered to help set improvement priorities. This was based on two principles. First, the organization needs to decide, which improvements would bring the organization most value. Second, weaker areas should be developed, and the overall maturity level kept equal across different areas. After improvement goals are set, the assessment must be repeated periodically to understand, if changes are implemented. After the company has seen benefit from using the maturity model, participation can be widened, and the assessment scaled up.

The author feels that the objectives laid out in the beginning of this thesis were successfully achieved. However, it became clear how large the whole process of choosing and applying a project management maturity model is, requiring much more

work than fits in one master thesis. Still, the author believes the work done here is a good foundation for further study.

5. KOKKUVÕTE

Kui ettevõtted hakkasid nägema projektijuhtimist kui strateegilist võtmeteguri oma visiooni elluviimisel, hakkasid välja ilmuma projektijuhtimise küpsusmudelid kui tööriist, millega ettevõtte projektijuhtimise protsesse hinnata ja parendada, ja seeläbi suurendada projektide edukust. Need mudelid pakkusid kolme peamist kasu: 1) praeguse protsessiküpsuse hindamine, 2) järgmiste sammude pakkumine küpsuse suurendamiseks ja 3) ettevõtte võrdlemise võimaldamine teiste sarnaste ettevõtetega.

Mida keerukamad on ettevõtte, seda olulisem on, et ettevõttel on tugev projektijuhtimise võimekus. Üks valdkondadest, kus projektid sisaldavad erakordselt palju ebamäärasust, on tarkvara-arendus. Kuigi peaaegu kõik tarkvarafirmad rakendavad tänapäeval agiilseid metoodikaid nagu Scrum ja eXtreme Programming, mis ei nimeta kordagi projektijuhi rolli, näitavad uuringud, et see roll eksisteerib siiski enamuses agiilsetest tarkvaraprojektidest. Arvestades, et projektijuhi roll eksisteerib enamuses agiilsetest tarkvaraprojektidest, võivad projektijuhtimise küpsusmudelid olla kasulik vahend projektijuhtimise protsesside parendamiseks tarkvarafirmades. Sellest lähtudes seadis see töö endale kaks eesmärki.

Esimene eesmärk, peatükis 2, oli sobiva küpsusmudeli leidmine selle töö näiteks toodud tarkvarafirma hindamiseks. Valitud näide oli keskmise suurusega tarkvara arendusega tegelev firma, mis pakub äritarkvara nii väikestele kui suurtele jaemüügiettevõtetele. Firma oli üles ehitatud toote- ja kliendipõhistest meeskondadest, kes rakendavad Scrum metoodikat ja agiilseid projektijuhtimismeetodeid.

Töö autor alustas projektijuhtimise küpsusmudelitega seotud kirjanduse uurimisega. Erinevatest teadustööandmebaasidest leiti kuus võimalikku mudelit. Nende mudelite sobivust hinnati nende rakendatavuse, hindamisvahendite ja põhjalikkuse alusel, samuti kas nad võtsid arvesse agiilseid metoodikaid. Edasiseks analüüsiks valiti kaks mudelit: Kent Crawfordi “Project Management Maturity Model (4th edition)” ja Harold Kerzneri “Kerzner’s Project Management Maturity Model”.

Mõlemaid mudeleid analüüsiti põhjalikult, kirjeldades nende teoreetilist alust, ülesehitust ja hindamisvahendeid. Mudelid on struktureeritud viie küpsustaseme ümber, mõlemad toetudes „PMBOK® Guide“ projektijuhtimisstandardile. Mudelid erinevad oma fookuses. Kui Crawfordi mudel kirjeldab projektijuhtimisprotsesse viiel üksteisele järgneval tasemel, siis Kerzneri mudel hindab igale tasemele spetsiifilisi omadusi, alustades üksiku projektijuhi teadmistest, liikudes edasi

projektijuhtimisprotsesside vastuvõtmise ja ettevõtte kultuuri ja projektijuhtimise laiema toetuse hindamiseni.

Kuna mõlemad mudelid sisaldasid väga põhjalikke hindamisprotsesse, otsustati näite-ettevõtte hindamiseks mudel kohandada. Esimeseks põhjuseks oli asjaolu, et mudeli eesmärk oli ainult ühe ettevõtte hindamine, mitte valdkonnaülese uuringu tegemine. Seetõttu pidi mudel lähtuma konkreetse ettevõtte vajadustest, pakkudest sellele maksimaalset väärtust. Teiseks põhjuseks oli mudelite mahukus ning nende rakendamine oleks väljunud magistritöö piirest. Analüüsitud mudelite põhjal loodi uus, kokkuvõtlikum mudel, mis sisaldas kahte osa: 1) organisatsiooni projektijuhtimise küpsuse hindamine ja 2) agiilsete metoodikate rakendamise hindamine.

Töö teine eesmärk, peatükis 3, oli ettevõte hindamine loodud mudeli põhjal, tulemuste esitamine ja järgnevate sammute pakkumine. Hinnang viidi läbi anonüümse küsitlusena ettevõtte projektijuhtide vahel. Üldiselt näitasid küsitluse tulemused erinevaid arvamusi, kuid ilmusid ka teatud ühised jooned.

Hinnangu esimese osa tulemusid viitasid sellele, et projektijuhtimise meetodite rakendamine varieerub ettevõttes kõvasti. Teatud protsessid eksisteerivad, kuid need ei ole standardiseeritud ning puudub kohustus neid kõikide projektide puhul rakendada. Puudub üldine projektijuhtimise protsesside kirjeldus ja dokumentatsioon. Hinnangu teine osa näitas, et kuigi teatud agiilsed protsessid on ettevõttes juurutatud, ei ole suurem osa neist standardiseeritud.

Hinnangutulemuste esitamise järel pakuti välja võimalikud sammud suurema protsessiküpsuse poole. Seda tehti kahest põhimõttest lähtuvalt. Esiteks, ettevõtte peab otsustama, milliste protsesside arendamine toob sellele kõige rohkem väärtust. Teiseks, järgi tuleks aidata mahajäänud alasid ning ettevõtte protsesside üldine küpsustase hoida ühtlasena. Eesmärkide seadmise järel tuleb hindamist perioodiliselt korrata, et näha, kas muutused on rakendunud. Kui ettevõte on näinud kasu küpsusmudeli kasutamisest, võib hindamises hõlmata suuremat osa organisatsioonist.

Autor tunneb, et selle töö algul seatud eesmärgid saavutati edukalt. Töö käigus sai ilmseks, kui mahukas protsess on projektijuhtimise küpsusmudeli leidmine ja rakendamine ettevõttes, vajades palju rohkem kui ühte magistritööd. Siiski, autor usub, et siin tehtud on heaks aluseks järgnevatele töödele.

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7. APPENDICES

Appendix 1. Maturity Level characteristics presented by CPMMM and KPMMM

Crawford PMMM	**Kerzner PMMM**
1. Initial Process (Crawford, 2021, p. 19)	**1. Common Language** (Kerzner, 2019, p. 45)
In my organization, there are no established project management practices or standards.	If the organization is using project management at all, the use is sporadic. Both senior management and middle-level management may be providing meaningless or lip-service support to the use of project management. Executive-level support is non-existent.
Project managers are not held to specific accountability by any process standards.	There may exist small pockets of interest in project management, with most of the interest existing in the project-driven areas of the firm.
Project documentation is loose and ad hoc.	No attempt is made to recognize the benefits of project management. Managers are worried more about their own empires, power, and authority, and appear threatened by any new approach to management.
Management understands the definition of a project, that there are accepted processes, and is aware of the need for project management.	Decision-making is based on what is in the best interest of the decision-maker, rather than the firm as a whole.
Metrics are informally collected on an ad hoc basis.	There exists no investment or support for project management training and education, for fear that this new knowledge may alter the status quo.
2. Structured Process and Standards (Crawford, 2021, p. 19)	**2. Common Processes** (Kerzner, 2019, p. 65)
Many project management practices exist in my organization, but they are not considered organizational standards.	Tangible benefits of using project management must become apparent. The most common benefits include lower cost, shortened schedules, no sacrifice of scope or quality, and the potential for a higher degree of customer satisfaction.
Management supports the implementation of project management, but there is neither consistent understanding and involvement nor an organizational mandate for all projects.	Project management must be supported throughout all levels of the organization, including the senior levels. It is possible that changes to the corporate culture may be necessary, thus mandating executive support.
Project documentation exists on basic processes.	A continuous stream of successfully managed projects requires methodologies and processes that can be used over and over again. This requires an organizational commitment.
Project information is often a mix between summary-level data and detail level data.	Managing projects within scope and time is only part of the effort. The projects must also be completed within cost, and this may mandate changes to the cost accounting system.
There are basic project metrics to track project cost, schedule and technical performance, although data may be collected or correlated manually.	The final characteristic of Level 2 is the development of a project management curriculum rather than just a project management course. This is often seen as proof of the organization's firm commitment to project management.
3. Organizational Standards and Institutionalized Process (Crawford, 2021, p. 20)	**3. Singular Methodology** (Kerzner, 2019, pp. 75-76)
All project management processes are in place and established as organizational standards. Nearly all projects use these processes with a minimal exception.	Integrated processes: The organization recognizes that multiple processes can be streamlined into a single integrated process encompassing all other processes. (However, not all companies have the luxury of using a single methodology nor do they desire to do so.)

Clients and internal customers are considered as active members of the project team.	Cultural support: Integrated processes create a singular methodology. It is through this singular methodology that exceptional benefits are achieved. The execution of the methodology is through the corporate culture, which now wholeheartedly supports the project management approach. The culture becomes a cooperative culture.
There is formal documentation existing on all project management processes and standards.	Management support: At this level, project management support permeates the organization throughout all layers of management. The support is visible. Each layer or level of management understands its role and the support needed to make the singular methodology work.
Management is regularly involved in input and approval of key decisions and documents and in key project issues.	Informal project management: With management support and a cooperative culture, the singular methodology is based on guidelines and checklists, rather than the expensive development of rigid policies and procedures. Paperwork is minimized.
Project management processes are automated.	Training and education: With strong cultural support, the organization realizes financial benefits from project management education. The benefits can be described quantitatively and qualitatively.
Each project is evaluated and managed in light of other projects.	Behavioral excellence: The organization recognizes the behavioral differences between project management and line management. Behavioral training programs are developed to enhance project management skills.
Available project management processes are tailorable to each project. There is a process to customize the implementation of applicable processes to the particular project.	
4. Managed Process (Crawford, 2021, p. 20)	**4. Benchmarking** (Kerzner, 2019, p. 98)
Projects are managed with consideration as to how they performed in the past, and what is expected in the future.	The organization must establish a project management office (PMO) or a center of excellence (COE) for project management. This is the focal position in the company for project management knowledge.
Management uses efficiency and effectiveness metrics to make decisions regarding a project and understands the impact on other projects.	The PMO or COE must be dedicated to the project management improvement process along with other activities. This is usually accomplished with full-time, dedicated personnel.
All projects, changes, issues are evaluated based on metrics from cost estimates, baseline estimates and earned value calculations.	Benchmarking must be made against both similar and nonsimilar industries. In today's world, a company with five years of experience in project management could easily surpass the capabilities of a company that has used project management for 20 years or more.
Project management processes and standards are documented and support using metrics to make project decisions.	The company should perform both quantitative and qualitative benchmarking. Quantitative benchmarking analyzes processes and methodologies, whereas qualitative benchmarking looks at project management applications.
Management understands its role in project management and manages at the right level. Management differentiates between management styles and requirements needed for different projects.	
Project management processes are integrated with other organizational processes and systems.	
5. Optimising Process (Crawford, 2021, p. 20)	**5. Continuous Improvement** (Kerzner, 2019, p. 109)

In my organization, processes are in place to actively used to improve project management activities.	The organization must create lessons-learned files from the debriefing sessions at the end of each project. Case studies on each project, discussing mistakes made and knowledge learned, are critical so that mistakes are not repeated.
Lessons learned files are regularly used to improve project management processes, standards and documentation.	The knowledge learned on each project must be transferred to other projects and teams. This can be accomplished through quarterly or semiannual lessons-learned forums or from lessons-learned case studies discussed in training programs.
Management and the organization focused on both effectively managing projects, but also on continuous improvement.	The company must recognize that a mentorship program should be put in place to groom future project managers. Knowledge and lessons-learned information can be transmitted through the mentorship program as well. The mentorship program is best administered through a project management office (PMO) or a center of excellence (COE).
Metrics from project execution are both used to understand project performance and to make organizational management decisions in the future.	The final characteristic of Level 5 is a corporate-wide understanding that strategic planning for project management is a continuous, ongoing process.

Appendix 2. Agile project management processes according to CPMMM and their respective PMBOK® knowledge area

PMBOK® Knowledge Area	#	Agile process
Project Integration Management		
	1	Collaboration
	2	Servant Leadership
	3	Project Management Office (PMO)
Project Scope Management		
	4	Epics and Features
	5	Release Planning
	6	Iteration Planning
Project Schedule Management		
	7	Work
	8	Estimation
Project Cost Management		
	9	Budgeting
	10	Costing
	11	Benefits/Value Realisation
Project Quality Management		
	12	Product Quality
	13	Testing
	14	Continuous integration
	15	Management Oversight: Awareness and support
	16	Management Oversight: Involvement
	17	Management Oversight: Adaptive/Agile environments
Project Resource Management		
	18	Capacity/Demand
	19	Self-Organizing
	20	Professional Development Management

Project Communications Management		
	21	Communications
Project Risk Management		
	22	Ownership
	23	Reviews
Project Procurement Management		
	24	Vendor Management
Project Stakeholder Management		
	25	Stakeholders

Appendix 3. Questionnaire

1. Questionnaire for the organizational project management level Beside each question, circle the number that corresponds to your opinion.	
#	**Statement**
1	In my organization, there are no established project management practices or standards.
2	Project managers are not held to specific accountability by any process standards.
3	Project documentation is loose and ad hoc.
4	Management understands the definition of a project, that there are accepted processes, and is aware of the need for project management.
5	Metrics are informally collected on an ad hoc basis.
6	Many project management practices exist in my organization, but they are not considered organizational standards.
7	Management supports the implementation of project management, but there is neither consistent understanding and involvement nor an organizational mandate for all projects.
8	Project documentation exists on basic processes.
9	Project information is often a mix between summary-level data and detail level data.
10	There are basic project metrics to track project cost, schedule and technical performance, although data may be collected or correlated manually.
11	All project management processes are in place and established as organizational standards. Nearly all projects use these processes with a minimal exception.
12	Clients and internal customers are considered as active members of the project team.
13	There is formal documentation existing on all project management processes and standards.
14	Management is regularly involved in input and approval of key decisions and documents and in key project issues.
15	Project management processes are automated.
16	Each project is evaluated and managed in light of other projects.
17	Available project management processes are tailorable to each project. There is a process to customize the implementation of applicable processes to the particular project.
18	Projects are managed with consideration as to how they performed in the past, and what is expected in the future.
19	Management uses efficiency and effectiveness metrics to make decisions regarding a project and understands the impact on other projects.
20	All projects, changes, issues are evaluated based on metrics from cost estimates, baseline estimates and earned value calculations.
21	Project management processes and standards are documented and support using metrics to make project decisions.
22	Management understands its role in project management and manages at the right level. Management differentiates between management styles and requirements needed for different projects.

23	Project management processes are integrated with other organizational processes and systems.
24	In my organization, processes are in place to actively used to improve project management activities.
25	Lessons learned files are regularly used to improve project management processes, standards and documentation.
26	Management and the organization focused on both effectively managing projects, but also on continuous improvement.
27	Metrics from project execution are both used to understand project performance and to make organizational management decisions in the future.

2. Questionnaire for the application of Agile project management practices	
Beside each topic, choose the description that in your opinion best describes your organization.	
#	**Question**
1	**Collaboration**
1	There is little or no collaboration (interactive meetings, informal dialog, knowledge sharing).
2	Collaboration is limited to a core function (such as development). Team collaboration tools and technology are limited.
3	There is collaboration between functions (such as development, testing, operations, business areas). Team collaboration tools are a standard.
4	There is collaboration between multiple functions and agile teams (Scrum of Scrum, cross team release planning).
5	There is collaboration between multiple functions and agile teams (Scrum of Scrum, cross team release planning). Policies and procedured implemented for knowledge management.
2	**Servant Leadership**
1	There is little or no demonstration of servant leadership.
2	Servant leadership disciplines are documented but inconsistently executed.
3	Servant leadership disciplines are organizational standard, with accompanying training, mentoring/coaching.
4	Servant leadership disciplines are integrated into individual performance measures.
5	Servant leadership disciplines are in place and continually improved through performance measures and lessons learned.
3	**Project Management Office (PMO)**
1	An informal Project Management Office (PMO) may exist that consists of 1-2 people interested in bringing project management standards to the organization.
2	A basic PMO is established and recognized by executive management as responsible for defining the processes and standards for project management.
3	PMO is considered a reference site and overseer of PM methodology. Comprehensive standard PM methodology in place and teams are actively trained to use it. PMO is accepted and involved integrally with the project managers. Functions and services of PMO are defined and communicated throughout the organization.

4	Best practices are collected and maintained by the PMO. Management level reporting in place. "Ego-free" reviews of major projects are compared against standard methodologies and processes. Realistic resource projections generated. Few surprises on projects.
5	PMO manages project portfolio, provides PM tools and training, oversees scoping of projects. Project managers are accountable to the PMO. PMO is responsible for resource leveling and critical resource assignment. Processes in place for lessons learned for improvement.
4	**Epics and Features**
1	Epics and Features are usually incomplete and lack detail.
2	Epics and Features standards exists, but use is inconsistent, lacking detail to translate into Stories.
3	Epics are derived from product roadmaps and the Product Owner is responsible for Epics and Features. Business requirements are translated into Epics and Features.
4	Product Owner is responsible for Epics and Features and there is standard traceability from Epics to Features to Stories to delivered product.
5	Product Owner is responsible for Epics and Features and there is standard traceability from Epics to Features to Stories to delivered product. There is continuous improvement of Epics and Features.
5	**Release Planning**
1	Release planning is ad hoc with infrequent and unreliable releases.
2	Release planning is feature based, infrequent and partially automated.
3	Release plans derived from product roadmaps, releases defined by backlog. Fully automated.
4	Release plans derived from product roadmaps, releases defined by backlog. Fully automated. Release plans are refined based on team's performance. Releases are planned cross-team.
5	Release plans derived from product roadmaps, releases defined by backlog. Fully automated. Release plans are refined based on team's performance. Releases are planned cross-team. There is continuous improvement of release plans.
6	**Iteration Planning**
1	Iteration Planning is ad hoc resulting in missed commitments.
2	Scrum Master, PO and the agile team determine iterations, estimates are not refined based on team velocity.
3	Iterations are derived from backlog and associated releases.
4	Iterations are refined based on team's performance in related and previous sprints.
5	Iterations are derived from backlog, refined based on team's performance in related and previous sprints and there is continuous improvement of iteration planning.
7	**Work**
1	Product backlog refinement is inconsistent, sprint backlog is not aligned to product backlog, sprints are inconsistent, team is frequently without work. Heroic efforts are the norm.
2	Product backlog refinement uses standard techniques. Sprint backlog and product backlog are aligned, but sprints still independent.

3	Product backlog refinement follows defined process with roles and responsibilities. Sprint backlog and product backlog are aligned and tracked. Sprints executed per sprint backlog. Agile team determines work.
4	In addition to option 3, product backlog refinement uses data and team learning.
5	In addition to option 3 and 4, there is continuous improvement of work through lessons learned and performance reviews.
8	**Estimation**
1	Agile team is not using any standard estimation methods (T-Shirt, Poker, Points) and the velocity is not measured.
2	Agile team is using standard estimation methods, velocity is measured based on data (using burn-up, burn-down charts).
3	Agile team uses estimation methods, tracks actual vs. planned releases. Commitments are delivered.
4	Agile team uses estimation methods, tracks actual vs. planned releases, commitments are delivered and performance data is used to improve velocity and commitments.
5	In addition to option 4, continuous improvement of estimation through lessons learned and performance reviews.
9	**Budgeting**
1	Agile team is budgeted using traditional costing models (each function costing the resource and individual chargebacks).
2	Agile team is budgeted as resources to a project not a product.
3	Agile team is budgeted as a product team for the fiscal year.
4	Performance data is used to improve budgeting models.
5	Organization continually improves budgeting through lessons learned and performance measures.
10	**Costing**
1	Work is not costed or tracked.
2	Basic costing using the product backlog.
3	Teams use velocity, burnup and burndown data for costing and CapEx.
4	Organization uses EVM (Earned Value Management) techniques to manage and forecast cost and CapEx.
5	In addition to option 4, organization continually improves costing through lessons learned and performance measures.
11	**Benefits/Value Realisation**
1	Value is not defined or aligned to the roadmap or portfolio. There is no defined MVP, MVP is not linked to organisational benefit management.
2	MVP defined but not linked to product roadmap value.
3	MVP defined by key stakeholders and aligned to organizational benefit management.
4	In addition to option 3, organization uses performance data to improve benefits/value realization.
5	In addition to option 4, organization continually improves benefits/value realization through lessons learned and performance measures.
12	**Product Quality**
1	Product quality is variable and no quality assurance process is present.

2	Limited traceability from requirement to release. QA process is defined and quality is improving.
3	Quality and risk are integrated into product in the beginning, rather relying on testing to find defects.
4	In addition to option 3, focus on satisfying customer need relies heavily on customer feedback and input to optimize value of the product.
5	In addition to options 3 and 4, continually improves product quality through lessons learned and performance measures.
13	**Testing**
1	Testing is manual, no test scripts and test data used. Testing is done typically after development.
2	Test scripts and test data are integrated as part of the development process. These are used for automating some tests.
3	Automated unit and acceptance testing. Testing is part of the development process. Feedback loops are in place and continuous improvements measured and managed.
4	In addition to option 3, quality metrics and trends are tracked. Non-functional requirements are defined and measured.
5	In addition to options 3 and 4, testing is fully automated, product rollbacks rare, defects found and fixed immediately.
14	**Continuous integration**
1	Continuous integration is a manual and reactive process, there are uncontrolled artifacts, documentation and source code.
2	Automation is implemented in the build and test phase but remains siloed.
3	When a change is committed, automated build and test cycle is performed.
4	In addition to option 3, build metrics are gathered, made visible and action is taken.
5	In addition to options 3 and 4, lessons learned and continuous improvement in place, agile team meets regularly to discuss issues and resolve them.
15	**Management Oversight - Awareness and support**
1	Management is aware of project management processes and recognizes the difference between requirements for project and operational management. Management also supports individual interests in applying project management standards or processes on an ad hoc basis at the discretion of the project manager, but there is no conformity.
2	There is management oversight on larger and more visible projects, which encourages the establishment of cost, schedule, technical performance planning and tracking. Management provides project managers the tools or training required to develop such project planning elements. It is mandatory to implement project management processes for larger projects, because management recognizes the benefit.
3	Project management is recognized as a discipline involving leadership and support roles. Management ensures visibility and prioritization. Management is required to attend project management awareness training.
4	Management actively supports project management processes as keys to organizational success by ensuring that project outcomes are successful. Resource pool management and Project Management Office are in place.
5	In addition to options 3, and 4. Continuous improvement in place to enhance management's awareness and support of projects and their needs.

16	**Management Oversight - Involvement**
1	Management's involvement in daily activities is limited to inquiring about the status when the need for such information arises.
2	Management assigns project managers, approves charter. Management approves changes. There is milestone level summary progress reporting. Baseline vs actual project performance metrics are tracked.
3	Management is involved in key decisions like change control, issue escalation, risk response, QA and customer interaction.
4	Management expects formal variance analysis comparing project base lines to actual performance. Management regularly serves in project-related roles.
5	In addition to point 3, continuous improvement in place to improve management's involvement in all aspects of pm.
17	**Management Oversight - Adaptive/Agile environments**
1	Agile teams must adhere to predictive/traditional management oversight such as project sponsors, executive sponsors, steering committees. Steering committees lack knowledge to understand agile data, status and reporting.
2	Agile recognized as as part of the hybrid environment, but traditional oversight status and reporting are still expected from the project manager.
3	Management recognizes the importance of the product manager and the product owner in providing direction and support for the agile team. Management oversight emphasis on the portfolio and operational capabilities.
4	Product managers on the portfolio level, product owners on the program level and scrum masters on delivery level represent management oversight. Organizational oversight is at the portfolio level making strategic decisions using performance data.
5	Management oversight at the enterprise portfolio level, key initiatives can have an executive level steering committee.
18	**Capacity/Demand**
1	Teams formed based on traditional resource supply and demand. Resources regularly multi-task.
2	Team capacity is determined by the product backlog, team members do not multitask.
3	Organization understands and manages agile team capacity across teams.
4	Organization is using team performance data on decisions.
5	Organization continually improves resource capacity and demand through lessons learned and performance measures.
19	**Self-Organizing**
1	Teams are disorganized and do not have the Agile mindset. Members are individualist and lack collaboration skills.
2	Teams organizing with an Agile and collaboration mindset.
3	Teams are self-organizing and collaborate within and across other dependent teams.
4	Team members have accountability for all aspects and are self-managed.
5	Team has the right members, trust, process, a sustainable pace, and delivers quality at a high velocity.
20	**Professional Development Management**
1	Professional development in the agile team is the responsibility of the individual.

2	On key teams, professional development for scrum master is supported.
3	Organization is responsible for the professional development for product owners and scrum masters for all projects. Certification is required for these roles.
4	Organization is responsible for the professional development for all agile teams. Certification required for all members.
5	In addition to option 4, organization uses team and individual performance data.
21	**Communications**
1	Communication is ad hoc.
2	Communication happens only in silos (development, testing, etc.) in the Agile team.
3	Communication and feedback loops initiated across all functions represented on the agile team.
4	Communication and feedback loops initiated across all functions represented on the agile team and communication is improved using internal and external feedback.
5	Communication and feedback loops initiated across all functions represented on the agile team and communication is improved using internal and external feedback. Organization continually improves communication management through lessons learned and performance measures.
22	**Ownership**
1	No ownership is taken for risks (financial, business, technical, operational, process, organizational).
2	Ownership is taken, but focused only on technical risk.
3	Ownership is taken and focused on financial, business, technical, operational, process, organizational risks.
4	Ownership is evident and managed in cross dependent agile teams.
5	Ownership is evident and managed in cross dependent agile teams. Organization continually improves risk management through lessons learned and performance measures.
23	**Reviews**
1	Frequent reviews are ad hoc and lack focus on managing risks (planning, daily stand-ups, metrics, retrospectives).
2	Frequent reviews occur, but lack focus on risk management.
3	Frequent reviews include risk management.
4	Frequent reviews include risk management and the organization is using team performance data to improve risk management.
5	Frequent reviews include risk management and the organization is using team performance data to improve risk management. Organization continually improves risk reviews through lessons learned and performance measures.
24	**Vendor Management**
1	Vendors are supplemented to the agile team on a contract basis.
2	Vendors are considered partners and are compensated based on their knowledge, quality and value.
3	Agile team consists of both contractor and product vendors.
4	Agile team consists of both contractor and product vendors. Vendor and agile team releases are aligned. Vendors are measured on knowledge, quality and value.

5	In addition to option 4, organization continually improves vendor management through lessons learned and performance measures.
25	**Stakeholders**
1	Stakeholders are not involved in the initiative, with little or no interaction with the agile team.
2	Stakeholders are only involved in the end of the initiative.
3	Stakeholders interact directly and frequently with agile team and are involved at all ceremonies and the final product, and provide direction and support.
4	Stakeholders interact directly and frequently with agile team and are involved at all ceremonies and the final product, and provide direction and support. Organization is using team performance data and feedback to improve.
5	In addition to option 4, the organization continually improves stakeholder management through lessons learned and performance measures.

Appendix 4. Assessment Results (Part 1)

Level #	Statement	Average Response	STDEV
Level 1	1. In my organization, there are no established project management practices or standards.	-0.3	1.3
	2. In my organization, project managers are not held to specific accountability by any process standards.	-0.3	2.1
	3. Project documentation is loose and ad hoc.	1.0	2.2
	4. The management of my organization understands the definition of a project, that there are accepted processes, and is aware of the need for project management.	0.5	1.7
	5. Project metrics are informally collected on an ad hoc basis.	1.8	0.5
Level 2	6. Many project management practices exist in my organization, but they are not considered organizational standards.	2.5	0.6
	7. Management supports the implementation of project management, but there is neither consistent understanding and involvement, nor an organizational mandate for all projects.	2.0	0.8
	8. Project documentation exists on basic processes.	-0.8	1.5
	9. Available project information is often a mix between summary-level and detail-level data.	2.5	0.6
	10. There are basic project metrics to track project cost, schedule and technical performance, although data may be collected or correlated manually.	0.8	2.1
Level 3	11. All project management processes are in place and established as organizational standards. Nearly all projects use these processes with a minimal exception.	-2.5	0.6
	12. In my organization, clients and internal customers are considered as active members of the project team.	2.8	0.5
	13. In my organization, there is formal documentation existing on all project management processes and standards.	-2.8	0.5
	14. Management is regularly involved in input and approval of key decisions and documents, and in key project issues.	1.3	1.7
	15. Project management processes are automated.	-0.8	1.5
	16. In my organization, each project is evaluated and managed in light of other projects.	0.0	2.3
	17. Available project management processes are customizable to each project. There is a process to customize the applicable processes to the particular project.	-0.3	1.7
Level 4	18. Projects are managed with consideration as to how they performed in the past, and what is expected in the future.	1.0	0.0
	19. In my organization, management uses efficiency and effectiveness metrics to make decisions regarding a project and understands the impact on other projects.	-1.0	1.4
	20. All projects, changes, issues are evaluated based on metrics from cost estimates, baseline estimates and earned value calculations.	-0.8	1.0
	21. In my organization, project management processes and standards are documented, and support using metrics to make project decisions.	-1.8	0.5
	22. Management understands its role in project management and manages at the right level. Management differentiates between management styles and requirements needed for different projects.	-0.8	1.7
	23. In my organization, project management processes are integrated with other organizational processes and systems.	-0.5	1.3
Level 5	24. In my organization, processes are in place and actively used to improve project management activities.	-1.3	1.0
	25. In my organization, lessons learned files are regularly used to improve project management processes, standards and documentation.	-2.5	0.6
	26. Management and the organization are focused on both effectively managing projects, but also on continuous improvement of project management practices.	-1.3	1.7
	27. Metrics from project execution are both used to understand project performance, and also to make organizational management decisions in the future.	-1.3	1.0

Appendix 5. Assessment Results (Part 2)

Knowledge Area	Level	Agile topic	Level	*Description*
Project Integration Management	**1**	1. Collaboration	**3**	*There is collaboration between functions (such as development, testing, operations, business areas). Team collaboration tools are a standard.*
		2. Servant Leadership	**1**	*There is little or no demonstration of servant leadership.*
		3. Project Management Office (PMO)	**1**	*An informal Project Management Office (PMO) may exist that consists of 1-2 people interested in bringing project management standards to the organization.*
Project Scope Management	**2**	4. Epics and Features	**2**	*Epics and Features standards exists, but use is inconsistent, lacking detail to translate into Stories.*
		5. Release Planning	**2**	*Release planning is feature based, infrequent and partially automated.*
		6. Iteration Planning	**3**	*Iterations are derived from backlog and associated releases.*
Project Schedule Management	**1**	7. Work	**2**	*Product backlog refinement uses standard techniques. Sprint backlog and product backlog are aligned, but sprints still independent.*
		8. Estimation	**1**	*Agile team is not using any standard estimation methods (T-Shirt, Poker, Points) and the velocity is not measured.*
Project Cost Management	**1**	9. Budgeting	**2**	*Agile team is budgeted as resources to a project not a product.*
		10. Costing	**1**	*Work is not costed or tracked.*
		11. Benefits/Value Realisation	**2**	*MVP defined but not linked to product roadmap value.*
Project Quality Management	**1**	12. Product Quality	**2**	*Limited traceability from requirement to release. QA process is defined and quality is improving.*
		13. Testing	**2**	*Test scripts and test data are integrated as part of the development process. These are used for automating some tests.*
		14. Continuous integration	**1**	*Continuous integration is a manual and reactive process, there are uncontrolled artifacts, documentation and source code.*
		15. Management Oversight - Awareness and support	**1**	*Management is aware of project management processes and recognizes the difference between requirements for project and operational management. Management also supports individual interests in applying project management standards or processes on an ad hoc basis at the discretion of the project manager, but there is no conformity.*
		16. Management Oversight - Involvement	**2**	*Management assigns project managers, approves charter. Management approves changes. There is milestone level summary progress reporting. Baseline vs actual project performance metrics are tracked.*
		17. Management Oversight - Adaptive/Agile environments	**2**	*Agile recognized as part of the hybrid environment, but traditional oversight status and reporting are still expected from the project manager.*
Project Resourse Planning	**1**	18. Capacity/Demand	**1**	*Teams formed based on traditional resource supply and demand. Resources regularly multi-task.*
		19. Self-Organizing	**2**	*Teams organizing with an agile and collaboration mindset.*

		20. Professional Development Management	**1**	*Professional development in the agile team is the responsibility of the individual.*
Project Communications Management	**2**	21. Communications	**2**	*Communication happens only in silos (development, testing, etc.) in the agile team.*
Project Risk Management	**2**	22. Ownership	**2**	*Ownership is taken, but focused only on technical risk.*
		23. Reviews	**2**	*Frequent reviews occur, but lack focus on risk management.*
Project Procurement Management	**2**	24. Vendor Management	**2**	*Vendors are considered partners and are compensated based on their knowledge, quality and value.*
Project Stakeholder Management	**3**	25. Stakeholders	**3**	*Stakeholders interact directly and frequently with agile team and are involved at all ceremonies and the final product, and provide direction and support.*

Appendix 6. Agile processes from lowest to highest level of maturity

Current Level	Agile Process	Next Level	Next Level Description
1	Capacity/Demand	2	Team capacity determined by product backlog, team members do not multitask.
1	Professional Development Management	2	On key teams, professional development for scrum master is supported.
1	Estimation	2	Agile team is using standard estimation methods, velocity is measured based on data (using burn-up, burn-down charts).
1	Servant Leadership	2	Servant leadership disciplines are documented but inconsistently executed.
1	Project Management Office (PMO)	2	Basic PMO established and recognized by executive management as responsible for defining the processes and standards for project management.
1	Costing	2	Agile team is budgeted as resources to a project not a product.
1	Continuous integration	2	Automation is implemented in the build and test phase but remains siloed.
1	Management Oversight - Awareness and support	2	Management oversight on larger and more visible projects encourages the establishment of cost, schedule, technical performance planning and tracking. Management provides the project managers the tools or training required to develop such project planning elements. Mandatory to implement project management processes for larger projects, because management recognizes the benefit.
2	Self-Organizing	3	Teams are self-organizing and collaborate within and across other dependent teams.
2	Work	3	Product backlog refinement follows defined process with roles and responsibilities. Sprint backlog and product backlog aligned and tracked. Sprints executed per sprint backlog. Agile team determines work.
2	Budgeting	3	Agile team is budgeted as a product team for the fiscal year.
2	Benefits/Value Realisation	3	MVP defined by key stakeholders and aligned to organizational benefit management.
2	Product Quality	3	Integrated quality and risk into product in the beginning rather relying on testing to find defects.
2	Testing	3	Automated unit and acceptance testing. Testing is part of the development process. Feedback loops are in place and continuous improvements measured and managed.
2	Management Oversight - Involvement	3	Management involved in key decisions like change control, issue escalation, risk response, QA and customer interaction.
2	Management Oversight - Adaptive/Agile environments	3	Management recognizes importance of product manager and product owner in providing direction and support for the agile team. Management oversight emphasis on the portfolio and operational capabilities.
2	Communications	3	Communication and feedback loops initiated across all functions represented on the agile team.
2	Ownership	3	Ownership focused on financial, business, technical, operational, process, organizational risks.
2	Reviews	3	Frequent reviews include risk.
2	Vendor Management	3	Agile team consists of both contractor and product vendors.
2	Epics and Features	3	Epics derived from product roadmaps, PO responsible for Epics and Features. Business requirements translated into Epics and Features (hybrid).

2	Release Planning	3	Release plans derived from product roadmaps, releases defined by backlog. Fully automated.
3	Collaboration	4	Collaboration between multiple functions and agile teams (Scrum of Scrum, cross team release planning).
3	Iteration Planning	4	Iterations refined based on team's performance in related sprints.
3	Stakeholders	4	Organization is using team performance data and feedback to improve.